August 2016

NOISE IMPACT STUDY

Noise Impact Study Riverside South Phase 15 Part of 4650 Spratt Road & 750 River Road, Ottawa, Ontario

Submitted to:
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REPORT

Report Number: 1406222

Distribution:
2 copies - Riverside South Development Corporation
1 copy - Golder Associates Ltd.

Golder Associates

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by the Riverside South Development Corporation (RSDC) to prepare a Noise Impact Study (NIS) in support of Rezoning, Official Plan Amendment and Plan of Subdivision applications for the Riverside South Phase 15 Development (The Development) – Part of 4650 Spratt Road and 750 River Road (Phase 15 Lands), in Ottawa, Ontario. Since The Development is still in the planning stages, a Phase 1 Noise Control Feasibility Study in accordance with City of Ottawa Environmental Noise Control Guidelines (ENCG) has been prepared and should be sufficient for the City of Ottawa to make a planning decision. This feasibility study assesses the noise impact from nearby road traffic and summarizes noise mitigation measures that are expected to be required for The Development to achieve compliance with the City of Ottawa's ENCG.

1.1 Proposed Development

This NIS has been prepared using the information received from RSDC for The Development on the Phase 15 Lands. The Phase 15 Lands consist of an approximately 102 hectare collection of three (3) distinct parcels of land, mostly located between River Road and Spratt Road, south of Borbridge Avenue and North of Rideau Road. A small portion of the development area is located on the west side of River Road. Residential areas surround the Phase 15 Lands.

RSDC is proposing a series of zoning designations that allows for a mix of low- to medium-density residential uses, together with commercial, institutional and open space uses in the Phase 15 Lands. The proposed lot layout for the Phase 15 Lands is shown in Figure 1.

For the purpose of this NIS it has been assumed that all homes will be two-storey, with a maximum receptor height of 4.5m. Noise levels on the blocks that may contain stacked townhomes and apartment are expected to be similar, but, for these denser units, the levels will be specifically assessed at the appropriate heights through the site plan control approval process.

2.0 NOISE SOURCES

The City of Ottawa *ENCG Part 1 (2016)* requires a noise study be prepared when a noise-sensitive development is proposed within 100 metres (m) of an existing or proposed arterial or major collector roadway. The primary noise sources of concern are Spratt Road, a 2-lane major collector road (2-UMCU) with a right-of-way width of 26 m, and River Road, a 4-lane urban arterial-divided road (4-UAD) with a right-of-way width of 37.5 m. Secondary noise sources of concern are Brian Good Avenue, Borbridge Avenue, and Street No. 8, 2-lane urban collector roads (2-UCU) with a right-of-way width of 20 m (2-UCU roadways). For the purposes of this report, the noise associated with road traffic along all previously mentioned roadways is assessed. Other surrounding roadways in the vicinity are sufficiently setback from the Site or have daily traffic volumes that are low enough that no adverse noise impact is expected. Therefore, noise impact from these roadways has not been further considered.

3.0 CRITERIA AND GUIDELINES

The City of Ottawa ENCG outlines the sound level criteria and noise control guidelines for land use planning in Ottawa.

3.1 Indoor Noise Level Criteria

The ENCG criteria for the sound level in 'living quarters' such as a living room and/or dining room is a maximum daytime equivalent indoor sound level (L_{eq} [16 hour]) of 45 dBA due to road traffic. Similarly, for sleeping quarters such as a bedroom, the allowable maximum equivalent nighttime indoor sound level (L_{eq} [8 hour]) is 40 dBA due to road traffic. These limits are summarized in Table 1.

Table 1: Indoor Sound Level Criteria Due to Roads*

Type of Space	Time Period	L_{eq} (dBA)
Living/dining areas of residences, hospitals, schools, nursing/retirement homes, day-care centres, theatres, places of worship, libraries, individual or semi-private offices, conference rooms, reading rooms, etc.	Daytime 16 hr., (07:00 – 23:00) ($L_{eq\ 16hr}$)	45
Sleeping quarters of residences, hospitals, nursing/retirement homes, etc.	Nighttime 8 hr., (23:00 – 07:00) ($L_{eq\ 8hr}$)	40

Note: *Reference: Table 2.2b Applicable Guidelines for Transportation Noise – Road and Rail, Ottawa ENCG (2016).

3.2 Outdoor Noise Criteria

An Outdoor Living Area (OLA) is anywhere the 'quiet' enjoyment of the outdoor environment or passive recreation is expected to occur. An OLA includes, but is not limited to; backyards, gardens, terraces, patios, open balconies that are at least 4 m deep, communal use areas such as amenity areas of apartment buildings, condominiums, group homes, campgrounds and area identified as being noise sensitive by the municipality such as parks.

The ENCG outdoor noise criteria for an OLA is a daytime sound level (L_{eq} [16 hour]) of 55 dBA due to road traffic. This limit is summarized in Table 2 below.

Table 2: Outdoor Sound Level Criteria Due to Roads*

Receptor Location	Time Period	L_{eq} (dBA)
Outdoor Living Area	Daytime 16 hr. (07:00 – 23:00) ($L_{eq\ 16hr}$)	55

Note: *Reference: Table 2.2a Applicable Guidelines for Transportation Noise – Road and Rail, Ottawa ENCG (2016).

3.3 Noise Mitigation Criteria

If the predicted daytime sound level due to road traffic in an OLA is less than or equal to 55 dBA, noise mitigations measures and/or warning clauses may not be required.

If predicted levels of road traffic noise (L_{eq}, 16-hr/8-hr) at the Plane of Window (POW) are less than or equal to 55 dBA during the 16-hr daytime period for living rooms or 50 dBA during the 8-hr nighttime period for bedrooms, noise mitigation measures and/or noise warning clauses may not be required.

If the predicted daytime 16-hour L_{eq} sound level due to road traffic in an OLA are in the range of to 55 to 60 dBA, noise mitigation is required, unless, at the City of Ottawa's discretion, it is agreed that mitigation is not technically or economically feasibility. In case of mitigation, the "Extension Mitigation of Indoor and Outdoor Amenity Area" warning clause as defined in the ENCG should to be included in the purchase / rental agreements. In the case of no mitigation, the ""No Outdoor Amenity Area" warning clause as defined in the ENCG should to be included in the purchase / rental agreements.

If predicted levels of road traffic noise (L_{eq}, 16-hr/8-hr) at the POW are in the range of 55 to 65 dBA during the 16-hr daytime period for living rooms or 50 to 60 dBA during the 8-hr nighttime period for bedrooms, at a minimum, the dwelling should be designed with provisions for central air conditioning to be installed in the future at the owner's discretion and the "Generic" Warning Clause as defined in the ENCG should to be included in the purchase / rental agreements.

If predicted levels of road traffic noise (L_{eq}, 16-hr/8-hr) at the POW are equal or greater than 65 dBA during the 16-hr daytime period for living rooms or 60 dBA during the 8-hr nighttime period for bedrooms, the ENCG requires the installation of central air conditioning and building components (i.e., exterior windows, walls, and doors) to be specified that will reduce indoor road traffic noise levels to comply with the indoor sound level criteria summarized in Table 1. The "Extension Mitigation of Indoor and Outdoor Amenity Area" Warning Clause as defined in the ENCG should also be included in the purchase / rental agreements. Table 3 below summarizes the requirements for noise mitigation and/or warning clauses.

Table 3: Outdoor, Ventilation and Warning Clause Requirements

Assessment Location	Time of Day	Sound Pressure Level	Minimum Noise Mitigation Requirement
Outdoor Living Area	Daytime	$L_{eq\ 16hr} \leq 55$ dBA	- None
		55 dBA $< L_{eq\ 16hr} \leq 60$ dBA	- Control measures (barriers) may be required - Warning clause
		$L_{eq\ 16hr} > 60$ dBA	- Control measures (barriers) - Warning clause
Plane of Window	Daytime	$L_{eq\ 16hr} \leq 55$ dBA	- None
		55 dBA $< L_{eq\ 16hr} \leq 65$ dBA	- Provision for central air conditioning; - Warning clause
		$L_{eq\ 16hr} > 65$ dBA	- Central air conditioning - Control measures (building components) - Warning clause
Plane of Window	Nighttime	$L_{eq\ 16hr} \leq 50$ dBA	- None
		50 dBA $< L_{eq\ 8hr} \leq 60$ dBA	- Provision for central air conditioning - Warning clause
		$L_{eq\ 8hr} > 60$ dBA	- Central air conditioning - Control measures (building components) - Warning clause

4.0 NOISE LEVEL PREDICTIONS

The predictions were carried out using ORNAMENT and STAMSON software. The proposed building layout used for the prediction model was based on the lot layout provided by RSDC (presented in Figure 1) and the City of Ottawa lot building requirements. The critical receptor locations are also given in the figure for both POW and OLA locations. For the POW locations, calculations were carried out for each floor of the building, at 1.5 m and 4.5 m heights above ground level, representing the first (living room/kitchen), and second (bedroom) floors, as per the ENCG. For the OLA's the prediction was carried out at a 1.5 m height above ground level and 3 m from the building façade, as per the ENCG. The POW locations were chosen to represent key areas of the development as follows:

- POW A – Dwelling with front facing Borbridge Avenue and side facing River Road;
- POW B – Dwelling with front facing River Road;
- POW C – Dwelling with front facing Street No. 8 and side facing River Road;
- POW D – Dwelling with front facing Brian Good Avenue and side facing Street No. 8;
- POW E – Dwelling with rear facing Street No. 8 and side facing Spratt Road;
- POW F – Dwelling with side facing Spratt Road;
- POW G – Dwelling with front facing Spratt Road and side facing Borbridge Avenue;
- POW H – Dwelling with front facing Brian Good Avenue and side facing Borbridge Avenue;
- POW I – Dwelling with front facing Borbridge Avenue;
- OLA A – Outdoor living area with side exposed to River Road and backing onto Borbridge Avenue;
- OLA B – Outdoor living area block by house from River Road;
- OLA C – Outdoor living area with side exposed to River Road and blocked by house to Street No. 8;
- OLA D – Outdoor living area with side facing Street No. 8 and blocked by house to Brian Good Avenue;
- OLA E – Outdoor living area with side exposed to Spratt Road and rear facing street No. 8;
- OLA F – Outdoor living area with side facing Spratt Road;
- OLA G – Outdoor living area with side facing Borbridge Avenue and blocked by house from Spratt Road;
- OLA H – Outdoor living area with side facing Borbridge Avenue and blocked by house from Brian Good Avenue; and,
- OLA I – Outdoor living area blocked by house from Borbridge Avenue.

Road traffic data for the prediction model is based on the parameters outlined in Part 4, Appendix B Table B1 of the ENCG and is summarized below in Table 4. Spratt Road is a 2-lane major collector (2-UMCU) road with a right-of-way of 26 m, River Road is a 4-lane urban arterial-divided (4-UAD) road with a right-of-way of 37.5 m, and Brian Good Avenue, Borbridge Avenue and Street No. 8 are 2-lane urban collector (2-UCU) roads with a right-of-way of 20 m.

Table 4: Road Traffic Data

Parameter	Spratt Road	River Road	Borbridge Avenue	Brian Good Avenue	Street No. 8
Roadway Class	2-Lane major Collector (2-UMCU)	4-Lane Urban Arterial-Divided (4-UAD)	2-Lane Urban Collector (2-UCU)	2-Lane Urban Collector (2-UCU)	2-Lane Urban Collector (2-UCU)
AADT Vehicles / Day	12,000	35, 000	8, 000	8, 000	8, 000
Posted Speed km/hr	80 km/hr	80 km/hr	50 km/hr	50 km/hr	50 km/hr
Day / Night Split%	92% / 8%	92% / 8%	92% / 8%	92% / 8%	92% / 8%
Medium Trucks%	7%	7%	7%	7%	7%
Heavy Trucks%	5%	5%	5%	5%	5%
Road Elevation	Flat	Flat	Flat	Flat	Flat

4.1 Results

The predicted 16-hr daytime and 8-hr nighttime road traffic noise levels at the proposed residential building façades (i.e., POW) are summarized in Table 5, and the predicted 16-hr daytime noise levels in the Outdoor Living Areas are summarized in Table 6. The approximate perpendicular distance from each receptor to the middle of each road up to a maximum of 500 m (the maximum distance allowable in STAMSON) is also included. A sample calculation of results is provided in Appendix A. While there are some minor elevation differences throughout the development, all calculations have been completed with the option “Flat/gentle slope” selected in STAMSON.

Table 5: Predicted Road Traffic Sound Levels at Plane of Window (POW) Receptor Locations

Receptor Label	Perpendicular Distance from Road Centreline (m)					Daytime $L_{eq\ 16hr}$ (dBA) First Floor POW (Living Room / Kitchen)	Nighttime $L_{eq\ 8hr}$ (dBA) Second Floor POW (Bedroom)
	Spratt Road	River Road	Borbridge Avenue	Brian Good Avenue	Street No. 8		
POW A	>500	30	24	>500	>500	70	63
POW B	>500	46	146	>500	405	68	61
POW C	>500	23	26	>500	26	73	66
POW D	>500	>500	>500	27	45	60	53
POW E	27	>500	>500	>500	33	66	59
POW F	24	>500	365	>500	368	67	60
POW G	40	>500	40	>500	>500	63	56
POW H	>500	>500	20	27	>500	63	56
POW I	>500	>500	21	260	>500	62	55

Table 6: Predicted Road Traffic Sound Levels at Outdoor Living Area (OLA) Receptor Locations

Receptor Location	Perpendicular Distance from Road Centreline (m)					Daytime $L_{eq\ 16hr}$ (dBA) OLA Rear/Side Yard
	Spratt Road	River Road	Borbridge Avenue	Brian Good Avenue	Street No. 8	
OLA A	>500	32	40	>500	>500	67
OLA B	>500	58	143	>500	405	52
OLA C	>500	30	>500	>500	19	69
OLA D	>500	>500	>500	38	48	54
OLA E	24	>500	>500	>500	34	51
OLA F	30	>500	350	>500	383	47
OLA G	62	>500	41	>500	>500	43
OLA H	>500	>500	21	41	>500	46
OLA I	>500	>500	40	260	>500	43

4.2 Discussion and Recommendations

The following section provides discussion and recommendations related to expected acoustical requirements for The Development

4.2.1 Ventilation Requirements

Based on the predicted noise levels, it is expected that a few of the homes in The Development will require mandatory central air conditioning in order to allow windows to remain closed during warmer periods. This requirement is generally expected to apply to homes directly exposed to noise from River Road and Spratt Road such as Receptors A, B, C, E, F and similar surrounding dwellings.

For all other homes on the exterior of the development exposed to noise from the identified roads forced-air heating, with the provisions for the installation of central air conditioning must be provided. This would allow occupants to retrofit central air conditioning and keep their windows closed during the warmer months at their own discretion.

4.2.2 OLA Barriers

Based on the predicted noise levels, it is expected that homes with OLAs directly exposed to the noise from River Road will require acoustical barriers in order to reduce OLA noise levels to the 55 dBA criterion identified in Table 2. For example, the OLAs of Receptor A and C are predicted to have road traffic noise levels of 67 dBA and 69 dBA respectively, which represent the highest expected OLA impacts for the entire development. These two homes are estimated to require a 5 m tall property line acoustical barrier in order to achieve a daytime 16-hr L_{eq} OLA noise level due to road traffic of 55 dBA. However, if the City of Ottawa is willing to allow for a 5 dB OLA noise level exceedance, as indicated may be acceptable in the ENCG, the barrier height could be reduced to 3.1 m resulting in a road traffic noise level just less than 60 dBA in these two OLAs.

Since the OLA of Block 1 has a similar exposure to noise as the OLA of Receptor A, it will also require a similar acoustical barrier.

Based on the remaining OLA noise predictions, it is not expected that other homes within The Development would require barriers to achieve the 55 dBA criterion.

4.2.3 Building Components

Receptors A, B, C, E, F, and surrounding homes with similar noise exposure will require building components (windows and exterior walls) to be specified since predicted POW noise levels exceed the thresholds identified in Table 1.

To demonstrate the feasibility of The Development, the worst-case scenario was analyzed. This corresponds to Receptor C with a predicted daytime 16-hr L_{eq} road traffic noise level of 73 dBA that must be reduced to an interior noise level of 45 dBA in the living room as indicated in Table 1. Given that detailed designs for the dwellings of The Development are currently not available, assumptions must be made in order to estimate building component acoustical performance requirements. For this purpose it is assumed that the exterior wall exposed to the predicted level of road traffic noise has an area that is 75% of the living room floor area and similarly the exposed windows have an area that is 30% of the living room floor area. Using Building Practice Note (BPN) 56 method developed by the National Research Council of Canada (NRCC) for prediction of building component acoustical performance requirements, the following building component acoustical performance requirements were determined for the Receptor C:

1) Exterior living room walls should provide a minimum Sound Transmission Class rating of STC 40. This could be achieved using an EW2 Wall Type, which consists of the following:
   - 12.7 mm gypsum board;
   - Vapour Barrier;
   - 38x89 mm wood studs;
   - 50 mm acoustical insulation;
   - 25 mm rigid insulation; and,
   - Metal or Wood siding with fibre backer board.
2) Living room windows should provide a minimum STC 33 rating. This could be achieved using an operable 6-13-6 window, which consists of the following:
   - 6 mm glass;
   - 13 mm air space; and,
   - 6 mm glass.

For Receptor C, similar building components are also expected to be required for bedrooms.

As the predicted noise levels for all other receptors within The Development are lower than Receptor C, it is currently estimated, based on the indicated assumptions, that exterior walls and windows meeting the minimum non-acoustical requirements of the OBC (e.g., thermal) will provide sufficient sound isolation to achieve the required indoor road traffic sound levels indicated in Table 1.

4.2.4 Warning Clauses

Warning clauses required for indoor noise levels due to road traffic will be considered first. Based on the predicted noise levels, it is expected that all the homes on the exterior of The Development exposed to noise from the identified roads, which includes all the receptors locations considered in this study, will require at least "Generic" type noise warning clauses related to indoor noise levels. For the identified homes that require upgraded building components, the "Extensive Mitigation of Indoor and Outdoor Amenity Area" type noise warning clauses would be required.

Warning clauses required for OLA noise levels due to road traffic will now be considered. Based on the predicted noise levels, it is expected that a few homes with OLAs directly exposed to the noise from River Road may require OLA noise warning clauses. This would include Receptor A and C as well as Block 1. If the City of Ottawa approves the up to 5 dB exceedance of the OLA daytime 16-hour L_{eq} 55 dBA road traffic noise level criterion in order to reduce barrier height requirements, a "No Outdoor Amenity Area" type warning clause would be required. If the taller barrier option is pursed and OLA road traffic noise levels are reduced to 55 dBA, then the "Extensive Mitigation of Indoor and Outdoor Amenity Area" type warning clause would be required.

5.0 CONCLUSIONS

Golder Associates Ltd. has been retained by the RSDC to prepare a feasibility Noise Impact Study (NIS) as supporting documentation for Rezoning, Official Plan Amendment and Plan of Subdivision applications for the proposed development, Riverside South Phase 15 – Part of 2650 Spratt Road and 75 River Road, in the City of Ottawa. Based on the results of the NIS, the proposed development will be capable of meeting the guidelines as set out in the ENCG, provided the detailed noise control recommendations are provided and followed, which should include acoustical barriers for Outdoor Living Areas (OLAs), building component specifications (exterior walls and windows), and appropriate warning clauses. Golder will continue to work with RSDC during the course of the detailed design of the development to ensure that the ENCG requirements are achieved.

6.0 LIMITATIONS

In evaluating the impacts on the proposed development, Golder has relied in good faith on information provided by others. We accept no responsibility for any deficiency, misstatements, or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of the persons involved. The report cannot account for changes in the proposed development after it has been submitted to RSDC.

Golder prepared this report using its commercially reasonable best efforts consistent with the level and skill ordinarily exercised by members of the profession currently practicing under similar conditions.

7.0 CLOSURE

We trust that the information presented in this study meets your requirements. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Sincerely,

GOLDER ASSOCIATES LTD.

Ryan Bessey, B.A.Sc., P.Eng.
Acoustic, Noise, and Vibration Engineer

Joe Tomaselli, M.Eng., P.Eng.
Associate

DGSA/RNB/Dd/ng/md
\\golder.gds\gal\ottawa\active\2014\1122 - clg\1406222 rsdc - rs phase 15 - part of 4650 spratt and 750 river\noise\report\final\1406222 final rpt riverside south nis august2016 v1.1.docx

LICENSED PROFESSIONAL ENGINEER
R. N. BESSEY
100124319
Aug. 10/2016
PROVINCE OF ONTARIO

FIGURES

LEGEND

- CRITICAL RECEPTOR LOCATIONS

KEY MAP

0 50 100 200

1:5,000 METRES

NOTE(S)

THIS FIGURE IS TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING GOLDER ASSOCIATES LTD. REPORT NO. 1406222

REFERENCE(S)

1. SERVICE LAYER CREDITS: CITY OF OTTAWA
SOURCES: ESRI, HERE, DELORME, USGS, INTERMAP, INCREMENT P CORP., NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI (THAILAND), MAPMYINDIA, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: MTM ZONE 9 VERTICAL DATUM: CGVD28

CLIENT

RIVERSIDE SOUTH DEVELOPMENT CORPORATION

PROJECT

NOISE IMPACT STUDY
PART OF 4650 SPRATT ROAD AND 750 RIVER ROAD
OTTAWA, ONTARIO

TITLE

PROPOSED LOT LAYOUT

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-08-09
DESIGNED	BR
PREPARED	DA
REVIEWED	RNB
APPROVED	JT

PROJECT NO.	PHASE	REV.	FIGURE
1406222	2000	0	**1**

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APPENDIX A

Stamson Calculations

STAMSON 5.0 NORMAL REPORT Date: 30-05-2016 11:29:57
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

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

Road data, segment # 1: River RD SB (day/night)

Car traffic volume : 14168/1232 veh/TimePeriod *
Medium truck volume : 1127/98 veh/TimePeriod *
Heavy truck volume : 805/70 veh/TimePeriod *
Posted speed limit : 80 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): 17500
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: River RD SB (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 22.50 / 22.50 m
Receiver height : 1.50 / 4.50 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

♀
Road data, segment # 2: River RD NB (day/night)

Car traffic volume : 14168/1232 veh/TimePeriod *
Medium truck volume : 1127/98 veh/TimePeriod *
Heavy truck volume : 805/70 veh/TimePeriod *
Posted speed limit : 80 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): 17500
Percentage of Annual Growth : 0.00
Number of Years of Growth : 0.00
Medium Truck % of Total Volume : 7.00
Heavy Truck % of Total Volume : 5.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 2: River RD NB (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 1 (Absorptive ground surface)
Receiver source distance : 37.50 / 37.50 m
Receiver height : 1.50 / 4.50 m

```
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

♀
Road data, segment # 3: Borbridge (day/night)
-------------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     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):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 3: Borbridge (day/night)
-------------------------------------------
Angle1   Angle2           :  -5.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  27.00 / 27.00  m
Receiver height           :   1.50 / 4.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :   0.00 deg   Angle2 : 90.00 deg
Barrier height            :  11.00 m
Barrier receiver distance :   0.01 / 0.01   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00

♀
Results segment # 1: River RD SB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.78 + 0.00) = 68.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.66  73.16   0.00  -2.92  -1.46   0.00   0.00   0.00  68.78
-------------------------------------------------------------------------------

Segment Leq : 68.78 dBA

♀
Results segment # 2: River RD NB (day)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.09 + 0.00) = 65.09 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------------
   -90     90   0.66  73.16   0.00  -6.61  -1.46   0.00   0.00   0.00  65.09
```

Segment Leq : 65.09 dBA

♀
Results segment # 3: Borbridge (day)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	1.50	1.50	1.50

ROAD (45.95 + 41.27 + 0.00) = 47.22 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-5	0	0.66	65.75	0.00	-4.24	-15.57	0.00	0.00	0.00	45.95
0	90	0.00	65.75	0.00	-2.55	-3.01	0.00	0.00	-18.91	41.27

Segment Leq : 47.22 dBA

Total Leq All Segments: 70.35 dBA

♀
Results segment # 1: River RD SB (night)

Source height = 1.50 m

ROAD (0.00 + 61.49 + 0.00) = 61.49 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	65.56	0.00	-2.76	-1.30	0.00	0.00	0.00	61.49

Segment Leq : 61.49 dBA

♀
Results segment # 2: River RD NB (night)

Source height = 1.50 m

ROAD (0.00 + 58.01 + 0.00) = 58.01 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.57	65.56	0.00	-6.25	-1.30	0.00	0.00	0.00	58.01

Segment Leq : 58.01 dBA

♀
Results segment # 3: Borbridge (night)

Source height = 1.50 m

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)
1.50	4.50	4.50	4.50

ROAD (38.58 + 34.05 + 0.00) = 39.89 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-5	0	0.57	58.16	0.00	-4.01	-15.57	0.00	0.00	0.00	38.58
0	90	0.00	58.16	0.00	-2.55	-3.01	0.00	0.00	-18.55	34.05

Segment Leq : 39.89 dBA

Total Leq All Segments: 63.12 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 70.35
(NIGHT): 63.12

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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