Appendix H

Acoustic Impact Assessment

HEGGIES

REPORT 20-2038-R1

Revision 0

George Booth Drive, Edgeworth
Road Traffic Noise Assessment

PREPARED FOR

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George Booth Drive, Edgeworth Road Traffic Noise Assessment

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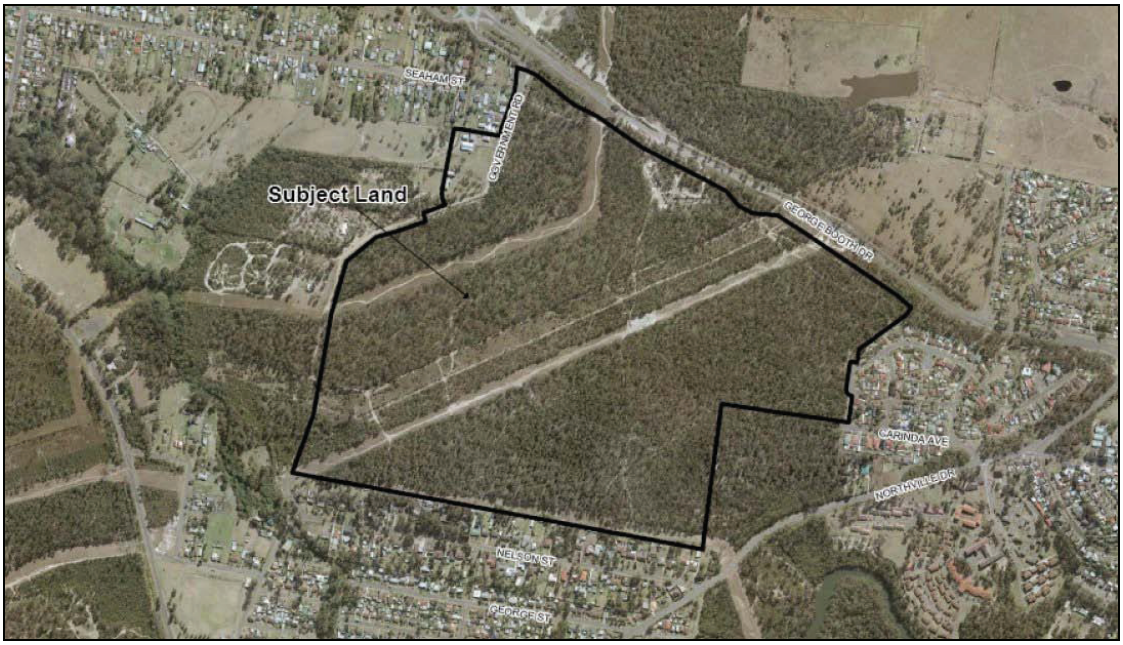
1 INTRODUCTION

Heggies has been engaged by RoadNet to undertake a road traffic noise assessment for a proposed residential development adjacent to George Booth Drive, Edgeworth. The NSW Department of Planning has directed City of Lake Macquarie Council (Council) to prepare a Local Environmental Study (LES) for a proposed urban development of approximately 95 hectares of zone 10 investigation land off George Booth Drive, Edgeworth. To satisfy the requirements of the LES, a road traffic noise assessment is required to determine potential noise impacts on the development and outline practical noise mitigation techniques to minimise potential impacts.

The location of the proposed development is shown in **Figure 1**.

Figure 1 Location of Proposed Residential Development



At the time of preparation of the road traffic noise impact assessment, information regarding lot plans for the subject site was not available. It was therefore assumed for assessment purposes that residential dwellings will potentially be constructed immediately adjacent to George Booth Drive. Additionally the assessment has assumed two storey dwellings.

It is anticipated that the development would be completed in 2009. It is standard practice to assess road traffic noise impacts 10 years from project opening ("Design Year"). Accordingly, road traffic noise amelioration would be designed to mitigate Design Year 2019 impacts.

2 ROAD TRAFFIC NOISE CRITERIA

2.1 Intrusive Noise Criteria - External Spaces

Road traffic noise emission impacting on the external areas of the proposed development should be assessed in accordance with:

- The NSW *Department of Environment and Climate Change's* (DECC) *Environmental Criteria for Road Traffic Noise* (ECRTN) for vehicle-related noise emissions on public roads.

The ECRTN document presents recommended road traffic noise criteria for various types of road and residential land use developments as well as criteria for other noise-sensitive land uses. The relevant criteria relating to new residential land use developments affected by various types of road traffic noise are summarised in **Table 1**, extracted from the NSW Environmental *Criteria for Road Traffic Noise* document.

Table 1 Road Traffic Noise Criteria

Type of Development	Criteria		
	Day 7 am – 10 pm (dBA)	**Night 10 pm –7 am (dBA)**	**Where Criteria are Already Exceeded**
2. New residential land use developments affected by freeways / **arterial** traffic noise	$L_{Aeq(15hour)}$ 55	$L_{Aeq(9hour)}$ 50	Where feasible and reasonable existing noise levels should be reduced to meet the noise criteria via judicious design and construction off the development Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts
5. New residential land use developments affected by **collector** traffic noise	$L_{Aeq(1hour)}$ 60	$L_{Aeq(1hour)}$ 55	
11. New residential land use developments affected by traffic noise from **local** roads	$L_{Aeq(1hour)}$ 55	$L_{Aeq(1hour)}$ 50	Where feasible and reasonable existing noise levels should be reduced to meet the noise criteria via judicious design and construction off the development Relevant strategies will include optimum location and orientation of buildings on the site; planning internal layouts carefully; choosing the most appropriate building materials and using good construction techniques.

Definitions: New residential development affected by traffic noise - addresses the acceptable level of road traffic noise impact for new residential developments.

The DECC document includes the following guidance notes to assist in identifying road types:

- **Freeway/arterial** includes sub-arterial roads and refers to roads handling through traffic, with characteristically heavy and continuous traffic flows during peak periods. Through traffic is traffic passing through a locality bound for another locality.
- **Collector road** refers to a road situated in a built-up area that collects local traffic leaving a locality and connects to a sub-arterial road.
- **Local road – metropolitan** refers to a road situated in built-up areas and handling local traffic. These roads characteristically have intermittent traffic flows. Metropolitan refers to the built-up area of a city or town, and includes both the urban zone of the CBD and adjacent localities, and the suburban zone situated between the urban and rural zones.

Based on the guidance above, Heggies has determined that George Booth Drive is classed as a **Collector road**.

In summary, the **external** noise criteria for road traffic noise for this site, assessed 1 m from the building facade (facade reflected noise levels) are:

- Daytime 7.00 am - 10.00 pm: $L_{Aeq(1hour)}$ **60 dBA**
- Night-time 10.00 pm - 7.00 am: $L_{Aeq(1hour)}$ **55 dBA**

It is noted that the noise criteria presented within the ECRTN noise policy document are guidelines and non-mandatory.

In achieving compliance with the noise criteria, consideration needs to be given to aesthetics, cost implications, equity, community preferences and practicality. Where noise criteria cannot be achieved in consideration of the above, the benefits of the project would need to be evaluated and weighed up against the acoustical impacts.

2.2 Intrusive Noise Criteria - Internal Spaces

As a guide, the ECRTN suggests that internal noise levels should not exceed a value greater than 10 dBA below the relevant external noise level on the basis of operable windows being opened sufficiently to provide adequate ventilation. This typically equates to a minimum of 20% of the window area left open.

Based on the external noise criteria outlined in **Table 1,** the equivalent internal noise requirements for a residential land use development affected by collector traffic noise would be those presented in **Table 2.**

Table 2 ECRTN Internal Road Traffic Noise Criteria

Type of Development	ECRTN Internal Noise Criteria	
	Day 7 am – 10 pm (dBA)	**Night 10 pm –7 am (dBA)**
5. New residential land use developments affected by collector traffic noise	$L_{Aeq(1hour)}$ 50	$L_{Aeq(1hour)}$ 45

Heggies recommends that these internal noise levels may be considered somewhat high for the proposed development, and it is not recommended that they are adopted for this development. Alternatively, Heggies recommend that the internal noise levels presented in Australian/New Zealand Standard AS/NZS 2107:2000 - *"Acoustics - Recommended Internal Design Sound Levels and Reverberation Times for Building Interiors"* are used to derive noise criteria for internal spaces at the proposed development.

The relevant section of the Standard relating to 'Houses and Apartments near Major Roads' is presented in **Table 3**.

Table 3 AS/NZS 2107-2000 Recommended Internal Design Sound Levels

Type of Occupancy/Activity	Recommended Design Sound Level dBA	
	Satisfactory	**Maximum**
Houses and Apartments near Major Roads		
'Work areas'	35 dBA	45 dBA
Living areas	35 dBA	45 dBA
Sleeping areas	30 dBA	40 dBA

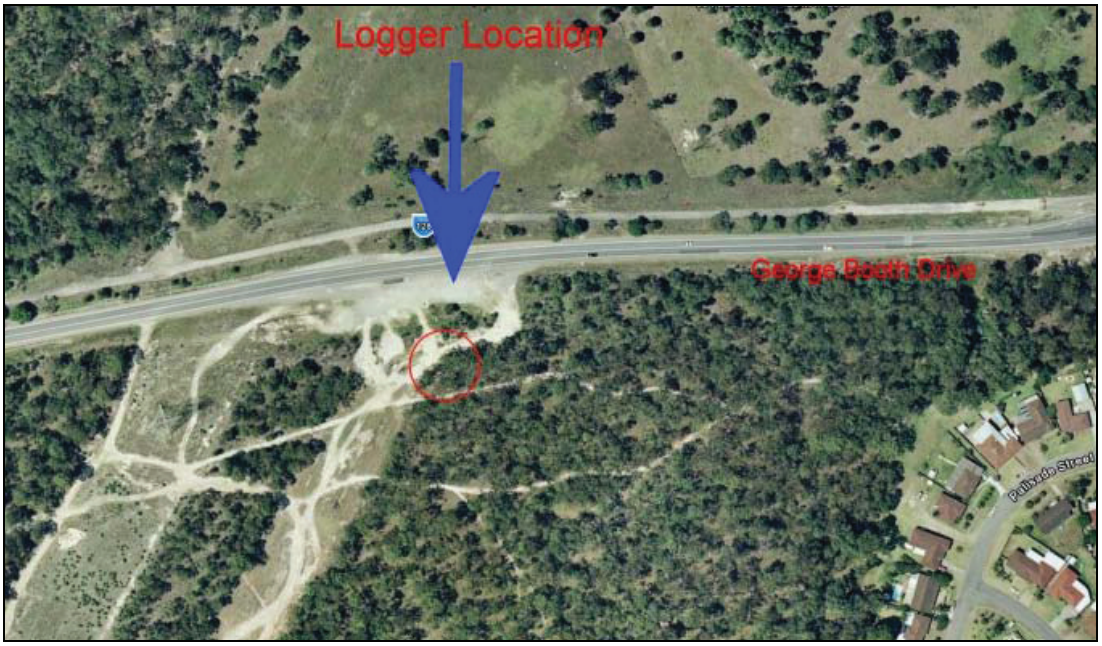
It is not often practical to achieve the noise levels at the lower "satisfactory" end of the range presented above, and the noise levels at the upper "maximum end of the range are approaching the ECRTN values which as already stated are considered somewhat high. It is therefore recommended that the internal noise level criteria for this development are in the middle of the range in AS/NZS 2107:2000, being:

- **Living Areas** (Daytime 7.00 am - 10.00 pm): **40 dBA**
- **Sleeping Areas** (Night-time 10.00 pm - 7.00 am): **35 dBA**

3 EXISTING NOISE ENVIRONMENT

Ambient noise monitoring was conducted on the subject site approximately 30m from George Booth Drive from Monday 12 May to Monday 19 May, 2008. The measurements were undertaken in the free-field and at a height of 1.5 m above ground level. The noise monitoring location is shown in **Figure 2.**

Figure 2 Ambient Noise Monitoring Location



Monitoring was carried out using an Acoustic Research Laboratories (ARL) type EL 316 noise logger, which was programmed to record a range of statistical noise levels, including the L_{A10}, L_{A90} and L_{Aeq} noise levels over consecutive 15 minute periods. The L_{A10} and L_{A90} are the A-weighted sound pressure levels exceeded for 10% and 90% of a given measurement period respectively. The L_{Aeq} is the average energy noise level, defined as the steady noise level that contains the same amount of acoustical energy as a given time-varying noise over the same measurement period. The logger was checked for calibration before and after the monitoring, using a Brüel & Kjær Tye 4230 Sound Level Calibrator.

Weather conditions during the monitoring period were obtained from the Bureau of Meteorology. For the duration of the monitoring period, conditions were fine with light easterly and westerly winds, no rainfall and daytime temperatures in the mid-twenties.

The results of the unattended noise measurements are summarised in **Table 4**. Detailed unattended noise measurement charts are presented in **Appendix A**.

Table 4 Ambient Noise Monitoring Results

Location	Measured Noise Level		
	LAeq (1hour) Day	LAeq (1hour) Night	LA10(18hour)
30 m from George Booth Drive	64	63	65

4 SOUNDPLAN NOISE MODELLING

4.1 Methodology

As part of this acoustic assessment, a SoundPLAN computer noise model has been developed. SoundPLAN uses the Calculation of Road Traffic Noise (CoRTN, 1988) algorithms to estimate road traffic noise levels over a defined area, taking into account the noise contribution of traffic volumes, traffic speed and traffic mix (ie percentage of heavy vehicles) and attenuation effects of the natural topography and barriers in the form of buildings and purpose-built noise control barriers. CoRTN is one of the Department of Environment and Climate Change's (DECC) accepted calculation procedures to model road traffic noise (refer *Environmental Criteria for Road Traffic Noise* (ECRTN) Section C5).

The noise modelling was undertaken with the following aims:

- Determining road traffic noise levels at all exposed locations across the proposed development site under existing (2008) road traffic conditions, with no acoustical treatment measures in place (Calibration).
- Determining road traffic noise levels at exposed locations across the proposed development site under future (2019) road traffic conditions with no acoustical treatment measures in place.
- Evaluate the exceedances of relevant criteria under the future scenario, and
- Evaluate the benefit of purpose-built noise mitigation measures such as at the boundary of the site and/or at the building facade, if required.

4.2 Modelling Inputs - 2008 Calibration

The SoundPLAN program requires topographical data and road traffic information to be entered into the model. The particular values and conditions used to verify/calibrate the computer noise model are presented in **Table 5**.

Table 5 Year 2008 Calibration Inputs

Road	Heading	Average Speed, kph	Pavement Surface	Total Traffic Volume, 18 hours [1]	% Heavy Vehicles, 18 hours [1]
George Booth Drive	East	87	DGA[2]	4098	13.2%
	West	88	DGA[2]	3879	12.5%

Note 1: The 18 hour traffic flow represents all traffic flows that occur between 6.00 am and 12 midnight.

Note 2: DGA refers to Dense Graded Asphalt.

The results of the model calibration are presented in **Section 4.5**.

4.3 Modelling Inputs - 2019 Future Scenario

When modelling road traffic noise impacts, it is typical to determine the impacts 10 years hence construction. In this case, it is therefore necessary to determine the likely road traffic noise impact upon the development site in year 2019.

In order to do this, year 2008 traffic data has been extrapolated to year 2019 based on an estimated annual traffic increase of 2% on George Booth Drive. The noise modelling inputs used to determine road traffic impacts in 2019 are shown in **Table 6**:

Table 6 Year 2019 Future Scenario Inputs

Road	Heading	Average Speed, kph	Pavement Surface	Time Period	Total Traffic Volume, Peak 1 hour	% Heavy Vehicles, Peak 1 hour
George Booth Drive	East	90	DGA	Day	561	6.6%
	West	90	DGA	Day	478	13.9%
	East	90	DGA	Night	255	16.3%
	West	90	DGA	Night	351	13.0%

.

4.4 Deviations from CoRTN

The Calculation of Road Traffic Noise (CoRTN, 1988) calculation algorithms have been modified as follows:

- A 'three source height model' has been used in lieu of CoRTN's 'single source height' model.

Vehicle source heights have been modelled as follows:

- Cars: 0.5 m above the carriageway
- Heavy Vehicle Tyres: 0.5 m above the carriageway
- Heavy Vehicle Engines: 1.5 m above the carriageway
- Heavy Vehicle Exhausts: 3.6 m above the carriageway

Appropriate sound power adjustments have been made to the heavy vehicle sources to correctly distribute the source power over the three source heights, being:

- Heavy Vehicle Tyres: - 5.44 dB
- Heavy Vehicle Engines: - 2.43 dB
- Heavy Vehicle Exhausts: - 8.45 dB

In addition, and according to data published by the Australian Road Research Board (ARRB), the values presented by CoRTN have been corrected by - 1.7 dB to account for Australian road traffic conditions, which, through testing and research, have been found to yield noise levels 1.7 dB lower than those output by CoRTN (which was originally designed to assess UK road traffic noise).

4.5 Model Calibration Results

The modelling inputs above were used to calculate road traffic noise levels at the unattended noise logging location described in **Section 3** so that the accuracy of the noise model could be verified against the results form the unattended noise logging.

The result of the noise modelling is presented in **Table 7**.

Table 7 Comparison of Measured and Modelled Results

Location	Unattended Noise Logger (Measured) LA10(18hour)	SoundPLAN (Modelled) LA10(18hour)
George Booth Drive	65	63

Preliminary modelling results, using the input information presented in **Table 5** showed that compared to the results of noise monitoring undertaken on site, the SoundPLAN model under-predicted the noise level from George Booth Drive by approximately 2 dBA.

5 NOISE MODELLING RESULTS AND MITIGATION

5.1 No Mitigation

The results from the SoundPLAN noise model for the design Year 2019 for the daytime and night-time assessment periods, in the form of noise contour plots, are presented in **Figure 3** and **Figure 4** respectively. Regions of the contour shaded in red represent exceedances of the relevant time period criterion. The modelling outputs indicate that both assessment time periods result in exceedances for the assessment Year 2019, however it is the night-time period (Figure 4) that presents the largest exceedance. Therefore, the night-time ECRTN criterion is the defining period for which noise mitigation options have been design to comply with (refer to **Section 5.2**).

Figure 3 Year 2019 Daytime LAeq(1hour) Road Traffic Noise Levels – No Mitigation

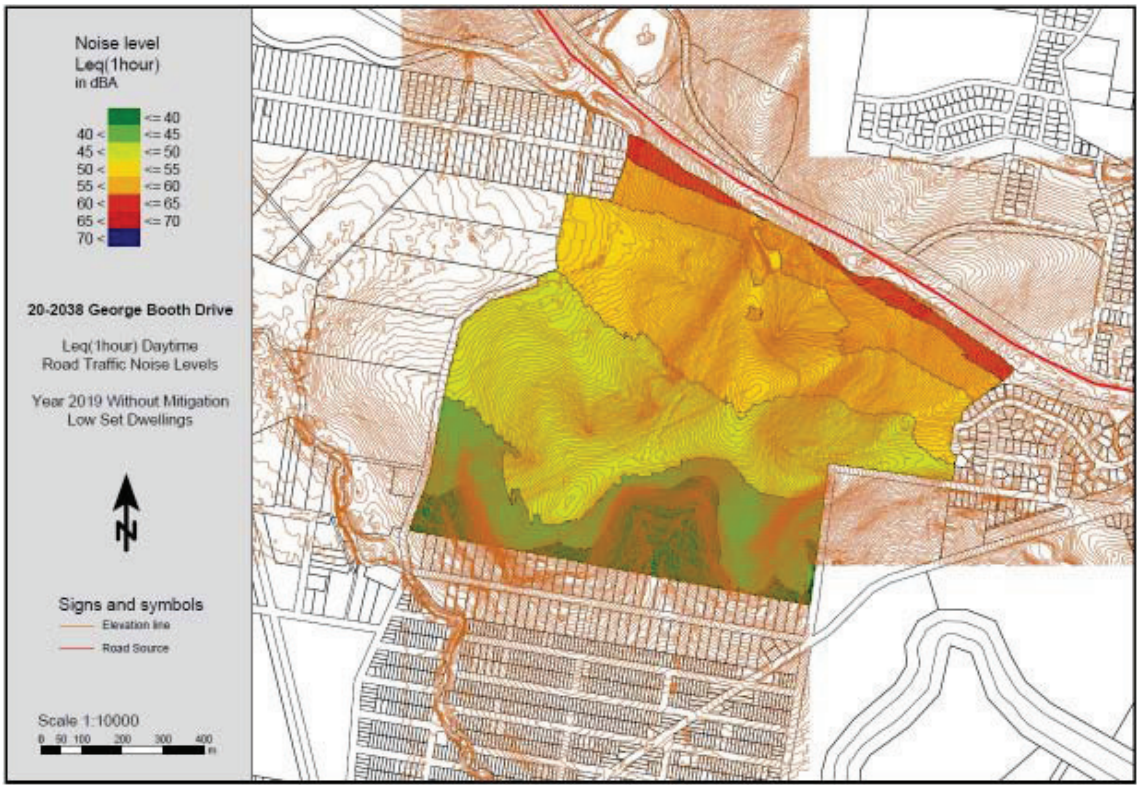
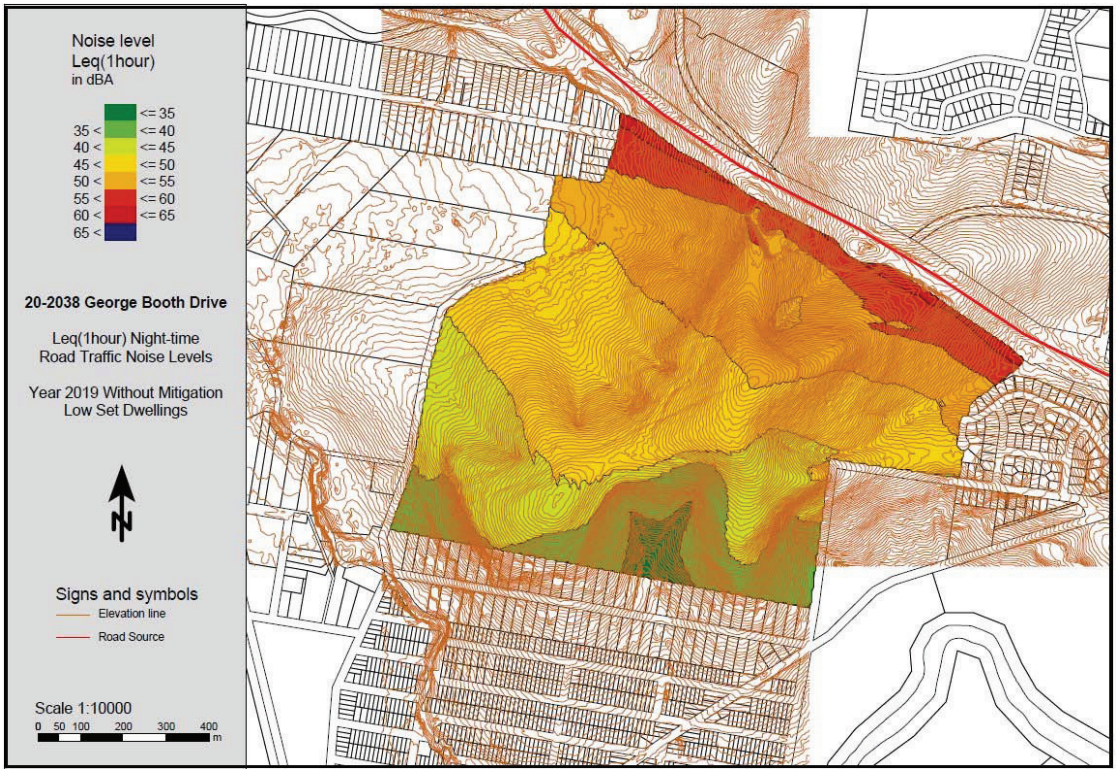


Figure 4 Year 2019 Night-time LAeq(1hour) Road Traffic Noise Levels – No Mitigation



5.2 Noise Barrier Design

As the residential allotments and building designs are not yet confirmed, generic noise barrier options, varying only in height, have been designed to demonstrate the options available to meet the objective of the ECRTN criteria. For simplicity, the noise barrier was located along the development boundary adjacent to George Booth Drive, however, it is acknowledge that a break in the barrier may be required for road traffic access from George Booth Drive. It is thought that this could be addressed acoustically by the construction of noise barrier returns along the entrance road off George Booth Drive.

The following noise barrier options were developed in the model to produce colour noise contour plots, presented in **Appendix B**, for low-set (ie single storey) and high-set (ie two storeys) dwellings:

- 4.0 m high barrier with returns
- 4.5 m high barrier with returns
- 5.0 m high barrier with returns
- 5.5 m high barrier with returns

As can be seen in **Appendix B**, the incremental increases (0.5 m) in noise barrier height diminishes the ECRTN criterion exceedance (red shaded areas) with the final contour plot of 5.5 m displaying a small area exceedance in the northern corner of the site. Depending on the layout of the proposed development, it is feasible to design the lots in such a way as to achieve compliance with the ECRTN criterion for low set dwellings with the construction of a barrier lower than 5.5 m in height.

For second storey facades that exceed the criterion, architectural treatments are recommended in **Section 5.3.**

5.3 Architectural Treatments

The predicted noise levels in **Appendix B** indicate that the ECRTN criterion for high set habitable floors will be exceeded for dwellings located within approximately 100 m of George Booth Drive even with the 5.5 m noise barrier. At the locations indicating criterion exceedances for the respective noise barrier heights, architectural treatments are required. The level of architectural treatment would be determined upon finalisation of the building design and layout.

The facades of residences located on all allotments are required to be designed to achieve the internal noise levels specified in **Section 2.2.** In order to comply with these internal noise levels, the level of traffic noise reduction (TNR) required by each facade has been calculated and the relevant construction category nominated.

A spreadsheet was set up in Microsoft Excel to complete the calculations for internal noise levels based on the methodology contained in AS3671:1989 *Acoustics – Road traffic noise intrusion- Building siting and construction.* For each of the noise affected facades, the maximum $L_{Aeq(1hour)}$ noise level (day or night as relevant) was used for the calculations. Section 3.3 of AS3671 *Acoustics - Road Traffic Noise Intrusion - Building Siting and Construction* contains details regarding various types of construction and the applicable TNRs for each type of construction:

> ***Category 1.*** *Standard construction; openings, including open windows and doors may comprise up to 10% of the exposed facade. TNR of approximately 10 dBA is expected.*
>
> ***Category 2.*** *Standard construction, except for lightweight elements such as fibrous cement or metal cladding or all-glass facades. Windows, doors and other opening must be closed. TNR of approximately 25 dBA is expected.*
>
> ***Category 3.*** *Special construction, chosen in accordance with Clause 3.4. Windows, doors and other openings must be closed. TNR between 25 and 35 dBA is expected.*

Table 8 below shows the indicative TNR required for dwellings, located within a particular distance from George Booth Drive, to achieve the internal noise levels specified in **Section 2.2.**

Table 8 Indicative TNRs Required by First Floor Affected Facades

Distance from George Booth Drive	Proposed Noise Barrier Height	LAeq(1hour)	TNR Required		Construction Category
			Sleeping Areas	Living Areas	
0 – 30 m	4.0 m	62 dBA	Up to 27 dBA	Up to 22 dBA	3
	4.5 m	61 dBA	Up to 26 dBA	Up to 21 dBA	3
	5.0 m	60 dBA	Up to 25 dBA	Up to 20 dBA	2
	5.5 m	60 dBA	Up to 25 dBA	Up to 20 dBA	2
30 - 60 m	4.0 m	60 dBA	Up to 25 dBA	Up to 20 dBA	2
	4.5 m	59 dBA	Up to 24 dBA	Up to 19 dBA	2
	5.0 m	58 dBA	Up to 23 dBA	Up to 18 dBA	2
	5.5 m	58 dBA	Up to 23 dBA	Up to 18 dBA	2
60 -100 m	4.0 m	57 dBA	Up to 22 dBA	Up to 17 dBA	2
	4.5 m	57 dBA	Up to 22 dBA	Up to 17 dBA	2
	5.0 m	57 dBA	Up to 22 dBA	Up to 17 dBA	2
	5.5 m	57 dBA	Up to 22 dBA	Up to 17 dBA	2

For the majority of the exceedance area adjacent to George Booth Drive, Category 2 façade construction is required for the various noise barrier options for both sleeping and living areas. It should be noted that the windows and doors must be closed to achieve compliance with the noise criteria, therefore mechanical ventilation should be provided to any upper floor sleeping and living areas on the affected facades to provide fresh air with windows closed.

6 CONCLUSION

Heggies has undertaken a road traffic noise assessment for a proposed residential development adjacent to George Booth Drive, Edgeworth. Noise measurements have been undertaken in order to characterise the existing noise environment of the proposed site. Based on the unattended noise measurement results, the DECC's ECRTN criteria applicable to collectors roads has been applied for assessment of habitable floors.

The results of the CoRTN road traffic noise modelling indicated that dwellings constructed within approximately 100 m of George Booth Drive will exceed the ECRTN night-time period criterion of 55 dBA $L_{Aeq(1hour)}$ in Year 2019 with no mitigation in place.

Accordingly, noise barrier options in the form of varying heights have been designed adjacent to George Booth Drive in order to demonstrate the extent of compliance with the ECRTN in the Year 2019.

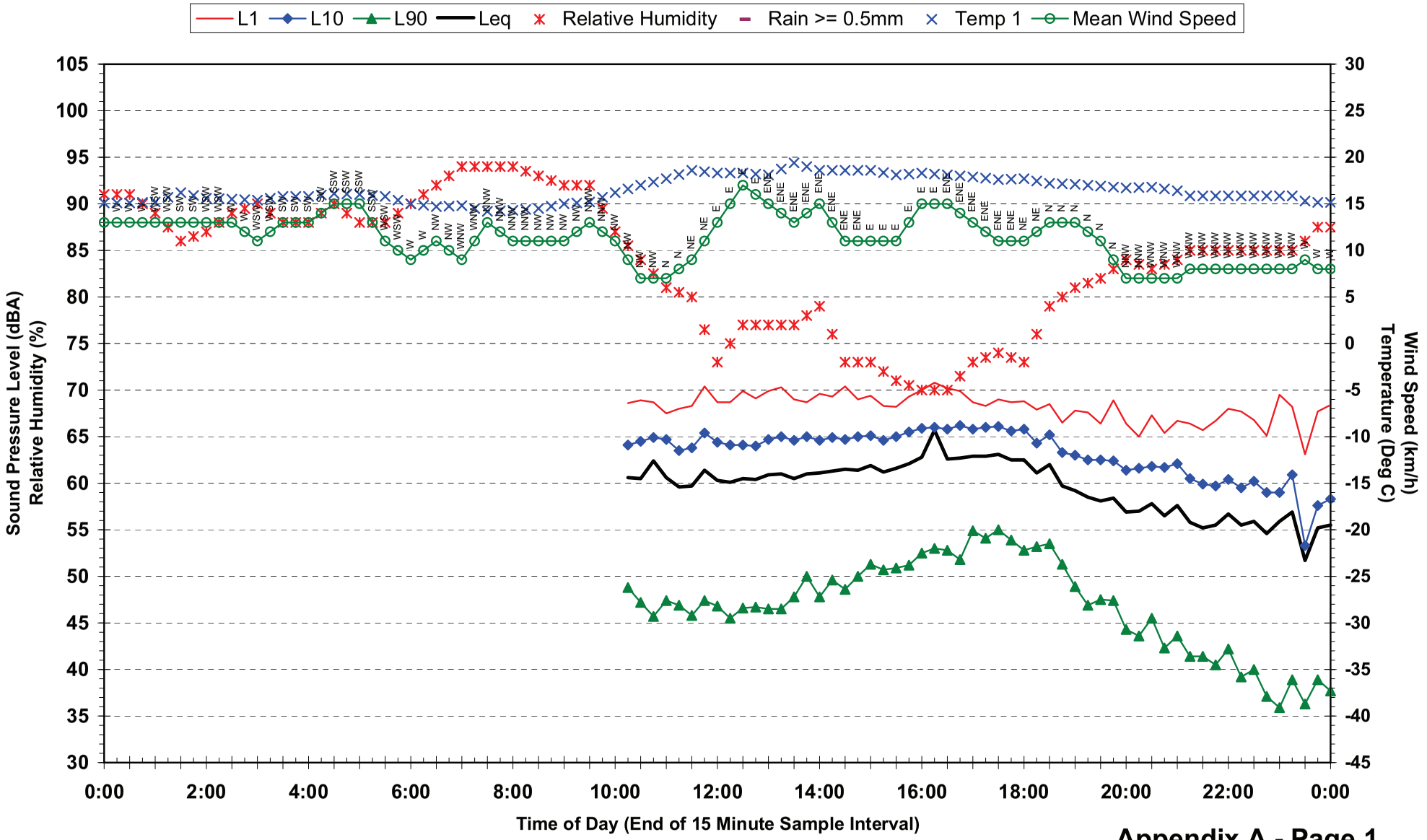
Increasing the height of the proposed noise barrier to mitigate road traffic noise for high set dwellings is not regarded as being reasonable or feasible. Therefore indicative architectural treatments have been assessed and recommended for habitable floors above ground level in accordance with AS3671. In most cases, category 2 construction would be required to achieve the internal design noise level of 35 dBA $L_{Aeq(1hour)}$ for the night-time period (ie sleeping areas) and 40 dBA $L_{Aeq(1hour)}$ for the daytime period (ie living areas).

The extent of final architectural treatment should be determined upon finalisation of the building design and layout.

Appendix A

UNATTENDED NOISE MONITORING RESULTS

Statistical Ambient Noise Levels
20-2038 George Booth Drive - Monday 12 May 2008



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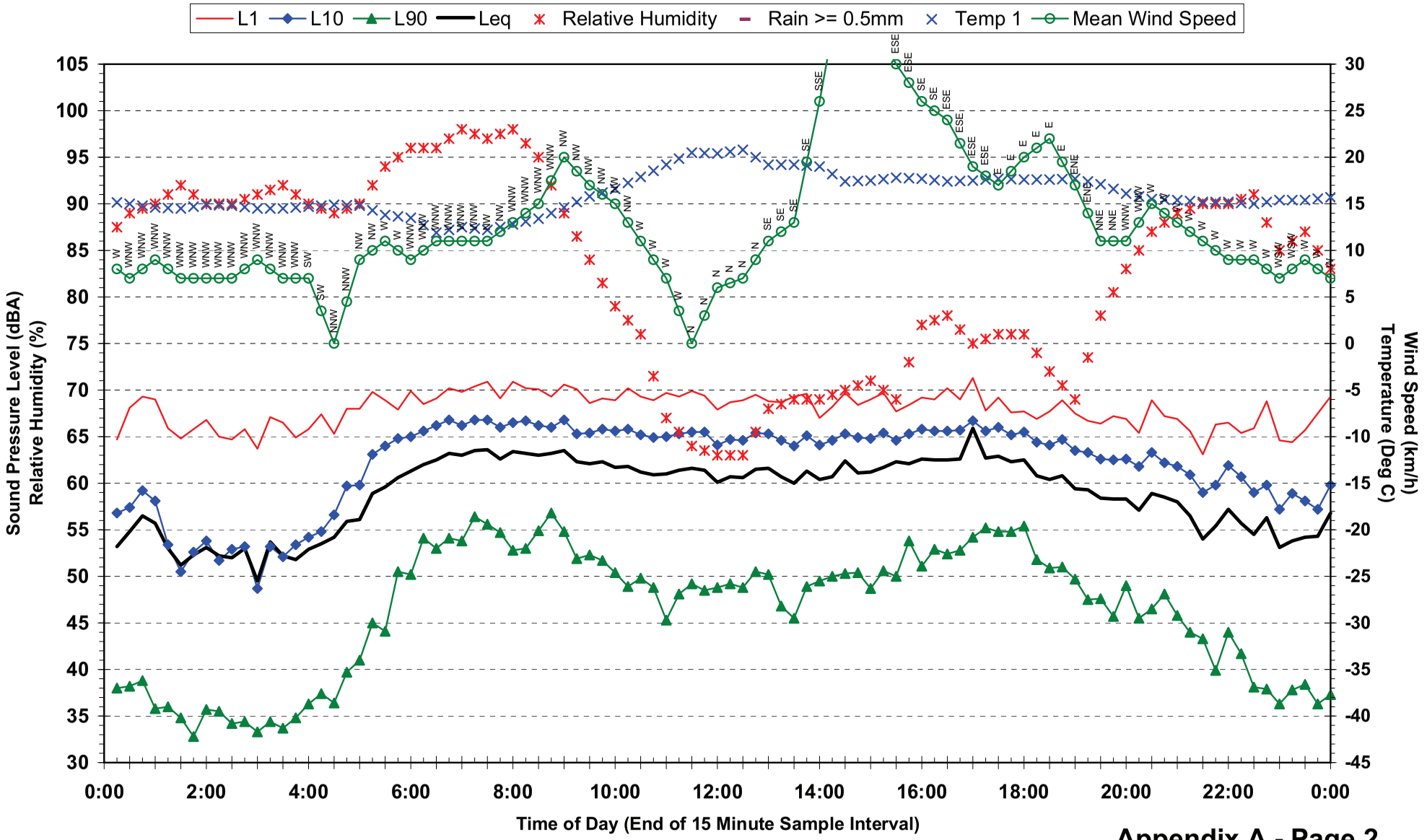
Statistical Ambient Noise Levels
20-2038 George Booth Drive - Tuesday 13 May 2008



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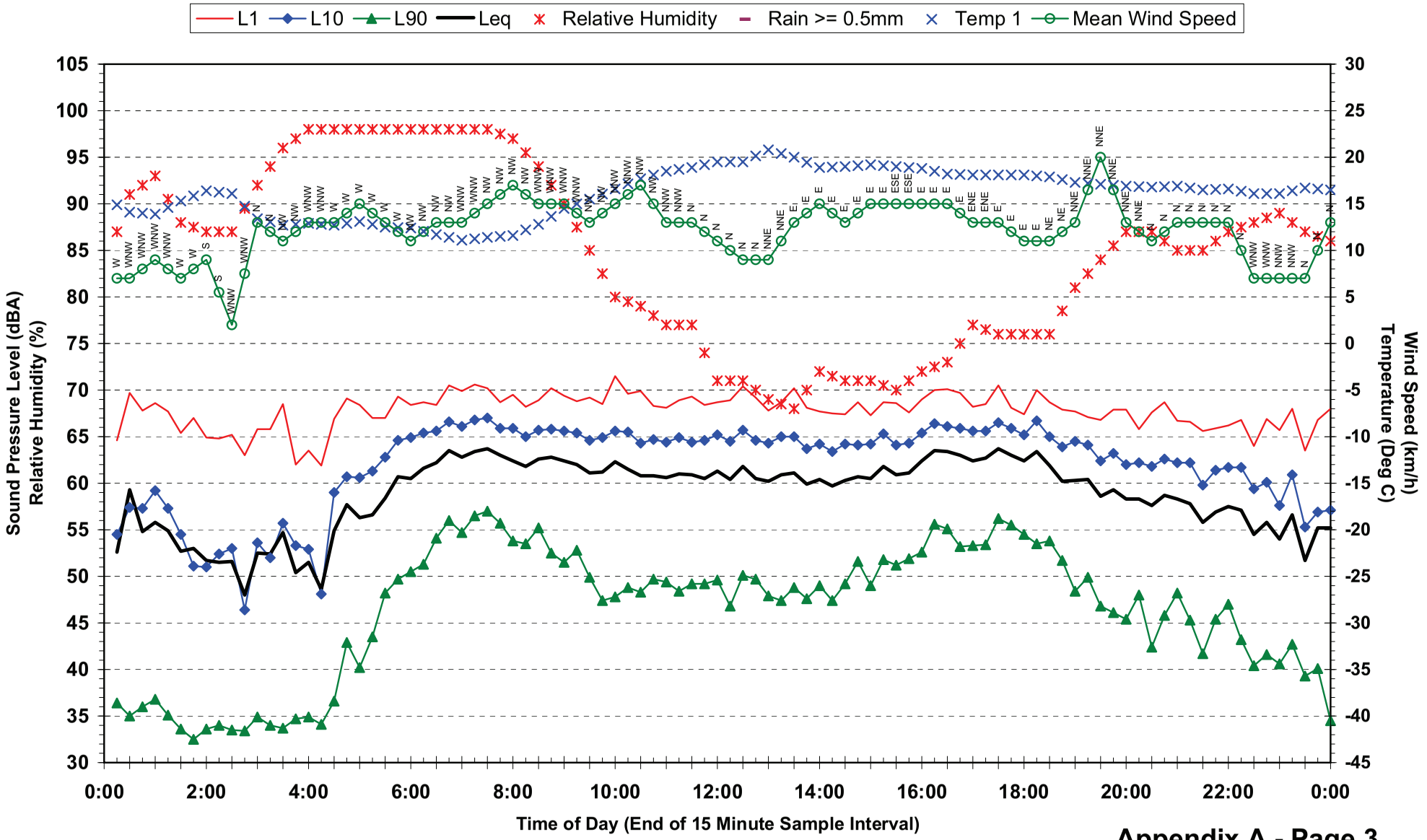
Statistical Ambient Noise Levels
20-2038 George Booth Drive - Wednesday 14 May 2008



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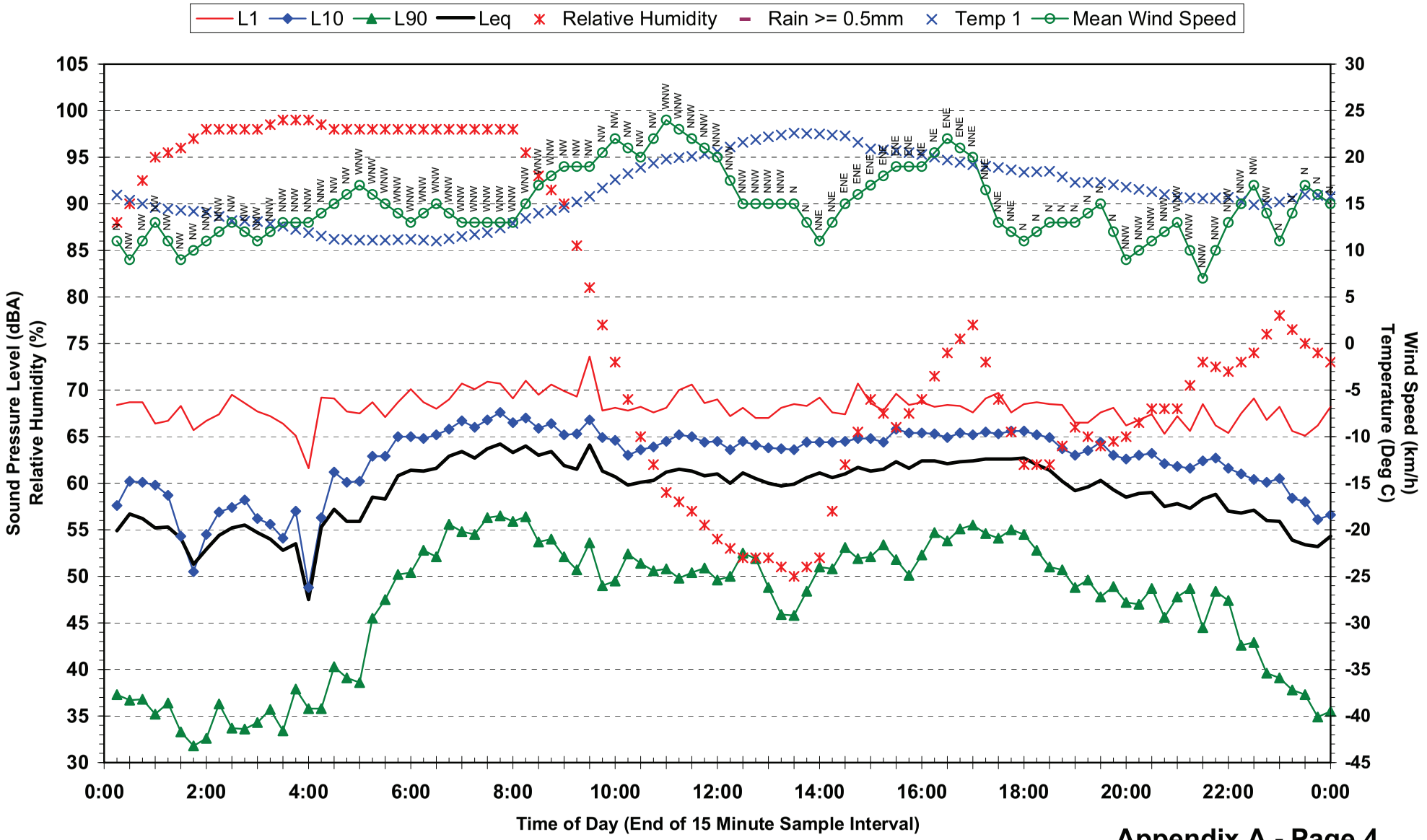
Statistical Ambient Noise Levels
20-2038 George Booth Drive - Thursday 15 May 2008



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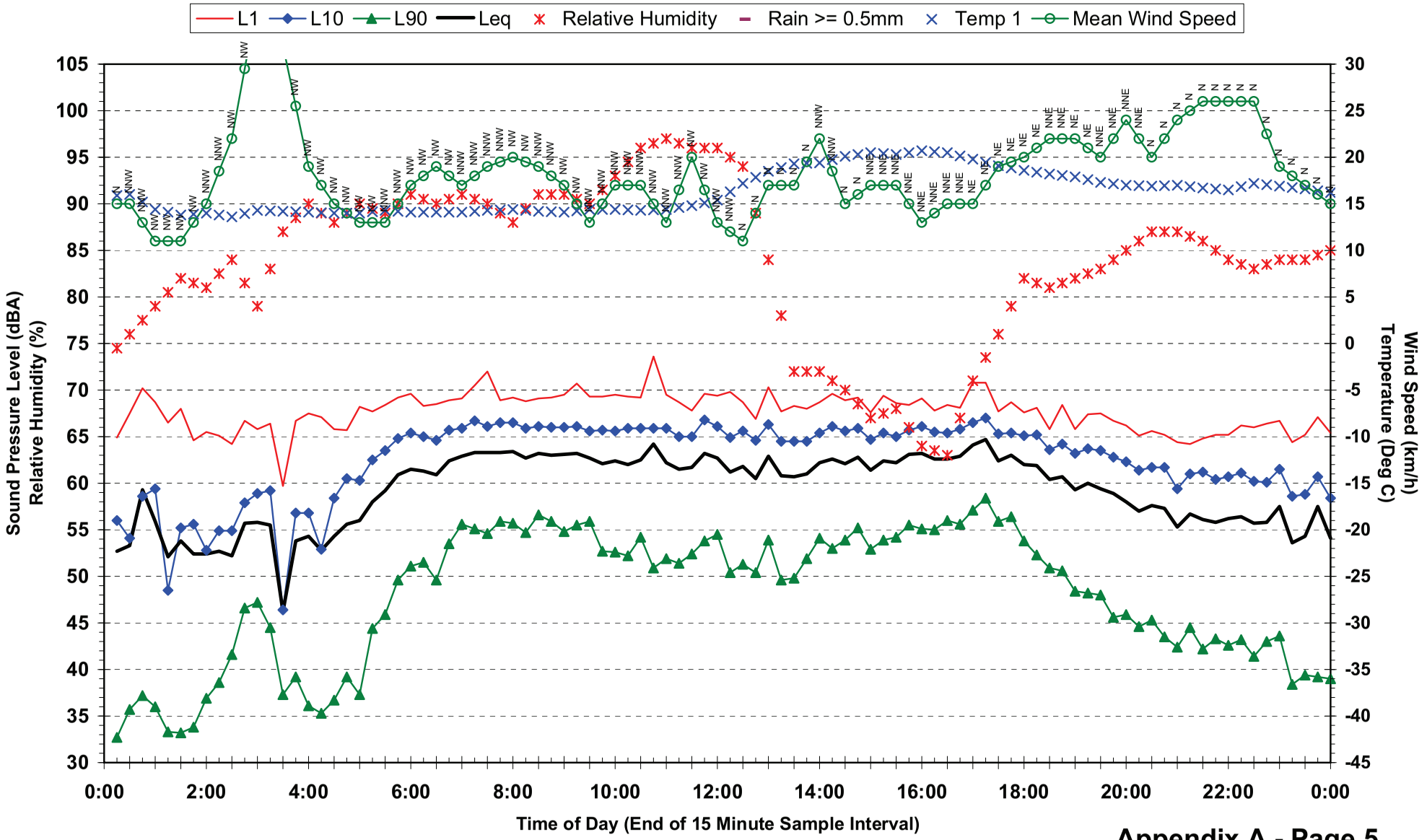
Statistical Ambient Noise Levels
20-2038 George Booth Drive - Friday 16 May 2008



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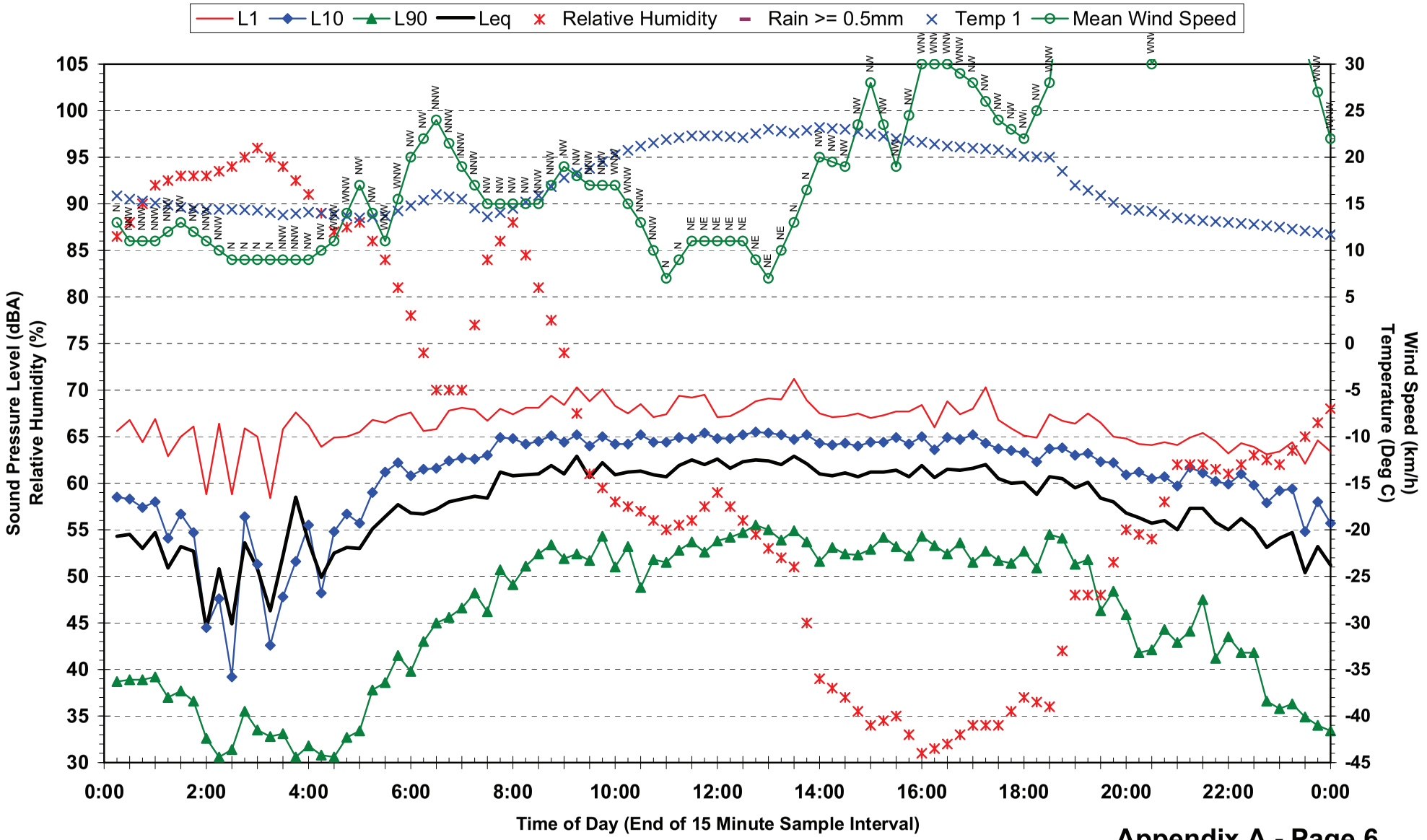
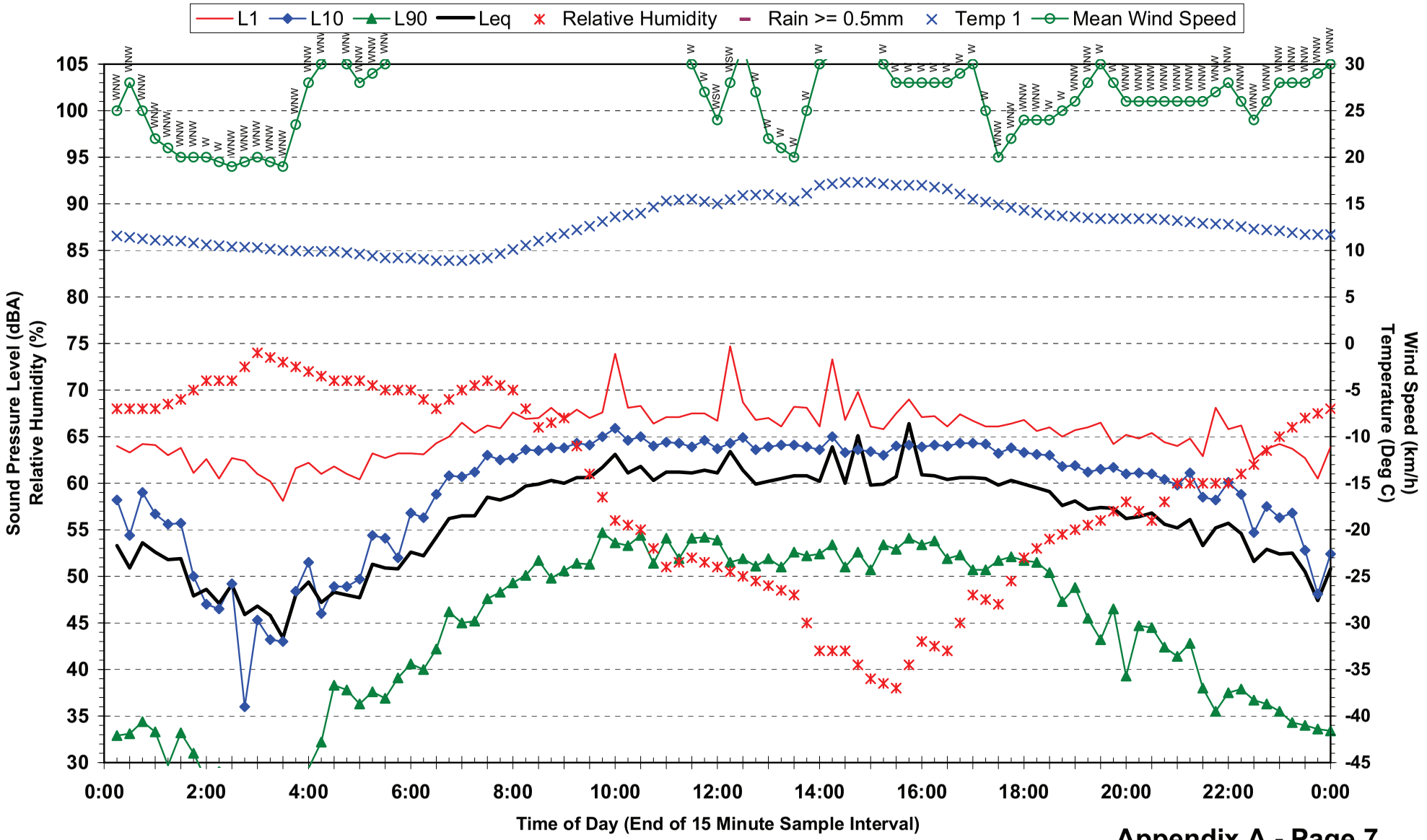
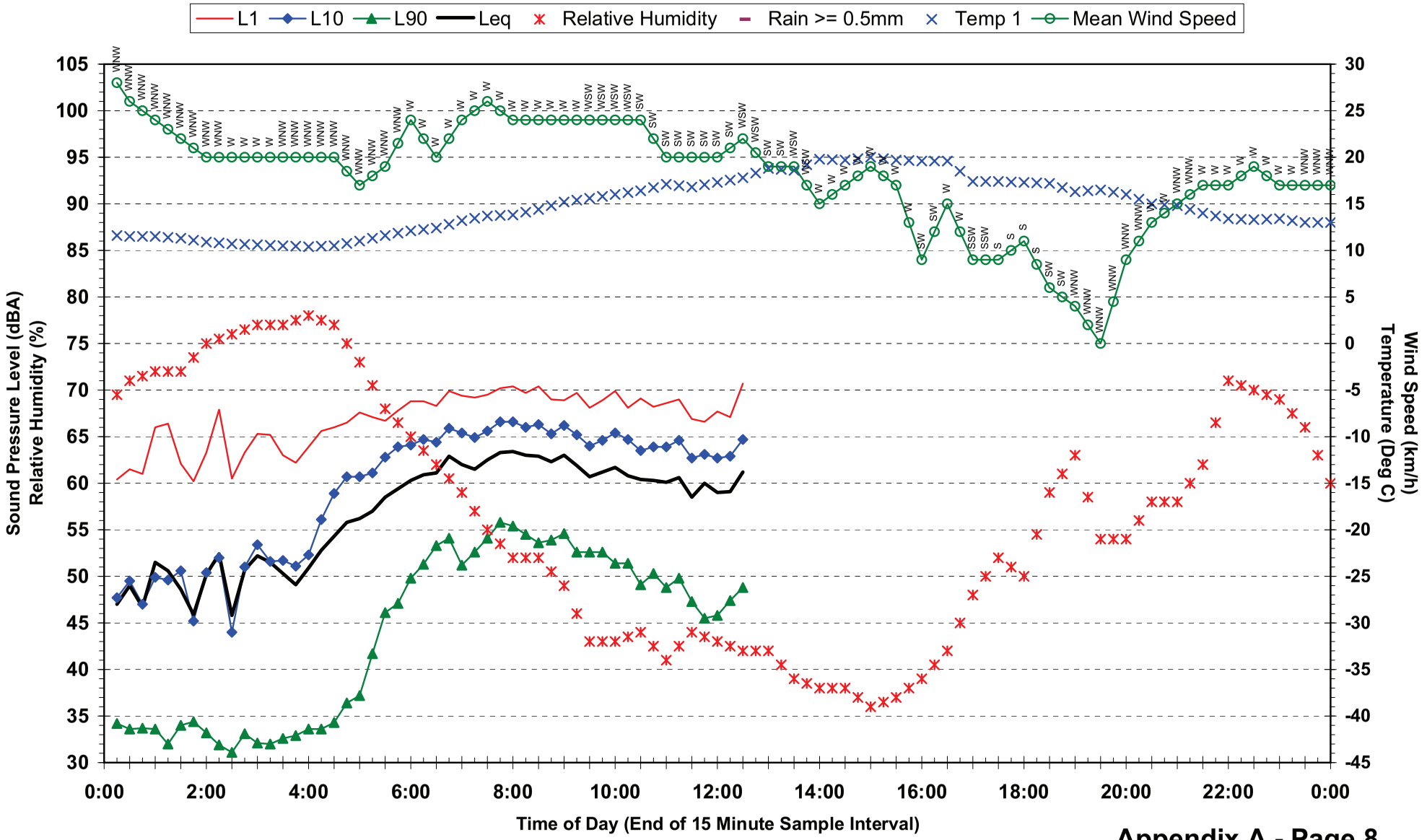
Statistical Ambient Noise Levels
20-2038 George Booth Drive - Saturday 17 May 2008



Statistical Ambient Noise Levels
20-2038 George Booth Drive - Sunday 18 May 2008



Statistical Ambient Noise Levels
20-2038 George Booth Drive - Monday 19 May 2008



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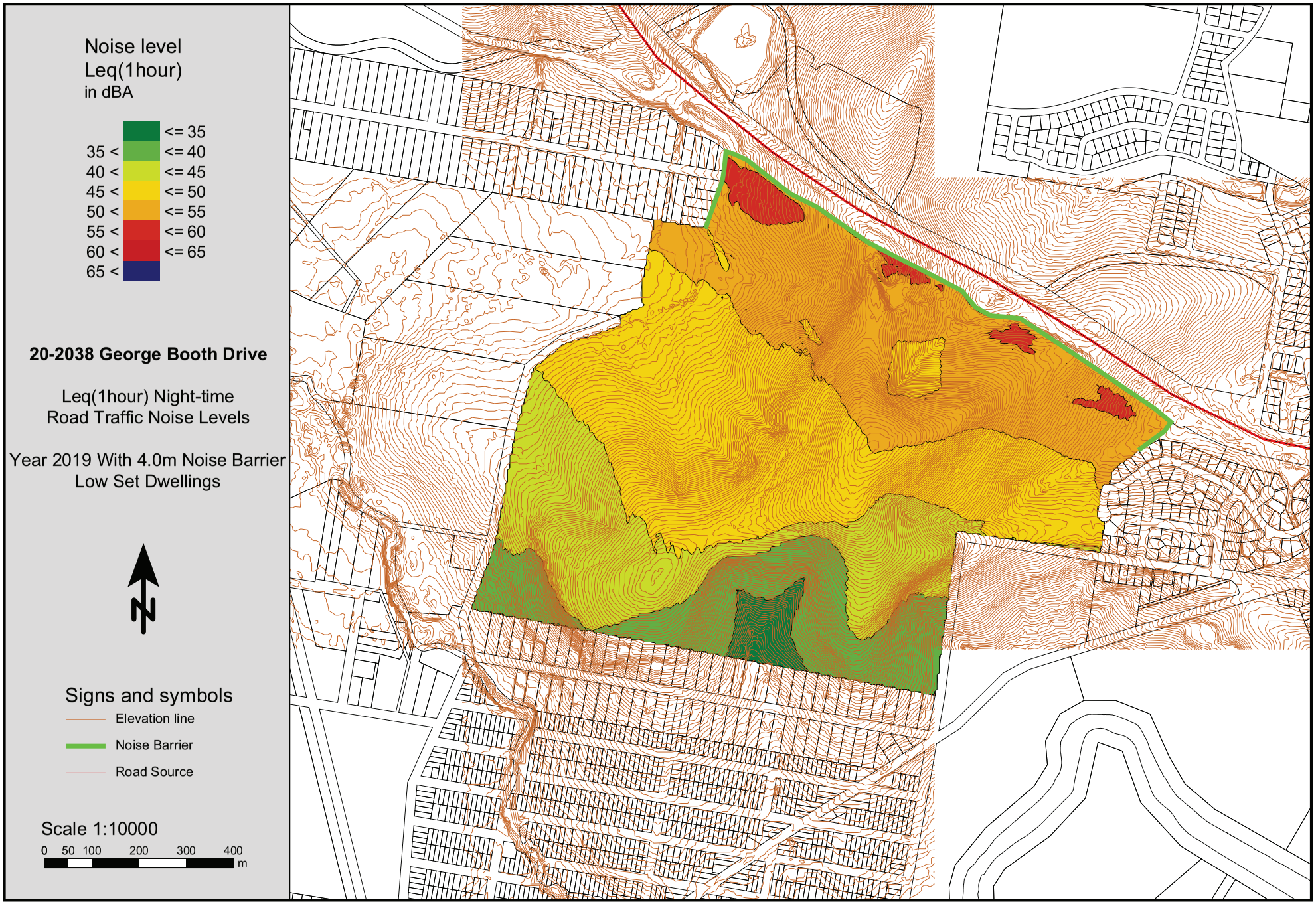
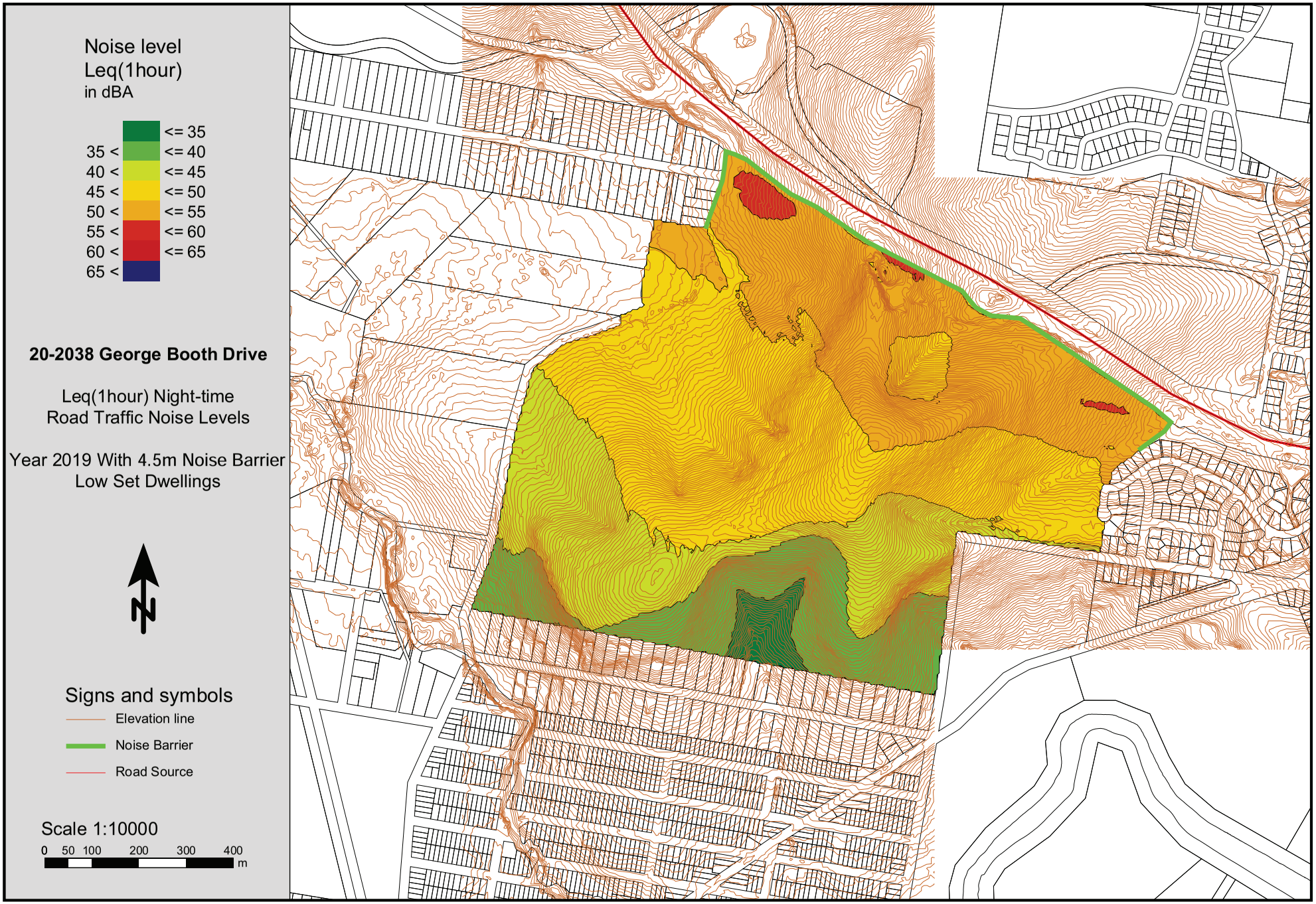
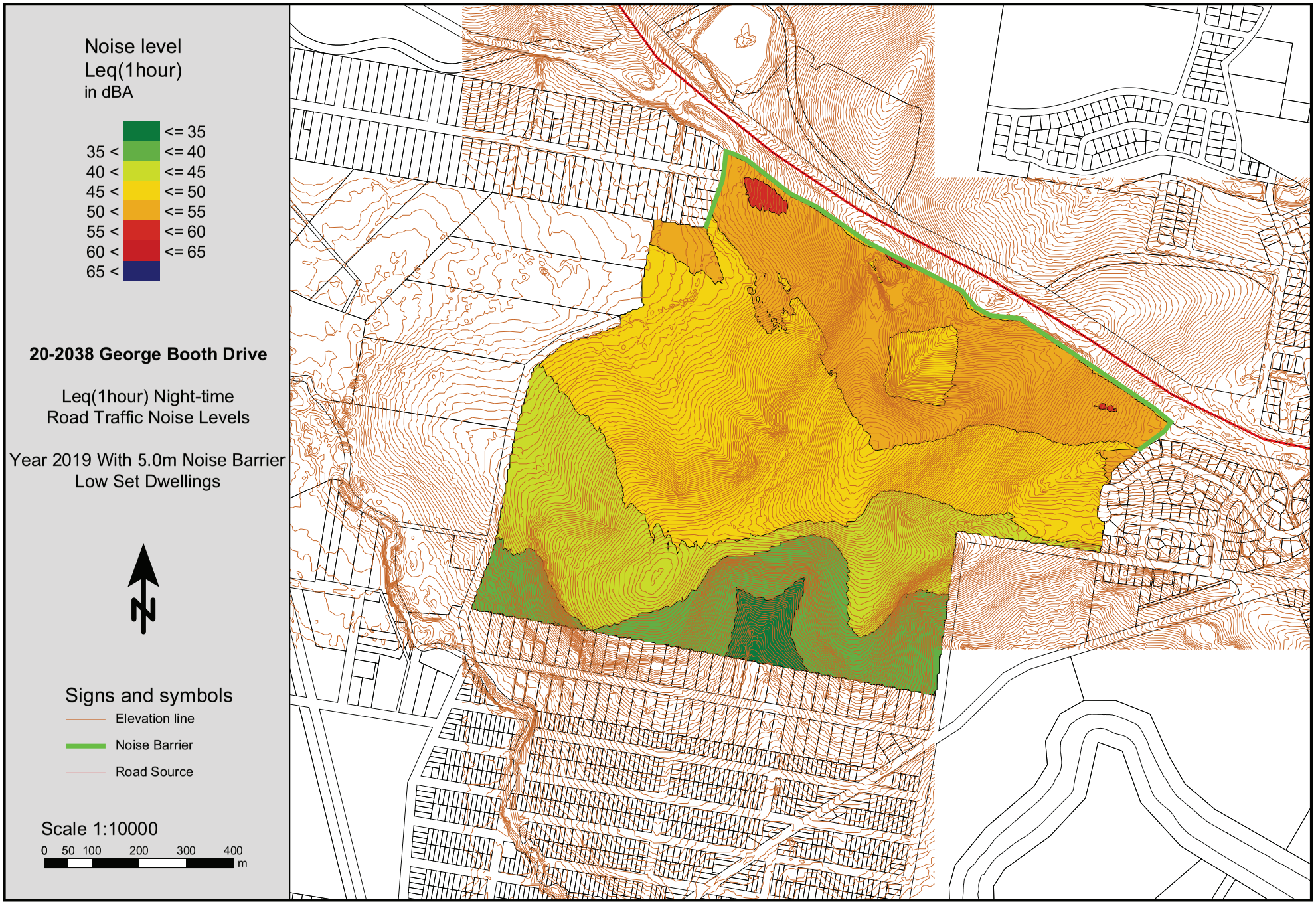
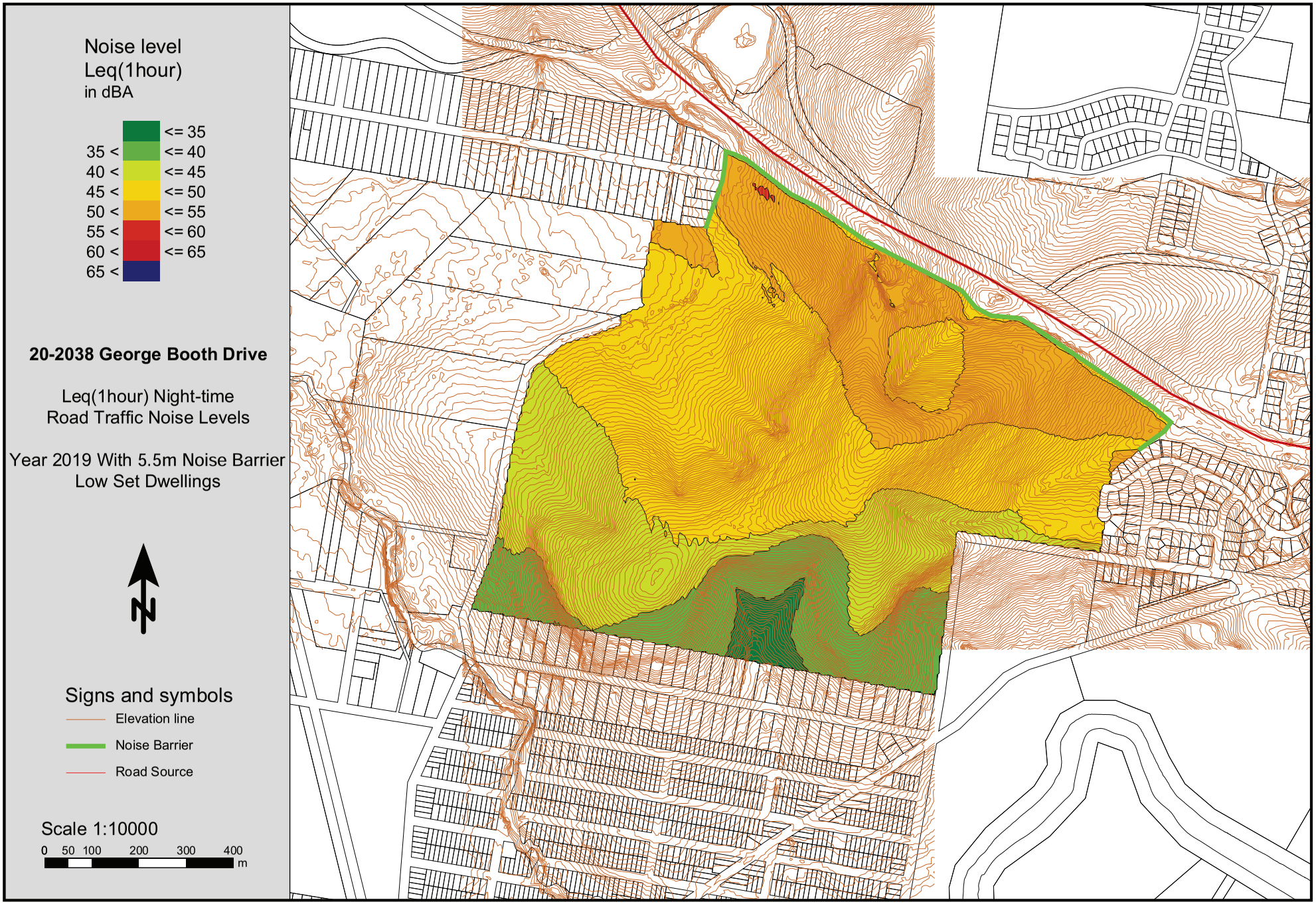
Appendix B

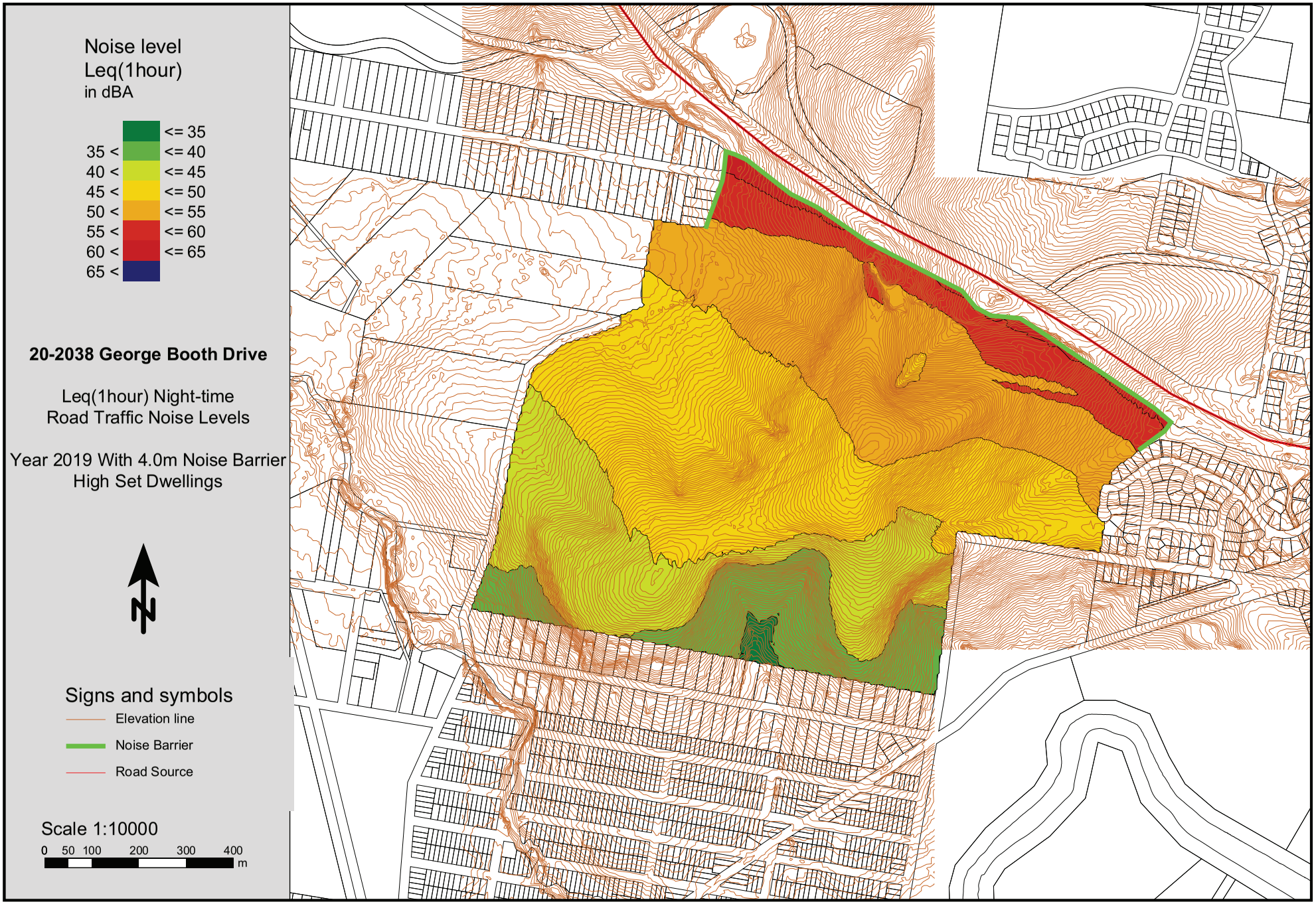
SOUNDPLAN NOISE CONTOUR PLOTS

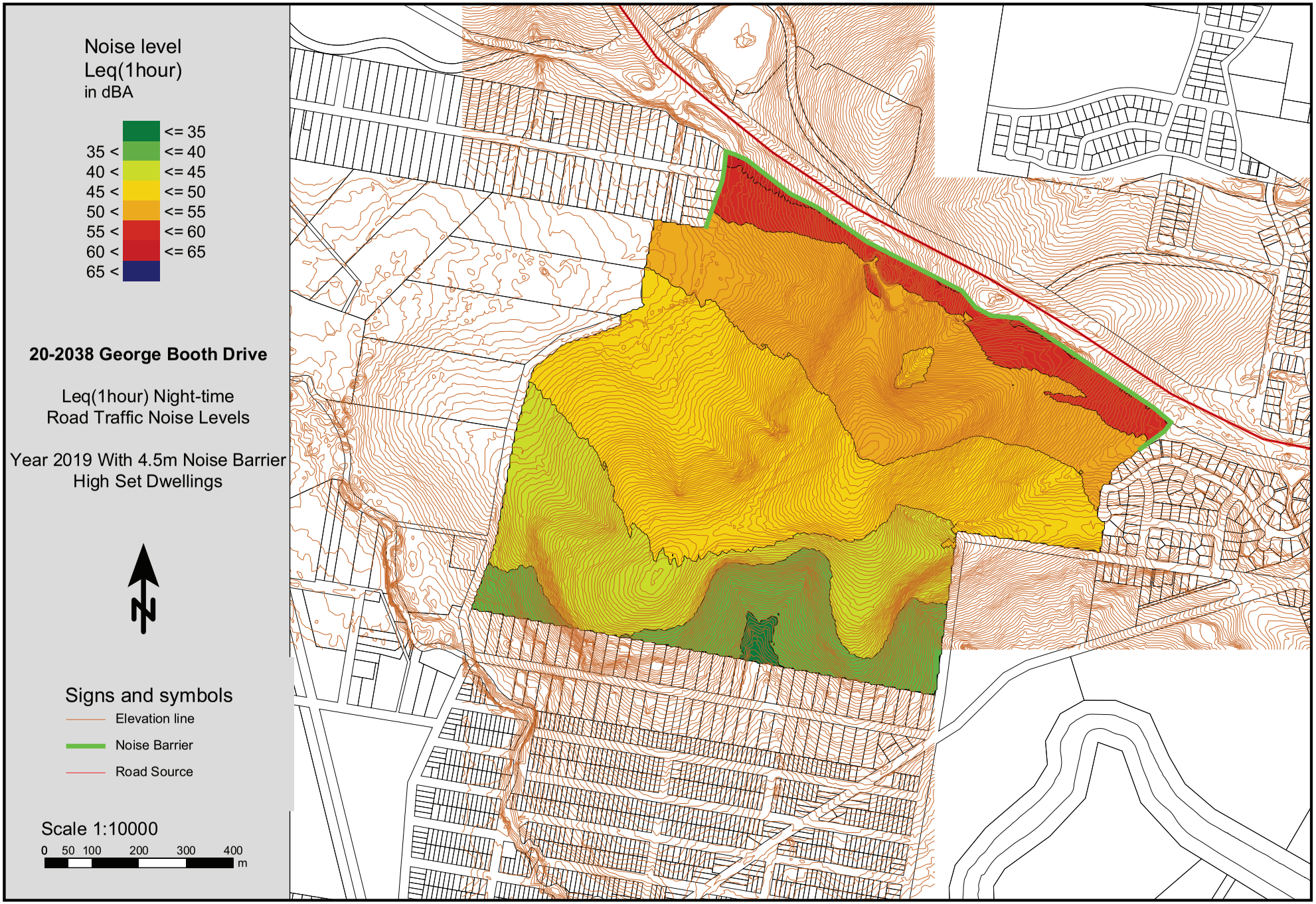

Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
20-2038 George Booth Drive
Leq(1hour) Night-time
Road Traffic Noise Levels
Year 2019 With 4.0m Noise Barrier
Low Set Dwellings
N
Signs and symbols
Elevation line
Noise Barrier
Road Source
Scale 1:10000
0 50 100 200 300 400
m


Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
20-2038 George Booth Drive
Leq(1hour) Night-time
Road Traffic Noise Levels
Year 2019 With 4.5m Noise Barrier
Low Set Dwellings
N
Signs and symbols
Elevation line
Noise Barrier
Road Source
Scale 1:10000
0 50 100 200 300 400
m


Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
20-2038 George Booth Drive
Leq(1hour) Night-time
Road Traffic Noise Levels
Year 2019 With 5.0m Noise Barrier
Low Set Dwellings
N
Signs and symbols
Elevation line
Noise Barrier
Road Source
Scale 1:10000
0 50 100 200 300 400
m


Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
20-2038 George Booth Drive
Leq(1hour) Night-time
Road Traffic Noise Levels
Year 2019 With 5.5m Noise Barrier
Low Set Dwellings
N
Signs and symbols
Elevation line
Noise Barrier
Road Source
Scale 1:10000
0 50 100 200 300 400
m


Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
20-2038 George Booth Drive
Leq(1hour) Night-time
Road Traffic Noise Levels
Year 2019 With 4.0m Noise Barrier
High Set Dwellings
N
Signs and symbols
Elevation line
Noise Barrier
Road Source
Scale 1:10000
0 50 100 200 300 400
m


Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
40 < <= 45
45 < <= 50
50 < <= 55
55 < <= 60
60 < <= 65
65 <
20-2038 George Booth Drive
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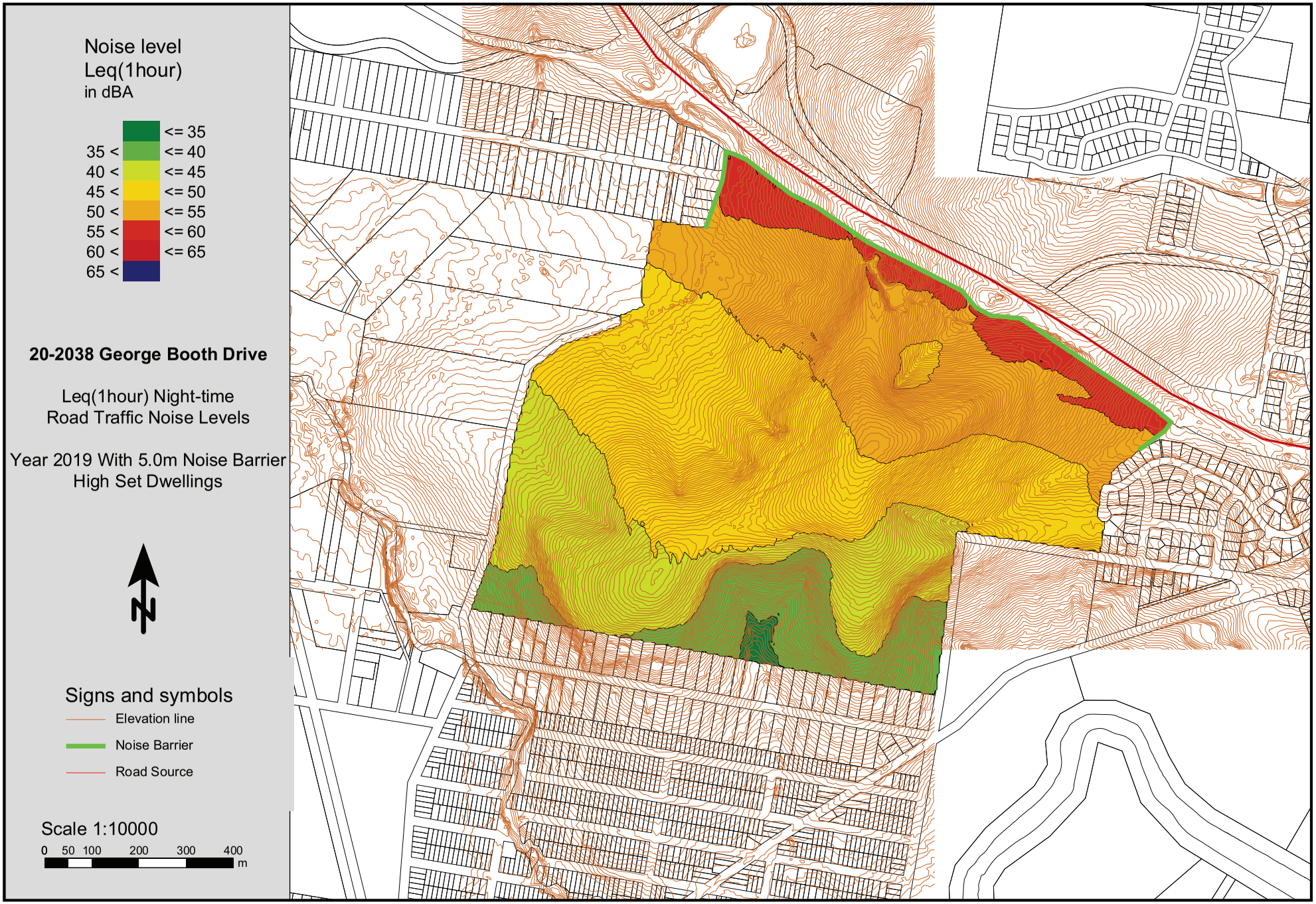
Signs and symbols
Elevation line
Noise Barrier
Road Source
Scale 1:10000
0 50 100 200 300 400
m


Noise level
Leq(1hour)
in dBA
<= 35
35 < <= 40
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45 < <= 50
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20-2038 George Booth Drive
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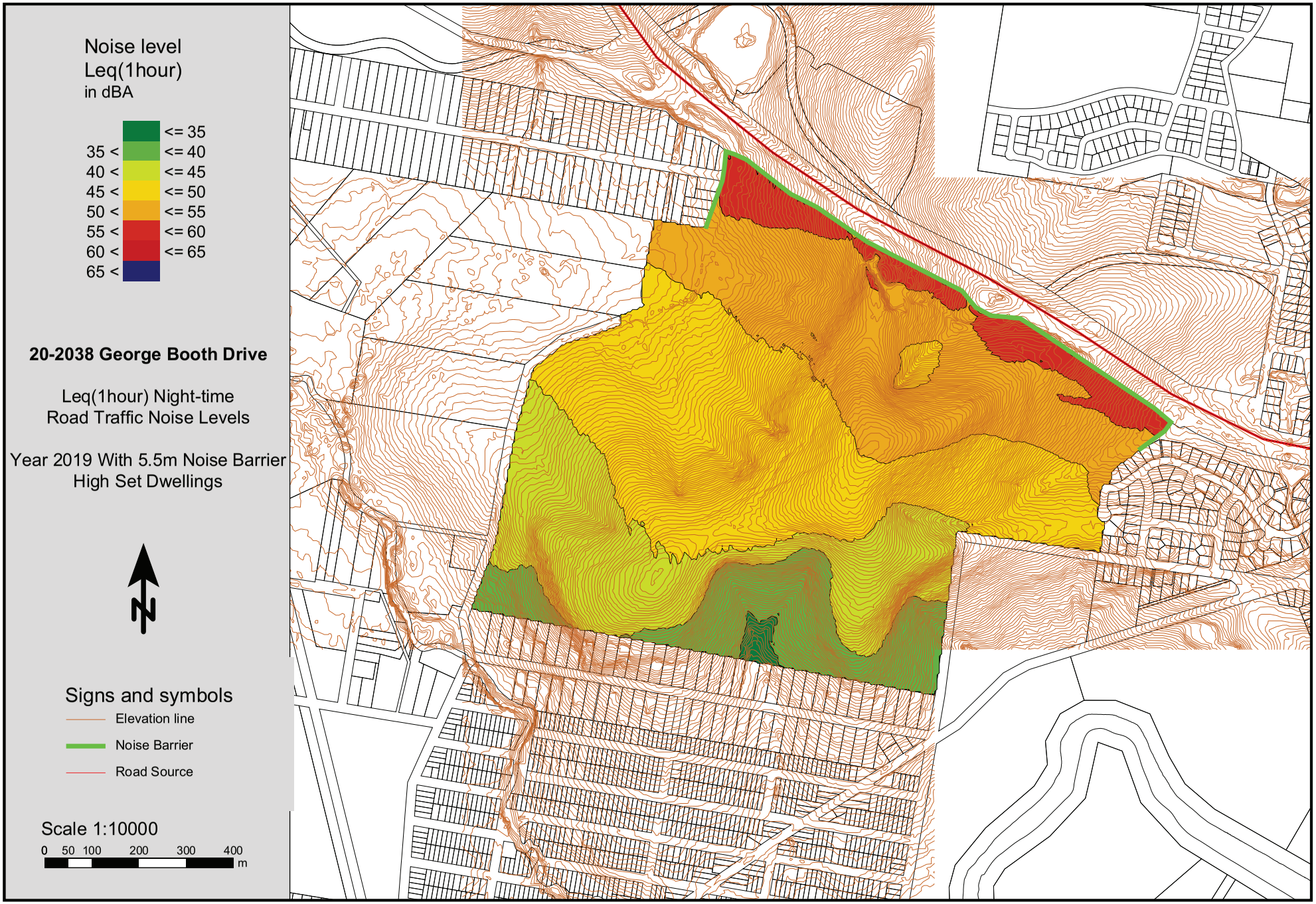
Noise level
Leq(1hour)
in dBA
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