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ACOUSTIC ASSESSMENT

HAULAGE ROUTE FOR MINERAL SANDS DEPOSIT, GWINDINUP

FOR

CABLE SANDS (WA) PTY LTD

BY

HERRING STORER ACOUSTICS

OCTOBER 2002

REFERENCE: 1082-1-02171

CONTENTS

APPENDICES

1.0 INTRODUCTION

Herring Storer Acoustics (HSA) was commissioned by Cable Sands (WA) Pty Ltd (Cable Sands) to assess the acoustic impact from trucks hauling mineral sands from the Gwindinup deposit to the Cable Sands Secondary Separation Plant in Bunbury. The Gwindinup deposit is located approximately 7 kilometres south of Boyanup (refer Appendix A for locality map).

It is anticipated the proposed development would commence January 2005, finishing in November 2011.

The preferred haulage route is to exit the mine at the southern end of Boundary Road, travel north to Railway Road, then east to Trigwell Road, east to South West Highway and then north to Bunbury.

At estimated production rates and truck haulage, there will be an average of 1 trucking day in 3, with 24 journeys taking place evenly in a 24 hour period.

This report presents the methodology, results of measurements and the assessment against *EIA No. 14 (Version 3) Road and Rail Transportation Noise (Draft 10/5/00)* (hereafter termed the Version 3 Policy).

2.0 EXECUTIVE SUMMARY

Two noise data loggers were deployed to quantify the existing acoustic environment at the residences adjacent the proposed haulage route.

The $L_{Aeq,day}$ and $L_{Aeq,night}$ values were determined from these loggers for the weekday and weekend data and are shown below in Table 2.1, as well as the associated Noise Amenity Rating (NAR).

TABLE 2.1 – AVERAGE EXISTING $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values, dB(A)

Parameter	Trigwell Road Logger		Boundary Road Logger	
	$L_{Aeq,day}$	$L_{Aeq,Night}$	$L_{Aeq,day}$	$L_{Aeq,Night}$
Weekday Average	57 (NAR2)	52 (NAR3)	46 (NAR0)	42 (NAR1)
Weekend Average	57 (NAR2)	50 (NAR2)	43 (NAR0)	41 (NAR1)

The Version 3 Policy allows the following increases to the existing noise levels, dependent upon the existing NAR.

NAR0	+4 dB(A) or top of NAR0*
NAR1	+3 dB(A)
NAR2	+1.5 dB(A)
NAR3	+0.5 dB(A)

* Top of NAR0 is 50 dB(A) and 40 dB(A) for the day and night time periods respectively.

The $L_{Aeq,day}$ and $L_{Aeq,night}$ values were also calculated for truck noise levels, based on the proposed numbers of movements, with the results shown below in Table 2.2.

TABLE 2.2 – TRUCK $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values, dB(A)

Truck Speed (km/hr)	$L_{Aeq,day}$	$L_{Aeq,Night}$
30	42	42
60	44	44
100	48	48

Note: Assumes trucks spaced evenly throughout the 24 hour period.

The results of Table 2.1 and 2.2 were then combined to assess the impact on the residences as shown in Table 2.3 and Table 2.4.

TABLE 2.3 – COMBINED $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values & RESULTANT INCREASE, TRIGWELL ROAD dB(A)

Truck Speed (km/hr)	Total $L_{Aeq,day}$	Increase to $L_{Aeq,Day}$	Total $L_{Aeq,Night}$	Increase to $L_{Aeq,Night}$
Weekday				
30	57.1	0.1	52.4	0.4
60	57.2	0.2	52.6	0.6
100	57.5	0.5	53.5	1.5
Weekend				
30	57.1	0.1	50.6	0.6
60	57.2	0.2	50.9	0.9
100	57.5	0.5	52.2	2.2

TABLE 2.4 – COMBINED $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values & RESULTANT INCREASE, BOUNDARY ROAD dB(A)

Truck Speed (km/hr)	Total $L_{Aeq,day}$	Increase to $L_{Aeq,Day}$	Total $L_{Aeq,Night}$	Increase to $L_{Aeq,Night}$
Weekday				
30	47.5	1.5	45.0	3.0
60	48.0	2.0	46.0	4.0
100	50.3	4.3	49.2	7.2
Weekend				
30	45.5	2.5	44.5	3.5
60	46.4	3.4	45.6	4.6
100	49.4	6.4	49.0	8.0

The criteria of the Version 3 Policy is satisfied at Trigwell Road for:

- weekday day time at speeds of 100km/hr or less for 15 journeys;
- weekday night time at speeds of less than 50km/hr for 9 journeys;
- weekend day time at speeds of 100km/hr or less for 15 journeys;
- weekend night time at speeds of less than 80km/hr for 9 journeys;

but not satisfied for speeds greater than those specified above.

The criteria of the Version 3 Policy is satisfied at Boundary Road for:

- weekday day time at speeds of 100km/hr or less for 15 journeys;
- weekday night time at speeds of 30km/hr or less for 9 journeys;
- weekend day time at speeds of 100km/hr or less for 15 journeys;
- weekend night time at speeds of less than 25km/hr for 9 journeys;

but not satisfied for speeds greater than those specified above.

Thus, the following is recommended in order to satisfy the criteria:

1. Restrict trucks speeds to those detailed above. If these are impracticable, consideration could be given to not hauling during these times (for instance, on weekends prior to 0700 hours).

2. Restrict all truck movements to daytime hours i.e. 7am – 10pm (i.e. all 24 movements within 15 hour period), and restricting speeds on Boundary Road to 70km/hr or less. Note that 'movements' actually refers to 'journeys' - see text (ND)

3. If a 100km/hr speed limit is preferred, an alternative option may be to reduce truck movements, noting that the vehicle numbers would have to be halved to reduce truck levels by 3 dB(A). This can be examined if considered worthwhile.

3.0 METHODOLOGY

To assess the acoustic impact of the proposed heavy vehicles, quantification of the existing noise levels was required. This was facilitated by the use of two automatic noise data loggers at residences, along the route. These loggers were set-up on 26 September and collected on 8 October 2002.

The loggers were set to store data at 15 minute intervals, with various parameters recorded. In this study, the L_{A1}, L_{Aeq} and L_{A90} values are reported as defined below.

L_{A1} The noise level exceeded for 1% of a 15 minute period.

L_{Aeq} The continuous equivalent noise level for a 15 minute period.

L_{A90} The noise level exceeded for 90% of a 15 minute period.

Note: It is the L_{Aeq} that is the parameter used for assessment in the Version 3 Policy.

The two loggers locations were as follows:

Location 1: Jalinda Orchard Residence – Trigwell Road (Location shown in Appendix B) – approximately 40 metres from Trigwell Road

Location 2: Boundary Road Residence – Approximately 2.6 km south of Railway Road (Location shown in Appendix B) – approximately 60 metres from Boundary Road

The stored data from the loggers was downloaded and graphed. These results were perused to ensure integrity of data.

For each complete 24 hour period, the $L_{Aeq,day}$ and $L_{Aeq,night}$ values were determined. These are the logarithmic average of the $L_{Aeq,15min}$ values recorded by the logger, between 0700 and 2200 hours and 2200 and 0700 hours (on the same day) respectively.

During the set-up of the noise loggers, hand held meter measurements were made of trucks equivalent to those proposed for the Gwindinup mine, at a distance of approximately 20 metres, as they passed the measurement position. For each vehicle pass-by, the travel speed was estimated. From these measurements, the $L_{Aeq,day}$ and $L_{Aeq,night}$ values were determined for various truck speeds, based on the proposed number of movements and extrapolated to a distance of 40 metres to represent the distance to dwellings. This allows the change in the acoustic environment, due to the proposed truck haulage, to be determined and hence, compared to the criteria.

4.0 CRITERIA

The *EIA No. 14 (Version 3) Road and Rail Transportation Noise (Draft 10/5/00)* considers the impact of road and rail noise in three contexts being:

- Proposed noise sensitive developments (residences, hospitals and the like) near existing road or railway transportation routes;
- New transportation infrastructure (road or railway) near existing noise sensitive premises;
- Traffic expansion on existing road or railway infrastructure.

It is stated that in all cases, the "as low as 'reasonably practicable' principle should apply".

A series of Noise Amenity Ratings (NAR) are defined in terms of L_{Aeq}, or average noise level ranges as follows:

TABLE 4.1 - NOISE AMENITY RATINGS, dB(A)

NAR	$L_{Aeq,day}$	$L_{Aeq,Night}$
NAR0	50	40
NAR1	51 – 55	41 – 45
NAR2	56 – 60	46 – 50
NAR3	61 – 65	51 – 55
NAR4	66 – 70	56 – 60
NAR5	70	60

Notes: (i) The NAR for a location is the higher of the day and night ratings.
(ii) Noise levels refer to external locations at 1 metre from a building façade.
(iii) "Day" means 7am – 10pm and "Night" means 10pm – 7am.

It is stated that the "...impact of transportation noise levels in these ranges would depend on a number of factors, including the characteristics of the transportation, the nature of the receiving area (rural, urban or commercial) and the use and construction of the receiving premises. With this in mind, for noise sensitive premises, the impact may be said to increase with rating number, from "acceptable" at N0 to "substantial" at N3 and above, with the impact becoming "noticeable" to "significant" over N1 and N2."

Section 5.3 of the Version 3 Policy "applies where an increase in traffic flow is proposed such that the total flow along the corridor exceeds that on which planning decisions were made ... and where a significant traffic flow, either temporary or permanent, would result from a specific industrial or transportation proposal.

The objectives are –

(i) That the noise levels inside noise sensitive premises associated with the proposed traffic should meet acceptable levels, or that the degree of increase in noise levels should be of low significance; and

(ii) That the noise emissions of the vehicles associated with a specific proposal should comply with best practice."

Section 5.3.2 is stated as "Traffic increase not associated with a specific industrial/transportation proposal" and provides the following acceptable increases in noise level.

TABLE 4.2 – PERMITTED INCREASE FOR NEW PROJECTS, dB(A)

Existing NAR	Allowable Increase
NAR0	4, or top of N0, whichever is greater
NAR1	3
NAR2	1.5
NAR3	0.5
NAR4	0

The above states that this does not apply to instances, where the increase in traffic is associated with a specific industrial proposal, such as the Gwindinup mine. Nevertheless, we have used this table for guidance, as no other information is provided in this section, presumably as the document is in draft form at concept stage only.

5.0 RESULTS

The results of the noise data logging of the existing acoustic environment are shown graphically in Appendix B. For each complete 24 hour period, the $L_{Aeq,day}$ and $L_{Aeq,Night}$ values have been determined, with an overall weekday and weekend average also shown.

TABLE 5.1 – EXISTING $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values TRIGWELL ROAD, dB(A)

Day / Date	$L_{Aeq,day}$	$L_{Aeq,Night}$
Friday, 27 September 2002	58.1	50.8
Saturday, 28 September 2002	57.0	49.2
Sunday, 29 September 2002	57.4	50.1
Monday, 30 September 2002	55.9	48.8
Tuesday, 01 October 2002	58.6	51.7
Wednesday, 02 October 2002	57.6	52.4
Thursday, 03 October 2002	56.5	54.9
Friday, 04 October 2002	57.8	-
Monday, 07 October 2002	56.4	52.2
Weekday Average	**57**	**52**
Weekend Average	**57**	**50**

Note: The 5 & 6 October 2002 were not utilised due to strong winds during this time affecting the results and night time levels during on 4 October 2002 deemed to contain spurious results.

TABLE 5.2 – EXISTING $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values BOUNDARY ROAD, dB(A)

Day / Date	$L_{Aeq,day}$	$L_{Aeq,Night}$
Friday, 27 September 2002	46.6	40.4
Saturday, 28 September 2002	43.4	42.8
Sunday, 29 September 2002	42.1	37.3
Monday, 30 September 2002	44.0	37.8
Tuesday, 01 October 2002	-	41.7
Wednesday, 02 October 2002	46.0	44.5
Thursday, 03 October 2002	45.8	38.8
Friday, 04 October 2002	46.4	40.4
Monday, 07 October 2002	47.9	43.1
Weekday Average	**46**	**42**
Weekend Average	**43**	**46**

Note: The 5 & 6 October 2002 were not utilised due to strong winds during this time affecting the results and 1 October 2002 daytime levels deemed to contain spurious results.

The results from the truck noise measurements are attached as one-third octave band analysis in Appendix C and summarised below in Table 5.3, with all trucks being converted to an $L_{Aeq,1min}$ value.

TABLE 5.3 – $L_{Aeq,1min}$ VALUES OF PASSING TRUCKS, dB(A) – AT 20 METRES

Truck Speed (km/hr)	Laden	Unladen
30	60	63
60	64	63
100	68	68

As hauling times are over a 24 hour period on days when trucking occurs, truck movements are assumed to be spaced evenly throughout the day. It is estimated therefore that the 24 journeys (48 movements, 50% laden, 50% unladen) occur at the rate of 1 per hour, hence there will be 30 movements within the daytime period and 18 during the night time period (consisting of 50% laden and 50% unladen). Based on this, the $L_{Aeq,day}$ and $L_{Aeq,Night}$ have been determined for truck movements alone, shown in Table 5.4 below.

TABLE 5.4 – TRUCK $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values, dB(A) – AT 40 METRES

Truck Speed (km/hr)	$L_{Aeq,day}$	$L_{Aeq,Night}$
30	42	42
60	44	44
100	48	48

Tables 5.5 and Table 5.6 below combines the noise levels of Table 5.4 with the existing noise levels as measured by the noise data loggers and shows the resultant increase in level.

TABLE 5.5 – COMBINED $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values & RESULTANT INCREASE TRIGWELL ROAD, dB(A)

Truck Speed (km/hr)	Total $L_{Aeq,day}$	Increase to $L_{Aeq,Day}$	Total $L_{Aeq,Night}$	Increase to $L_{Aeq,Night}$
Weekday				
30	57.1	0.1	52.4	0.4
60	57.2	0.2	52.6	0.6
100	57.5	0.5	53.5	1.5
Weekend				
30	57.1	0.1	50.6	0.6
60	57.2	0.2	50.9	0.9
100	57.5	0.5	52.2	2.2

TABLE 5.6 – COMBINED $L_{Aeq,Day}$ and $L_{Aeq,Night}$ Values & RESULTANT INCREASE BOUNDARY ROAD, dB(A)

Truck Speed (km/hr)	Total $L_{Aeq,day}$	Increase to $L_{Aeq,Day}$	Total $L_{Aeq,Night}$	Increase to $L_{Aeq,Night}$
Weekday				
30	47.5	1.5	45.0	3.0
60	48.0	2.0	46.0	4.0
100	50.3	4.3	49.2	7.2
Weekend				
30	45.5	2.5	44.5	3.5
60	46.4	3.4	45.6	4.6
100	49.4	6.4	49.0	8.0

6.0 DISCUSSION AND ASSESSMENT

6.1 Trigwell Road

The $L_{Aeq,day}$ during the week is predicted to increase by 0.1 to 0.5 dB(A), the $L_{Aeq,night}$ during the week is predicted to increase by 0.4 to 1.5 dB(A), the $L_{Aeq,day}$ during the weekend is between 0.1 and 0.5 dB(A) and the $L_{Aeq,Night}$ during the weekend is between 0.6 and 2.2 dB(A).

The results from the noise data logging indicate that residences on Trigwell Road are in the NAR2 category during daytime hours and weekend night-time hours and NAR3 category during weekday night-time hours, due to their high existing ambient noise levels.

Using the criteria of Table 4.2, the allowable increase is 1.5 dB(A) for NAR2 and 0.5 dB(A) for NAR3. This criteria is satisfied during the

- weekday day time at speeds of 100km/hr or less for 15 journeys;
- weekday night time at speeds of less than 50km/hr for 9 journeys;
- weekend day time at speeds of 100km/hr or less for 15 journeys;
- weekend night time at speeds of less than 80km/hr for 9 journeys;

but not satisfied for speeds greater than those specified above.

Thus, the following is recommended in order to satisfy the criteria:

1. Restrict trucks speeds to those detailed above.

2. Restrict haulage times to daytime hours only i.e. 7am – 10pm. All 24 journeys can be accommodated during daytime hours with an increase in existing levels of 0.2 – 0.8 dB(A) which is acceptable.

3. If a 100km/hr speed limit is preferred with unrestricted operating hours, restrict the number of night-time journeys to a total of 2.

6.2 Boundary Road

The $L_{Aeq,day}$ during the week is predicted to increase by 1.5 to 4.3 dB(A), the $L_{Aeq,night}$ during the week is predicted to increase by 3 to 7.2 dB(A), the $L_{Aeq,day}$ during the weekend is between 2.5 and 6.4 dB(A) and the $L_{Aeq,Night}$ during the weekend is between 3.5 and 8.0 dB(A).

The results from the noise data logging indicate that residences on Boundary Road are in the NAR0 category during daytime hours and NAR1 category during night-time hours.

Using the criteria of Table 4.2, the allowable increase is 4 dB(A), or to 50 dB(A), whichever is greater, for daytime hours and 3 dB(A) for night-time hours. This criteria is satisfied during the

- weekday day time at speeds of 100km/hr or less for 15 journeys;
- weekday night time at speeds of 30km/hr or less for 9 journeys;
- weekend day time at speeds of 100km/hr or less for 15 journeys;
- weekend night time at speeds of less than 25km/hr for 9 journeys;

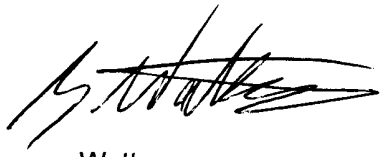
but not satisfied for speeds greater than those specified above.

Thus, the following is recommended in order to satisfy the criteria:

1. Restrict trucks speeds to those detailed above.

2. Restricting haulage times to daytime hours only i.e. 7am – 10pm, and speeds to 70km/hr or less allows 24 journeys during daytime hours with an increase in existing levels to 50 dB(A) which is acceptable.

For: **HERRING STORER ACOUSTICS**



George Watts Checked: Terry George

23 October 2002

APPENDIX A

LOCALITY MAP

APPENDIX B

NOISE LOGGER RESULTS

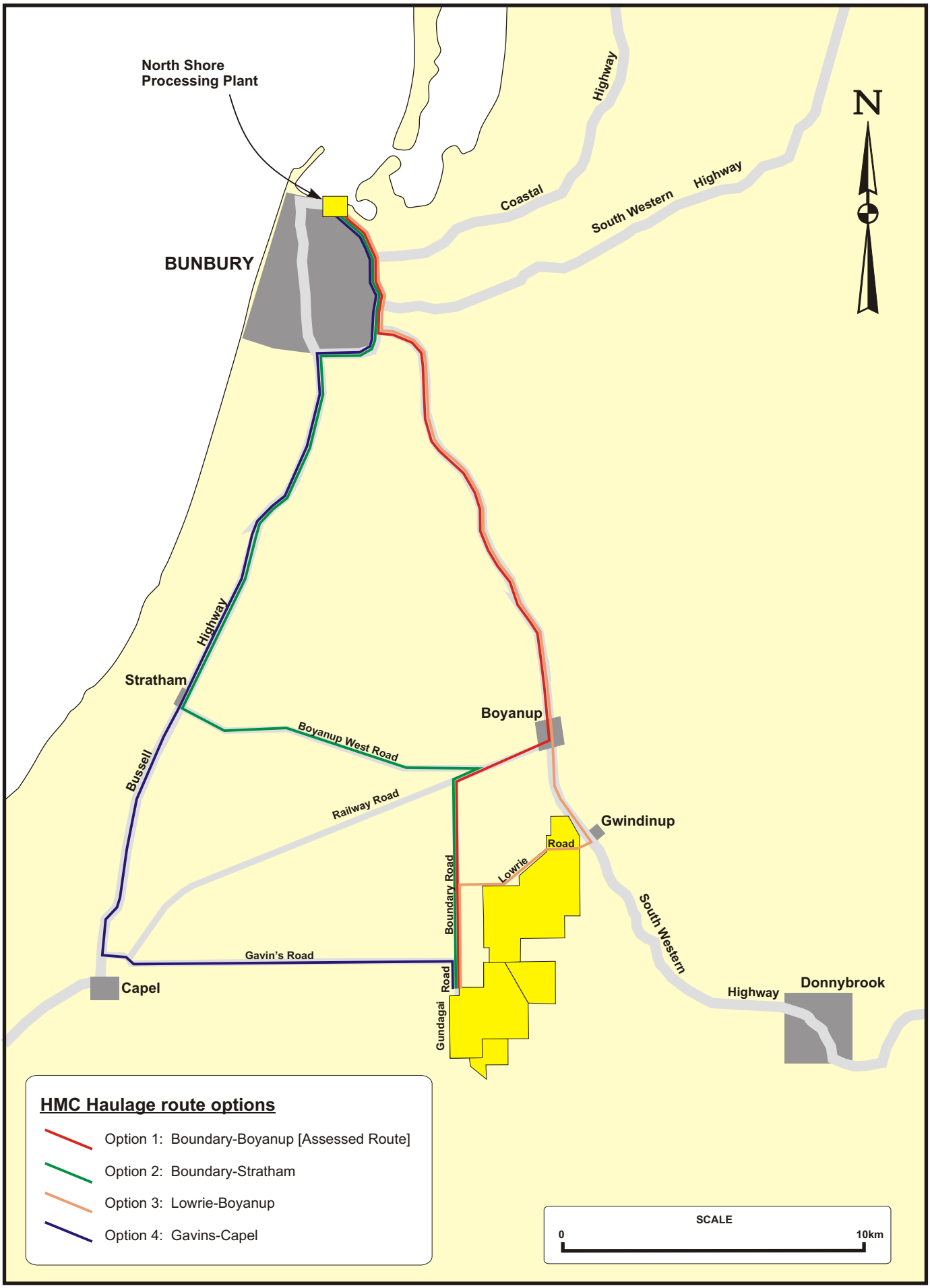
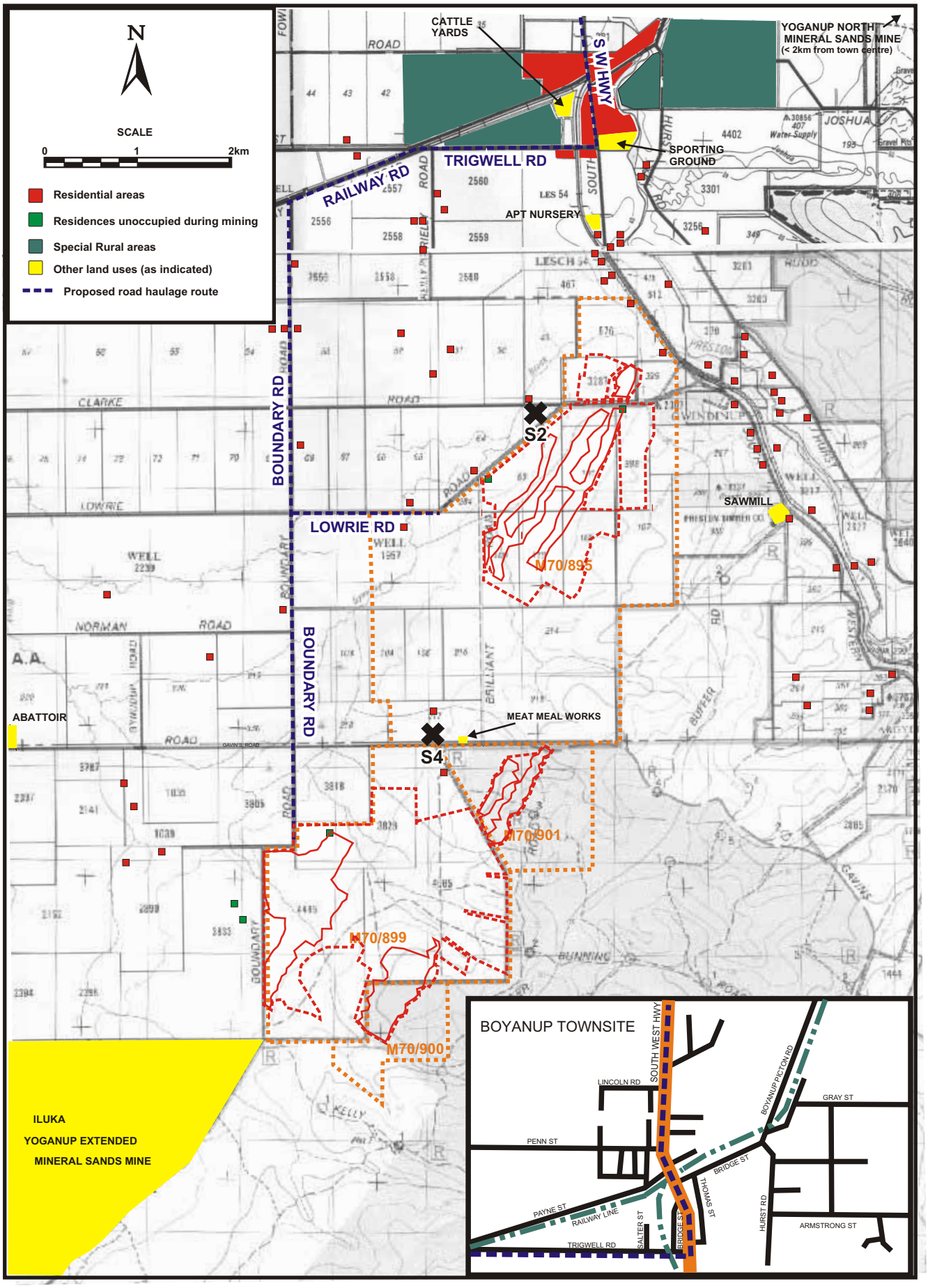
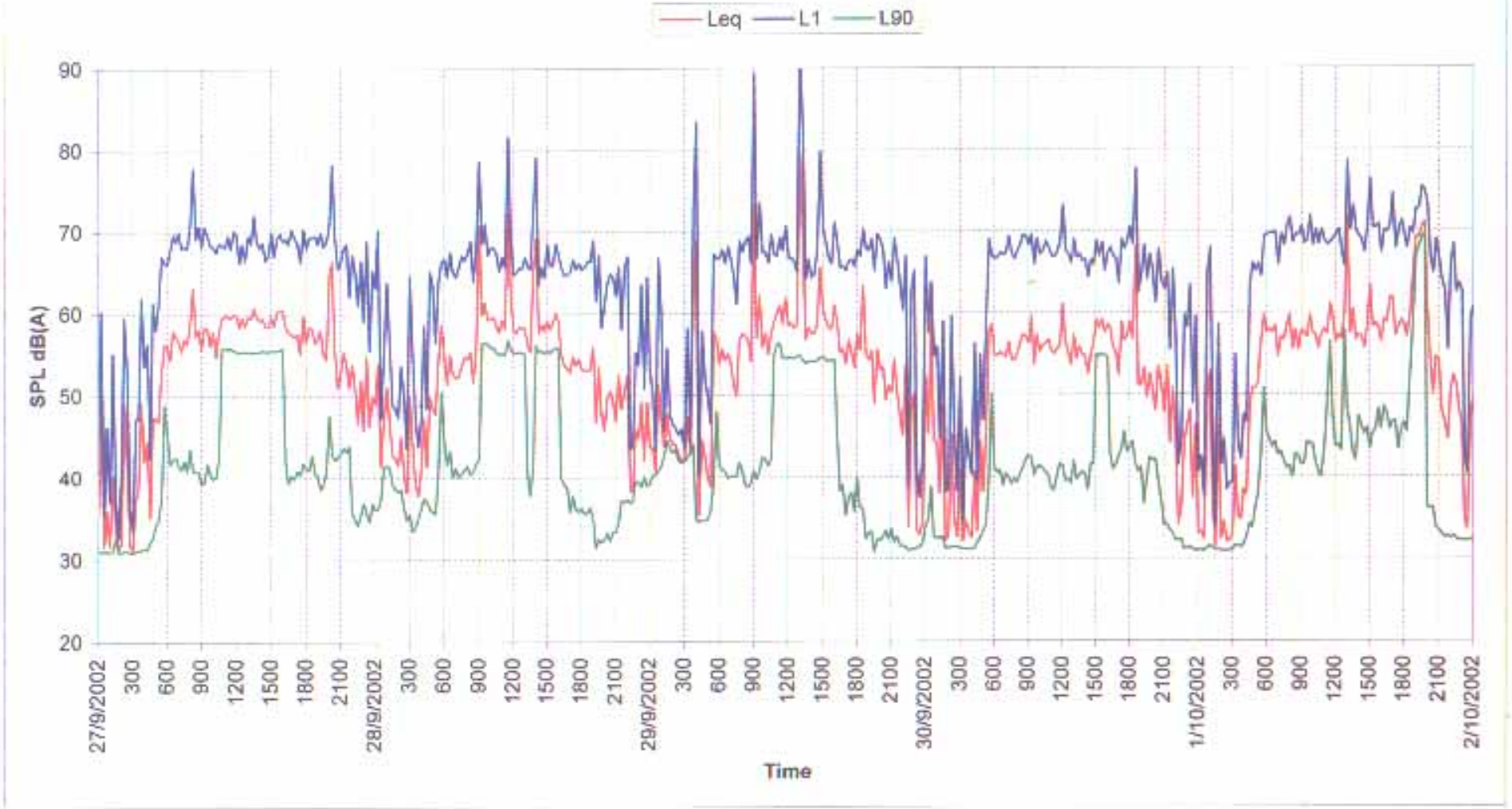
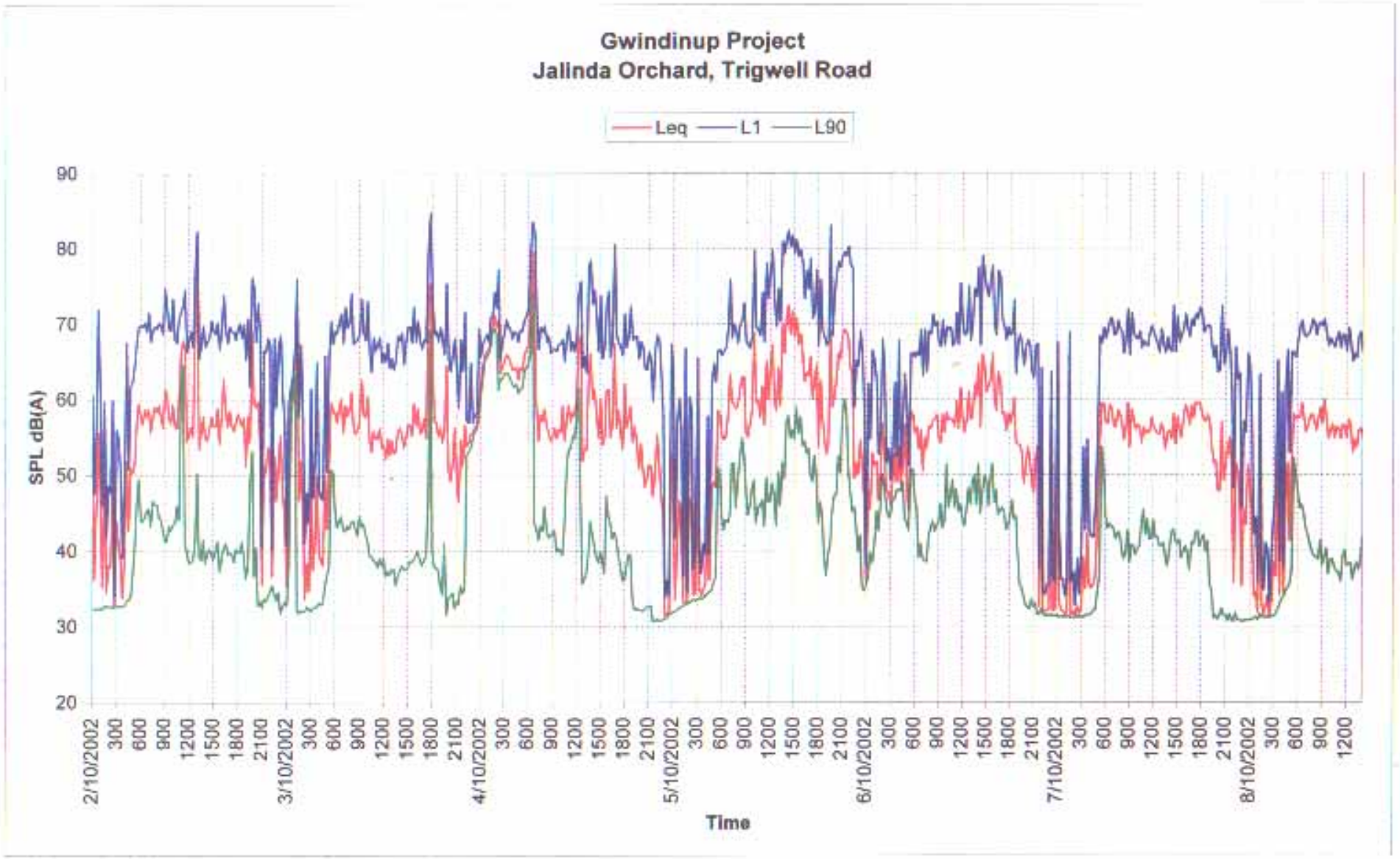


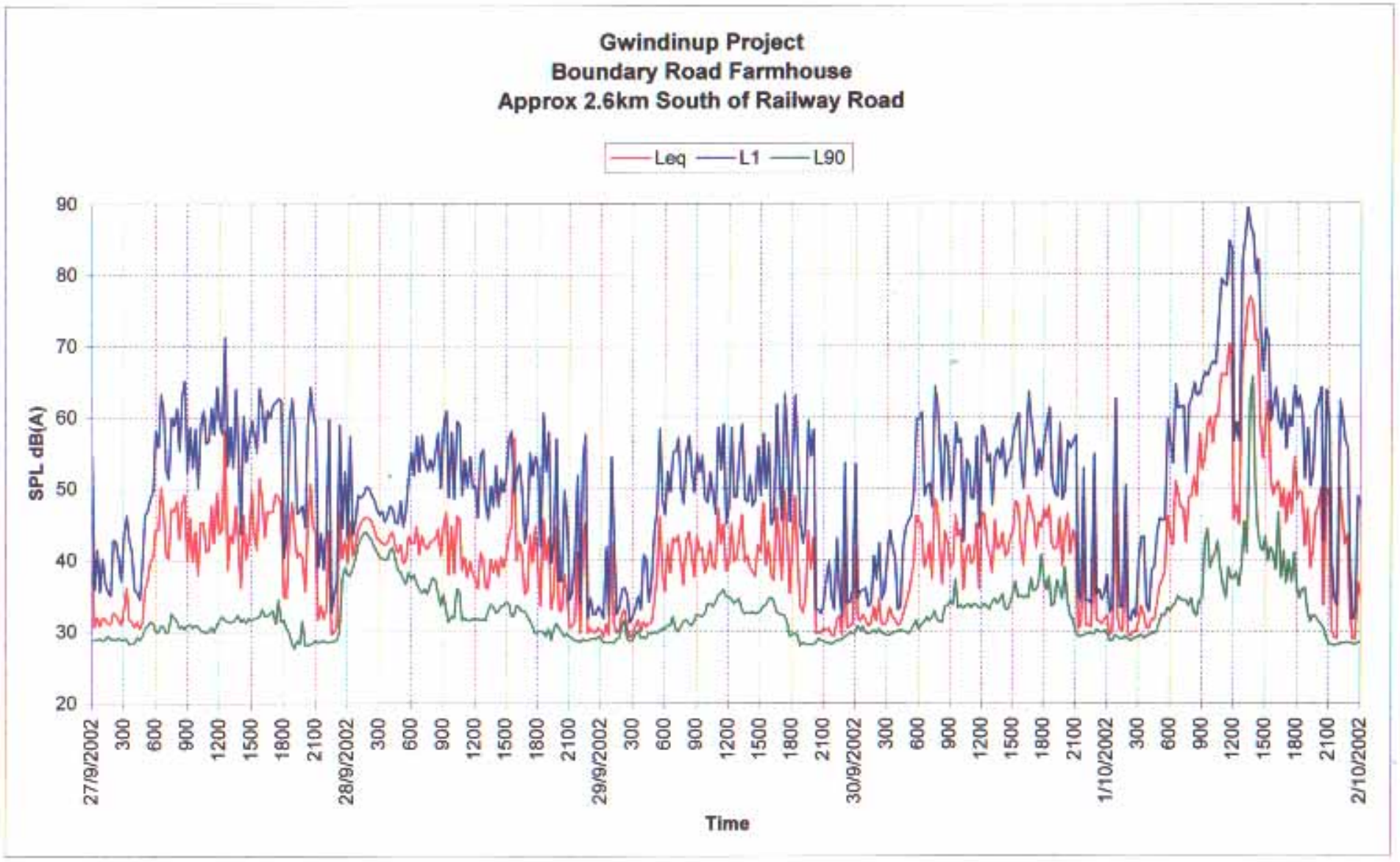
Figure 5 Haulage route options

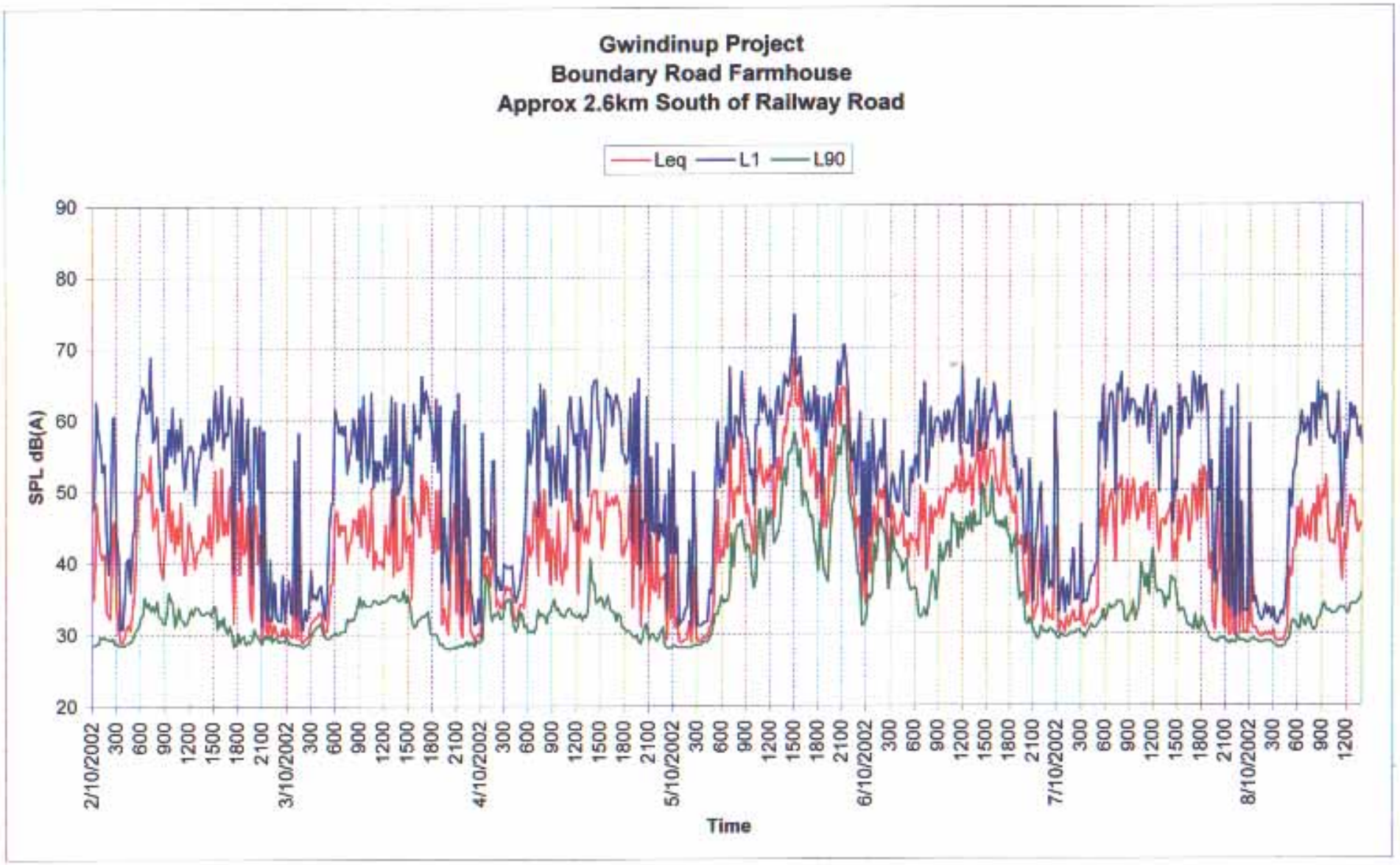

N
SCALE
0
1
2km
Residential areas
Residences unoccupied during mining
Special Rural areas
Other land uses (as indicated)
Proposed road haulage route
CATTLE YARDS
S WEST HWY
YOGANUP NORTH MINERAL SANDS MINE
(< 2km from town centre)
SPORTING GROUND
TRIGWELL RD
RAILWAY RD
APT NURSERY
BOUNDARY RD
LOWRIE RD
S2
SAWMILL
M70/895
ABATTOIR
MEAT MEAL WORKS
S4
M70/901
M70/899
M70/900
ILUKA
YOGANUP EXTENDED
MINERAL SANDS MINE
BOYANUP TOWNSITE
SOUTH WEST HWY
LINCOLN RD
BOYANUP PICTON RD
GRAY ST
PENN ST
BRIDGE ST
THOMAS ST
PAYNE ST
RAILWAY LINE
SALTER ST
BRIDGE ST
HURST RD
ARMSTRONG ST
TRIGWELL RD

Gwindinup Project
Jalinda Orchard, Trigwell Road



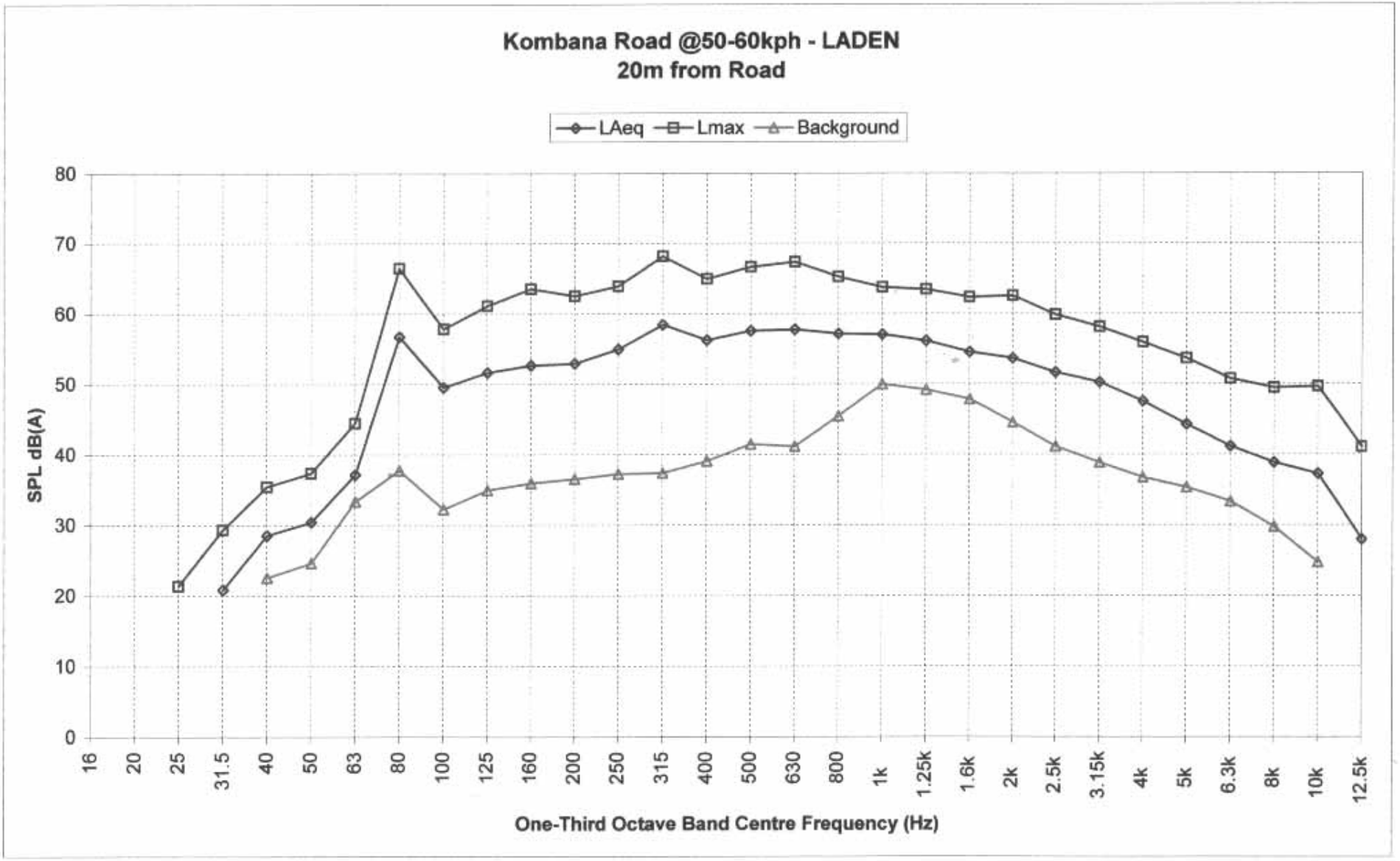

Gwindinup Project
Jalinda Orchard, Trigwell Road
Leq
L1
L90
SPL dB(A)
90
80
70
60
50
40
30
20
2/10/2002
3/10/2002
4/10/2002
5/10/2002
6/10/2002
7/10/2002
8/10/2002
300
600
900
1200
1500
1800
2100
Time

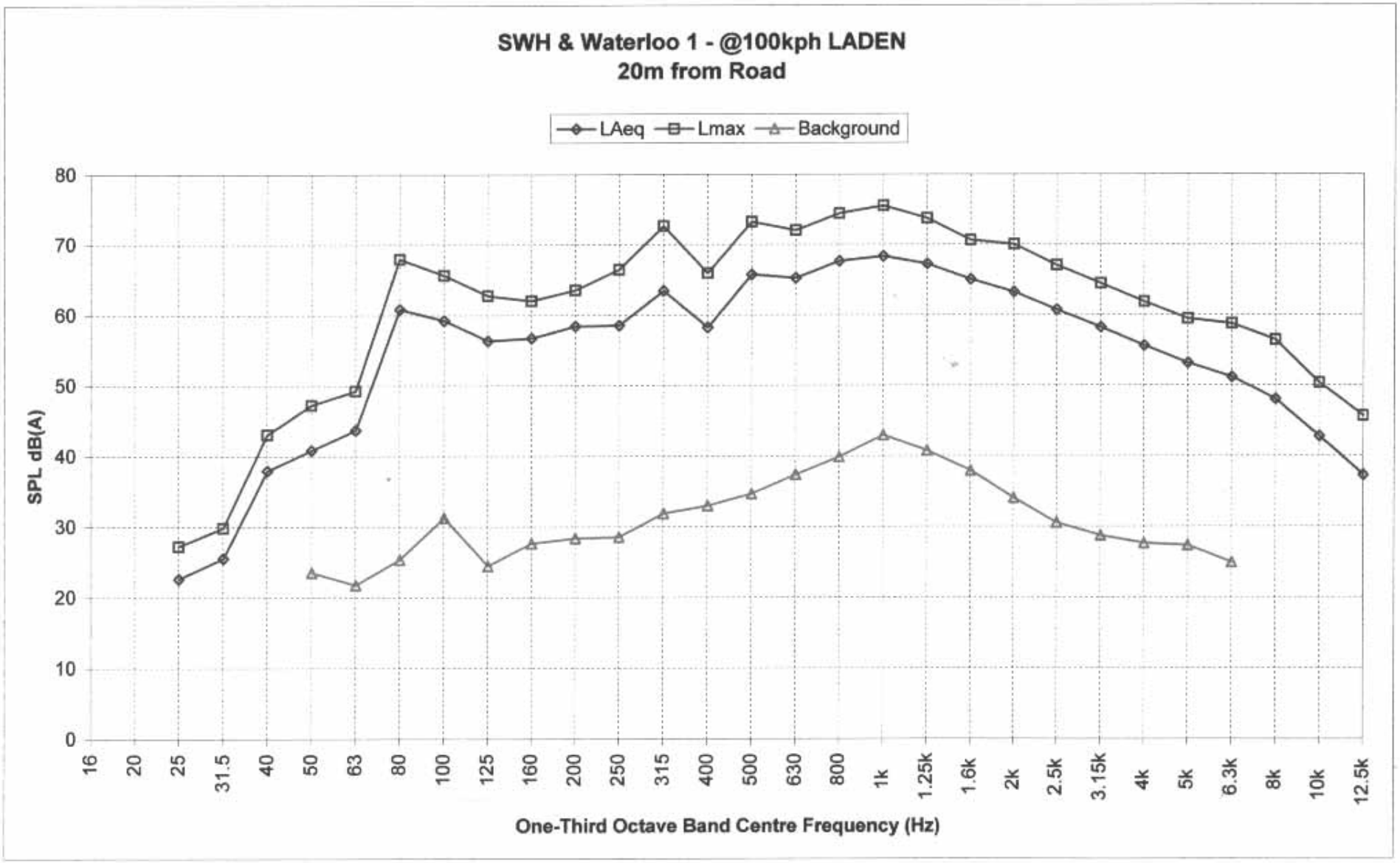

Gwindinup Project
Boundary Road Farmhouse
Approx 2.6km South of Railway Road
Leq
L1
L90
SPL dB(A)
90
80
70
60
50
40
30
20
27/9/2002
300
600
900
1200
1500
1800
2100
28/9/2002
300
600
900
1200
1500
1800
2100
29/9/2002
300
600
900
1200
1500
1800
2100
30/9/2002
300
600
900
1200
1500
1800
2100
1/10/2002
300
600
900
1200
1500
1800
2100
2/10/2002
Time

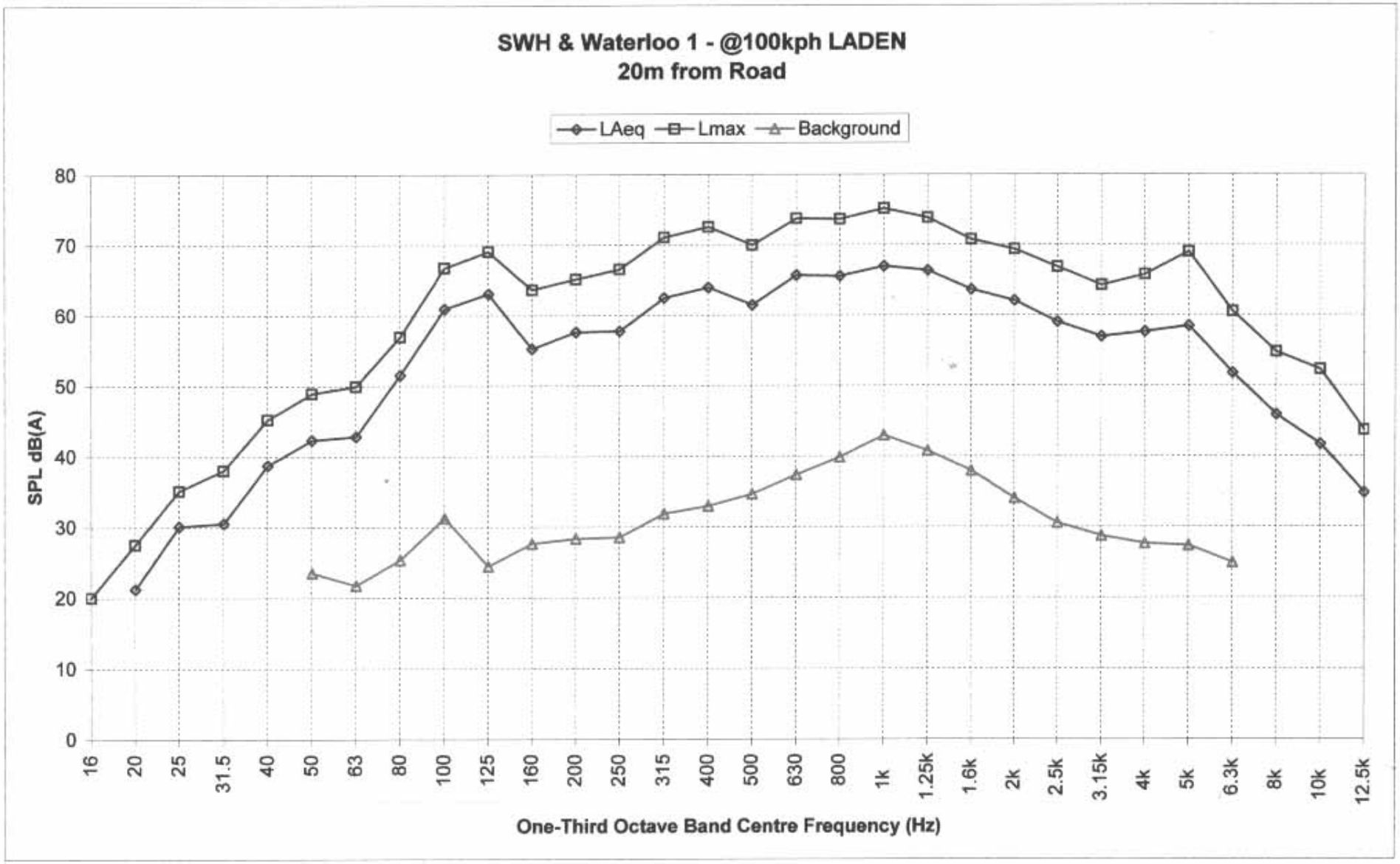

Gwindinup Project
Boundary Road Farmhouse
Approx 2.6km South of Railway Road
Leq
L1
L90
SPL dB(A)
90
80
70
60
50
40
30
20
2/10/2002
3/10/2002
4/10/2002
5/10/2002
6/10/2002
7/10/2002
8/10/2002
300
600
900
1200
1500
1800
2100
Time

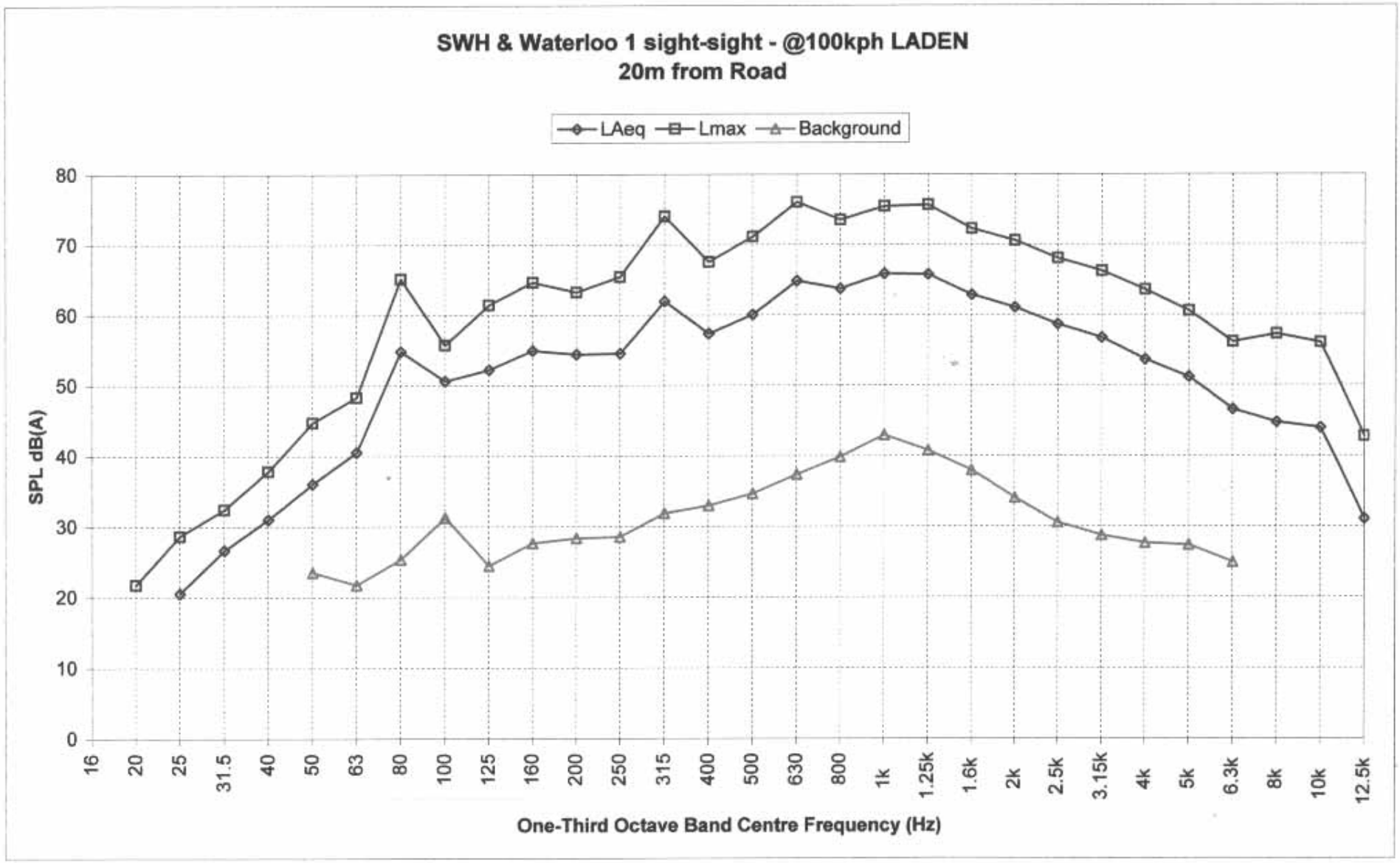
APPENDIX C

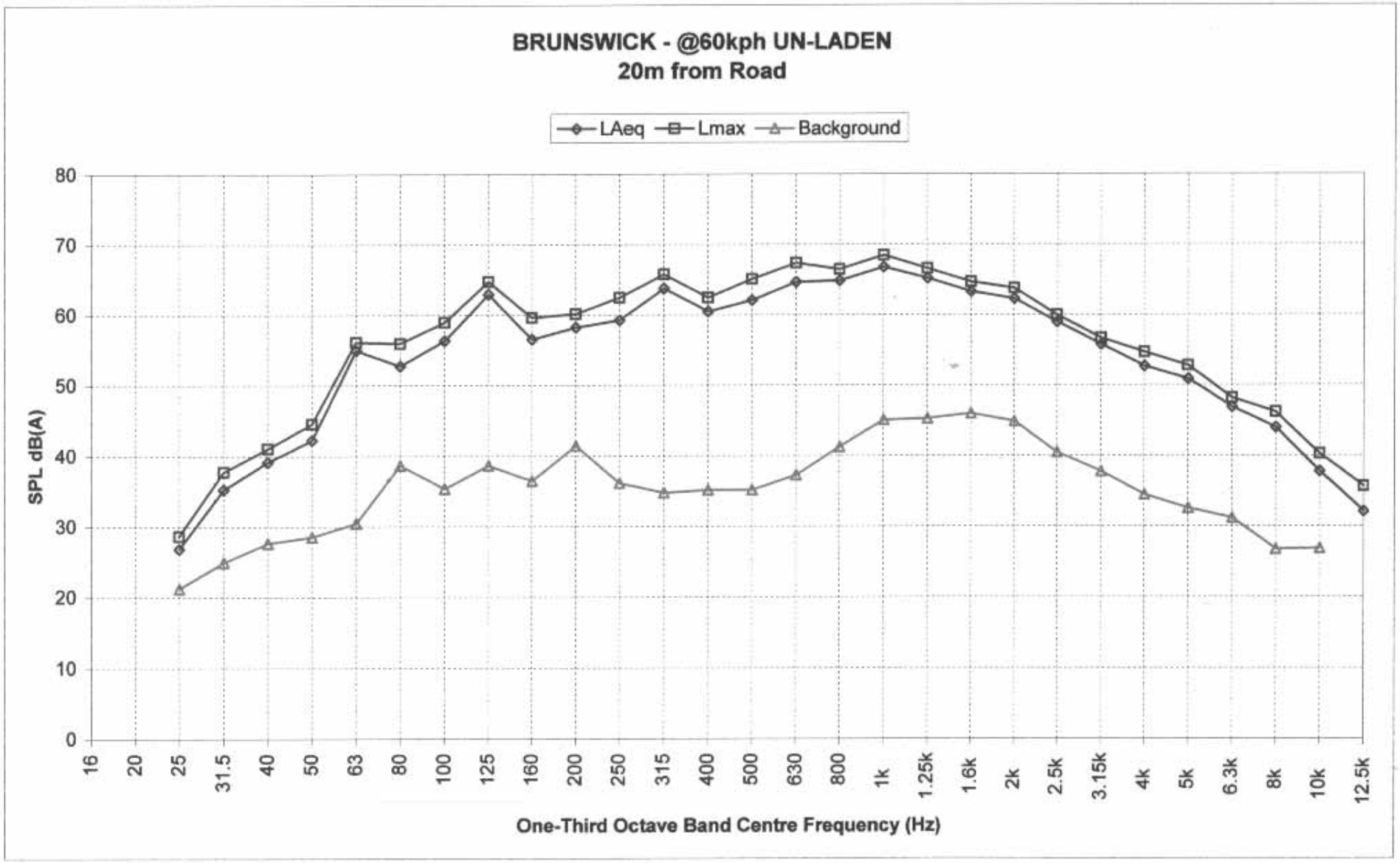
HAND HELD METER MEASUREMENTS

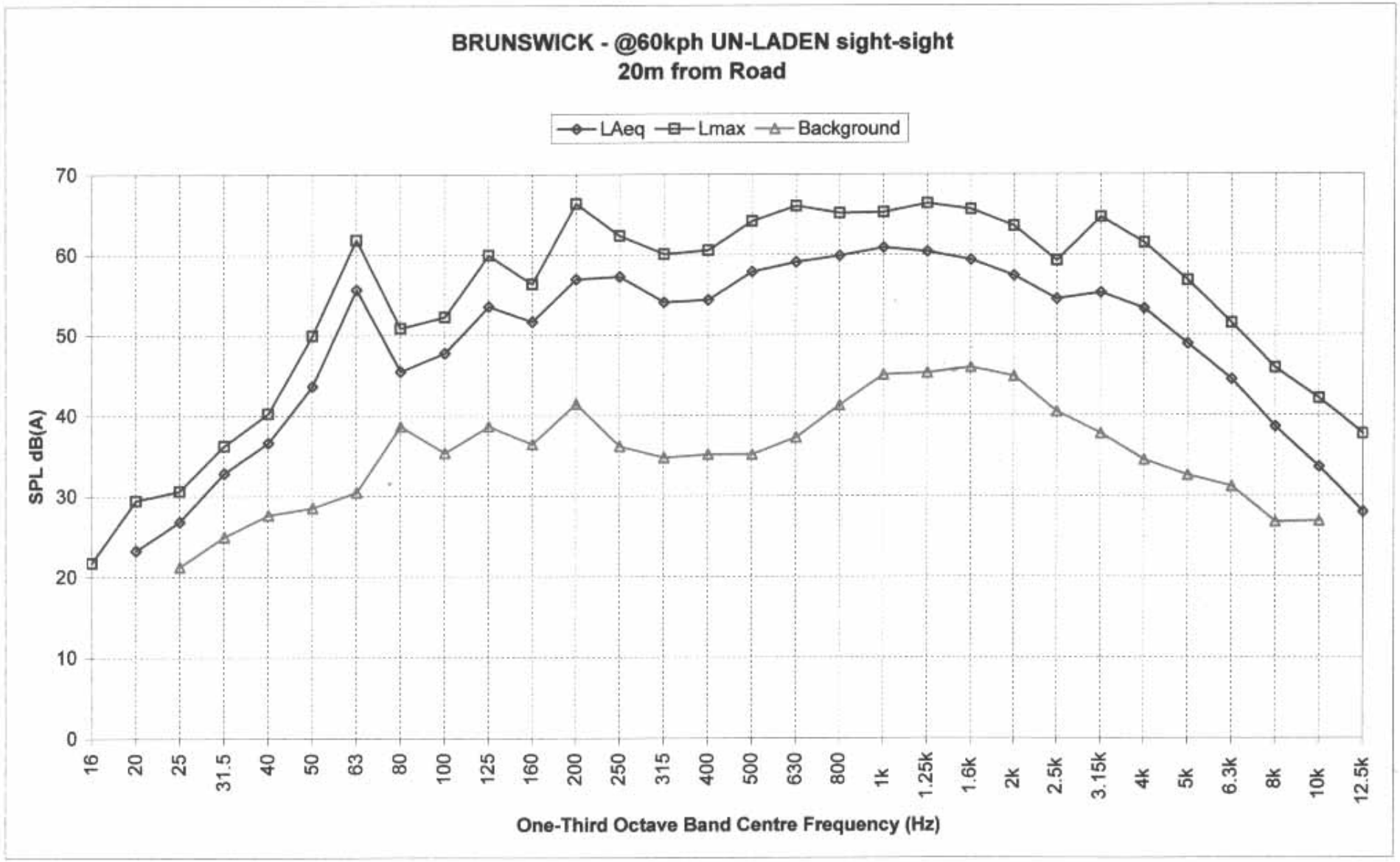

Kombana Road @50-60kph - LADEN
20m from Road
LAeq
Lmax
Background
SPL dB(A)
80
70
60
50
40
30
20
10
0
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)

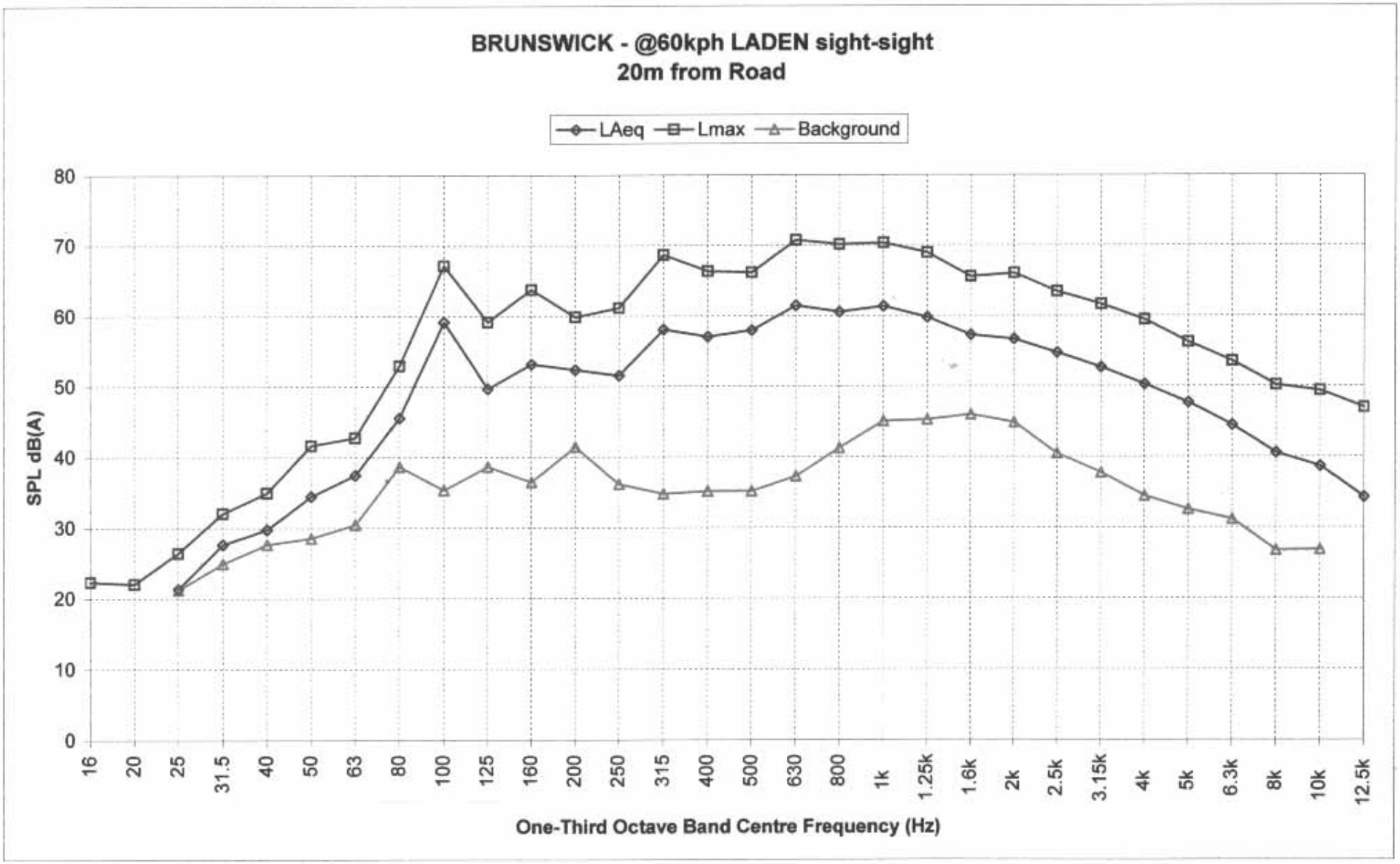

SWH & Waterloo 1 - @100kph LADEN
20m from Road
LAeq
Lmax
Background
SPL dB(A)
0
10
20
30
40
50
60
70
80
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)

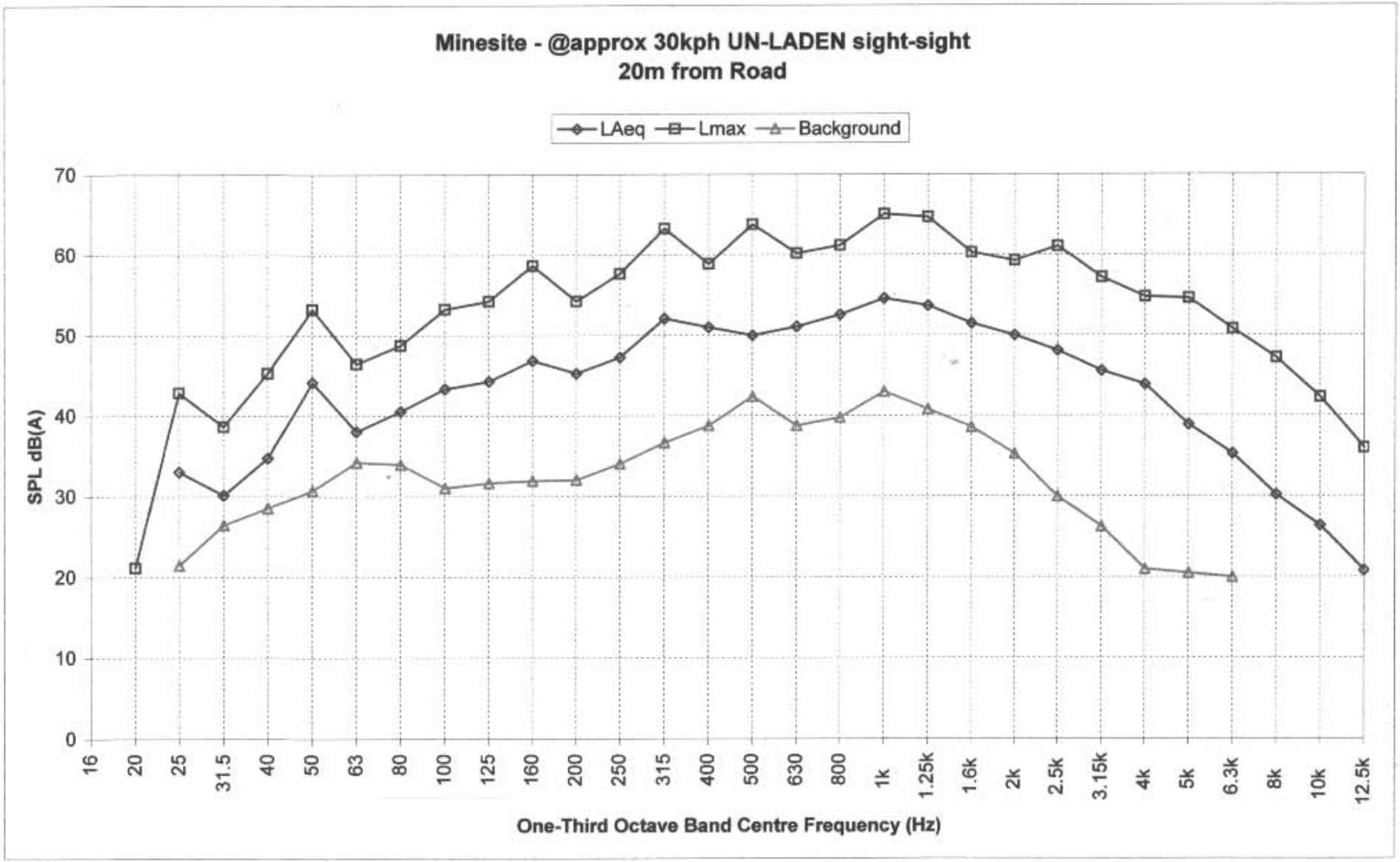

SWH & Waterloo 1 - @100kph LADEN
20m from Road
LAeq
Lmax
Background
SPL dB(A)
0
10
20
30
40
50
60
70
80
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)

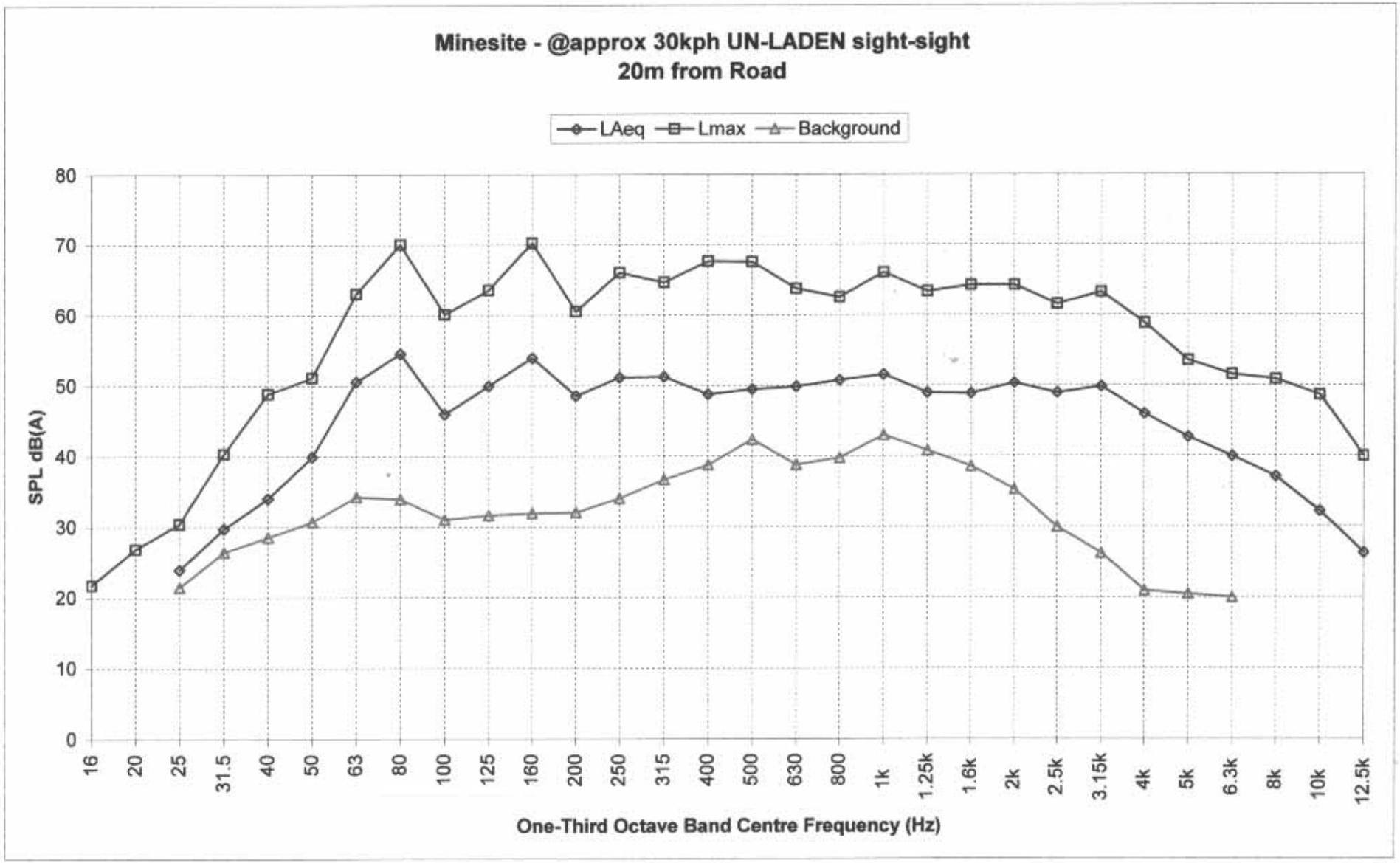

SWH & Waterloo 1 sight-sight - @100kph LADEN
20m from Road
LAeq
Lmax
Background
SPL dB(A)
0
10
20
30
40
50
60
70
80
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)


BRUNSWICK - @60kph UN-LADEN
20m from Road
LAeq
Lmax
Background
SPL dB(A)
0
10
20
30
40
50
60
70
80
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)


BRUNSWICK - @60kph UN-LADEN sight-sight
20m from Road
LAeq
Lmax
Background
SPL dB(A)
70
60
50
40
30
20
10
0
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)


BRUNSWICK - @60kph LADEN sight-sight
20m from Road
LAeq
Lmax
Background
SPL dB(A)
0
10
20
30
40
50
60
70
80
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)


Minesite - @approx 30kph UN-LADEN sight-sight
20m from Road
LAeq
Lmax
Background
SPL dB(A)
70
60
50
40
30
20
10
0
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)


Minesite - @approx 30kph UN-LADEN sight-sight
20m from Road
LAeq
Lmax
Background
SPL dB(A)
80
70
60
50
40
30
20
10
0
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
630
800
1k
1.25k
1.6k
2k
2.5k
3.15k
4k
5k
6.3k
8k
10k
12.5k
One-Third Octave Band Centre Frequency (Hz)