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Proposed Residential Subdivision
Fraser Drive, Tweed Heads
Major Project Approval MP 06-0243

ENVIRONMENTAL NOISE IMPACT REPORT

Prepared for:

Greenview Developments Pty Ltd

c/-

VKL Consulting Pty Ltd

17 February 2010
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1.0 INTRODUCTION

This report is in response to a request by VKL Consulting Pty Ltd on behalf of Greenview Developments Pty Ltd for an environmental noise impact assessment of a proposed residential subdivision situated on Fraser Drive at Tweed Heads.

In undertaking the above acoustic assessment, unattended noise monitoring was conducted, and through modeling, predictions of existing and future road traffic noise impacts were produced as well as commercial activity noise impacts (for the proposed onsite commercial lot).

This report is in addition to previous acoustic assessments undertaken for the development site (completed by Cardno (Qld) Pty Ltd in years 2006 and 2008) and provides additional information in response to an Acoustic Condition (B2) set by the NSW Minister for Planning for Major Project MP 06-0243. In detail, the Major Project Approval Acoustic Condition requires that for all residential lots the following noise criterion be achieved without the use of dwelling construction standards (i.e. architectural treatments).

- Day (7am – 10pm): $L_{Aeq(15hr)}$ 55; and
- Night (10pm – 7am): $L_{Aeq(9hr)}$ 50. (Refer to Appendix A for an extract of the condition)

The set criterion has been sourced from the NSW EPA "*Environmental Criteria for Road Traffic Noise*" (ECRTN) and relates to *"new residential developments affected by freeway / arterial traffic noise"*; given that Fraser Drive is to be upgraded within 10-15 years.

We note that the above criterion as presented in the ECRTN also refers to internal layouts, building materials and construction as methods for minimising road traffic noise impacts (for when the noise criteria is already exceeded); which conflicts with the Major Project MP 06-0243 Acoustic Condition B2.

Based upon the ECRTN noise criterion for *"new residential developments affected by freeway / arterial traffic noise"*, this assessment explores available acoustic treatment options suitable (reasonable and achievable) for the development site and provides recommendations for a balanced acoustic treatment outcome. We note that a balanced treatment strategy is supported by both the ECRTN (refer to Section 3.6 of the document); and the NSW Department of Planning document *"Development near Rail Corridors and Busy Roads – Interim Guideline"* (refer to Section 3.8 of the document). We note that the DOP's Interim Guideline:

> *"assists in the planning, design and assessment of development in, or adjacent to, rail corridors and busy roads."*
>
> *"It supports specific rail and road provisions of the State Environmental Planning Policy (Infrastructure) 2007 (the 'Infrastructure SEPP')."*
>
> *"While consideration of the Guideline is a requirement for development specified under the Infrastructure SEPP it can also provide a useful guide for all development that may be impacted by, or may impact on, rail corridors or busy roads"*

The final acoustic recommendations provided within this report not only provide a balance of suitable, reasonable and achievable options, which are generally considered urban planning best practice; but are also in-keeping with the existing built environment along Fraser Drive. Nearby existing development have either 2m high roadside acoustic barriers or no barriers at dwellings to the north, south and southeast of the subject site. It is further noted that the proposed development is an infill site, and not a greenfield site as indicated by DoP previous comments prior to the Minister making the determination to issue Major Project 06-0243 Approval.

2.0 SITE & DEVELOPMENT DESCRIPTION

The subject site is described as Lot 2 on DP1000385 and Lot 9 on DP1039569, Fraser Drive, Tweed Heads, NSW. The subject site is bounded by residential properties to the north, south and west, and Fraser Drive to the east.

The proposal is for a residential subdivision, comprising of 145 residential lots (comprising 132 detached lots and 13 attached lots; yielding 158 dwellings) and parkland lots. The development is divided into two precincts "A" and "B" to be developed in a total of 6 Stages with a future stage for integrated housing. Site entry and exits are proposed from Fraser Drive for the northern lots; and Ocean Avenue, Hillcrest Avenue and Merlot Court for the southern lots.

The acoustic environment at the site is influenced by traffic noise from Fraser Drive. Fraser Drive at the location of the site is a Council controlled two lane undivided road with a posted speed limit of 80km/hr. We have been advised by Council that Fraser Road is proposed to be upgraded to a four lane divided road within the next 10 to 15 years, with a predicted ultimate 2030 AADT volume of 16,868.

As the subdivision is likely to be impacted by road traffic noise from Fraser Road; the development is required to be assessed in accordance with New South Wales EPA "*Environmental Criteria for Road traffic Noise*" (ECRTN). The ECRTN requires assessment for a 10 year planning horizon (refer to Page 12 of the document).

Future potential onsite commercial activity noise at the local shops planned for the northeastern portion of the site (i.e. vehicle activities, deliveries, waste collection and mechanical plant) has the potential to impact upon onsite and surrounding noise sensitive receivers and has been assessed within this report for completeness, although it should be noted that a separate Development Application will be required for any future retail activity.

The nearest noise sensitive receivers are:

- Existing single storey residential dwellings to the north across the proposed new road;
- Future residential dwellings directly to the west and south of the possible future local shops; and
- Existing single storey bunkhouse accommodation to the east across Fraser Drive.

The location of the subject site is provided in Appendix A of this report. The development plans are provided in Appendix B.

3.0 AMBIENT NOISE SURVEY

3.1 Instrumentation

The following equipment was used to record ambient noise conditions at the subject site location:

- Rion NC 73 Calibrator; and
- Rion NL-21 Environmental Noise Loggers.

All instrumentation hold current calibration certificates from a certified NATA calibration laboratory.

3.2 Location A: Roadside Unattended Measurement Methodology

A logger was located along the eastern site boundary of the subject site fronting Fraser Drive. The microphone was in a free-field location approximately 1.2m above ground level and approximately 20m from the nearest lane of Fraser Drive. Refer to Figure 1 in Appendix A for the logger location.

The logger was set to record noise statistics in 15 minute blocks continually between 2pm on Wednesday 26/08/09 and 7am on Friday 4/09/09. The statistical interval was chosen to allow application of AS/NZS 2107:2000 *"Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors"*, and the NSW EPA's "*Environmental Criteria for Road traffic Noise*".

Road traffic noise levels were conducted generally in accordance with Australian Standard AS2702 - 1984 "*Acoustics - Methods for the measurement of road traffic noise*". The operation of the sound level logging equipment was field calibrated before and after the measurement session with no significant drift from the reference signal recorded.

Daily weather observations were obtained from the Bureau of Meteorology's website (http://www.bom.gov.au/) at the Coolangatta weather station. Weather conditions during the monitoring were fine, with temperatures between 6 and 28^{o}C, relative humidity between 50 and 85% and winds generally below 5m/s. Refer to Appendix C for daily weather observations.

Table 1 below presents the measured ambient noise levels from the logger location A. Graphical presentation of the measured levels from the logger is presented in the Appendix C. We note that recorded wind data on Saturday 29/08/09 were above 5m/s and have therefore been omitted from the Rating Background Level (RBL) calculations as presented in Table 1.

Traffic Noise Descriptors	**Time Period**	**Measured Level SPL dB(A) Leq**					
		Thursday 27/08/09	**Friday 28/08/09**	**Monday 31/08/09**	**Tuesday 1/09/09**	**Wednesday 2/09/09**	**Average**
$L_{A10\ (18hr)}$	6am - 12am	61	61	61	61	61	**61**
$L_{Aeq\ (24hr)}$	N/A	57	57	57	57	57	**57**
$L_{Aeq\ (15hr)\ Day}$	7am - 10pm	58	58	58	58	59	**58**
$L_{Aeq\ (9hr)\ Night}$	10pm - 7am	47	50	46	47	47	**47**
$L_{Aeq\ (1hr)\ Day}$	7am - 10pm	60	62	61	61	61	**61**
$L_{Aeq\ (1hr)\ Night}$	10pm - 7am	57	54	56	57	57	**56**
Background Noise Levels		**Background Level L_{A90} dB(A)**					
		Daytime (7am-6pm)		**Evening (6pm-10pm)**		**Night (10pm-6am)**	
Thursday 27/08/09		46		42		29	
Friday 28/08/09		47		41		34	
Saturday 29/08/09		50 (Omitted)		46 (Omitted)		34 (Omitted)	
Sunday 30/08/09		45		37		26	
Monday 31/08/09		46		36		28	
Tuesday 1/09/09		46		39		34	
Wednesday 2/09/09		47		45		36	
Thursday 3/09/09		48		43		34	
Rating Background Levels		**46**		**41**		**34**	

Table 1: Measured ambient noise levels at logger location A.

3.3 Location B: Setback Unattended Measurement Methodology

A logger was located along the western site boundary of the subject site at the eastern end of Ocean Avenue. The microphone was in a free-field location approximately 1.2m above ground level and approximately 175m from the nearest lane of Fraser Drive. Refer to Figure 1 in Appendix A for the logger location.

The logger was set to record noise statistics in 15 minute blocks continually between 2pm on Wednesday 26/08/09 and 7am on Wednesday 2/09/09. The statistical interval was chosen to allow application of AS/NZS 2107:2000 *'Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors'*, and the NSW EPA's '*Environmental Criteria for Road traffic Noise*'.

Road traffic noise levels were conducted generally in accordance with Australian Standard AS2702 - 1984 "*Acoustics - Methods for the measurement of road traffic noise*". The operation of the sound level logging equipment was field calibrated before and after the measurement session with no significant drift from the reference signal recorded.

Daily weather observations were obtained from the Bureau of Meteorology's website (http://www.bom.gov.au/) at the Coolangatta weather station. Weather conditions during the monitoring were fine, with temperatures between 6 and 28°C, relative humidity between 50 and 85% and winds generally below 5m/s. Refer to Appendix C for daily weather observations.

Table 2 below presents the measured ambient noise levels from the logger location B. Graphical presentation of the measured levels from the logger is presented in the Appendix C.

Traffic Noise Descriptors	**Time Period**	**Measured Level SPL dB(A) Leq**					
		Thursday 27/08/09	**Friday 28/08/09**	**Monday 31/08/09**	**Tuesday 1/09/09**	**Wednesday 2/09/09**	**Average**
$L_{A10\ (18hr)}$	6am - 12am	54	54	53	55		54
$L_{Aeq\ (24hr)}$	N/A	51	50	49	51		50
$L_{Aeq\ (15hr)\ Day}$	7am - 10pm	52	52	50	52		51
$L_{Aeq\ (9hr)\ Night}$	10pm - 7am	39	42	40	44		41
$L_{Aeq\ (1hr)\ Day}$	7am - 10pm	55	54	54	55		55
$L_{Aeq\ (1hr)\ Night}$	10pm - 7am	52	49	52	53		51

Background Noise Levels	**Background Level L_{A90} dB(A)**		
	Daytime (7am-6pm)	**Evening (6pm-10pm)**	**Night (10pm-6am)**
Thursday 27/08/09	40	37	29
Friday 28/08/09	41	40	34
Saturday 29/08/09	42 (Omitted)	43 (Omitted)	32 (Omitted)
Sunday 30/08/09	39	32	25
Monday 31/08/09	38	35	32
Tuesday 1/09/09	40	41	38
Rating Background Levels	**40**	**37**	**32**
Minima Background Levels	**38**	**32**	**25**

Table 2: Measured ambient noise levels at logger location B.

We note that recorded wind data on Saturday 29/08/09 were above 5m/s and have therefore been omitted from the Rating Background Level (RBL) calculations as presented in Table 1 above.

We note that we have applied the minimum recorded background noise levels during the survey period rather than Rating Background Levels as monitoring was conducted for less than 7 days due to battery failure.

4.0 NOISE CRITERIA

4.1 Road Traffic Noise

Assessment of potential noise impacts from road traffic are required to be conducted as per the New South Wales EPA ECRTN *"Environmental Criteria for Road traffic Noise"* (Refer to Table 3 below).

4.1.1 External Criterion

We note Fraser Drive is considered an Arterial Road based upon the road definitions provided within the ECRTN document. All other surrounding roads to the development (site access) are considered as local roads.

TYPE OF DEVELOPMENT	CRITERIA		
	DAY (7 am–10 pm) dB(A)	NIGHT (10 pm–7 am) dB(A)	WHERE CRITERIA ARE ALREADY EXCEEDED
2. New residential land use developments affected by freeway/arterial traffic noise	$L_{Aeq(15hr)}$55	$L_{Aeq(9hr)}$50	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design and construction of the development. Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts.
7. Land use developments with potential to create additional traffic on existing freeways/arterials	$L_{eq(15hr)}$60	$L_{eq(9hr)}$55	Where feasible, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.
13. Land use developments with potential to create additional traffic on local roads	$L_{Aeq(1hr)}$55	$L_{Aeq(1hr)}$50	Where feasible and reasonable, existing noise levels should be mitigated to meet the noise criteria. Examples of applicable strategies include appropriate location of private access roads; regulating times of use; using clustering; using 'quiet' vehicles; and using barriers and acoustic treatments. In all cases, traffic arising from the development should not lead to an increase in existing noise levels of more than 2 dB.

Table 3: Road noise criteria from NSW RTA's *"Environmental Criteria for Road Traffic Noise"*.

Based upon the measured levels presented in Table 1 of Section 3.2, the noise criterion is currently exceeded prior to the development (refer to Table 3 above).

4.1.2 Internal Criterion

Further to the above, as the criterion for *"new residential developments affected by freeway / arterial traffic noise"* refers to internal layouts, building arterials and construction as methods for minimizing road traffic noise impacts (for when the noise criteria is already exceeded – refer to Table 1 of Section 3.2) we provide the following internal noise limits for assessment of internal areas of future onsite dwellings:

We recommend applying the *"maximum"* indoor sound levels as specified in Australian Standard AS/NZS 2107:2000 *"Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors"*. These levels expressed as L_{Aeq} and are presented in Table 4 below:

7. RESIDENTIAL BUILDINGS	**Recommended Design Sound Level, L_{Aeq} dB(A)**	
	Satisfactory	**Maximum**
Houses and apartments near major roads –		
Living areas	35	45
Sleeping areas	30	40
Work areas	35	45

Table 4: Internal noise limits from AS/NZS 2107.

4.2 Onsite Commercial Activity Noise (Local Shopping Centre)

Onsite commercial activity noise associated the possible future local shops is regulated by the New South Wales EPA "*Industrial Noise Policy"*.

The assessment procedure has three components:

- Control of intrusive noise impacts – The limit criteria for this assessment is as follows: $L_{Aeq,\ 15\ min} \leq$ rating background level[1] + 5 dB;

- Maintaining noise level amenity for residential premises. This is achieved by ensuring that the proposed development complies with the noise limit criteria set in Table 2.1 of the Policy. If we assume that the area is within a Urban Area (as defined in the Policy), the following limits apply:

Indicative Noise Amenity Area	Time of Day	Recommended $L_{Aeq.}$ Noise Level, dB(A) *(see Note 8 in Section 2.2.1)*	
(see Notes in Section 2.2.1)		Acceptable *(See Note 11)*	Recommended Maximum *(See Note 11)*
Urban	Day	60	65
	Evening	50	55
	Night	45	50

Table 5: Amenity Criterion Prescribed in the New South Wales EPA "*Industrial Noise Policy"*.

With regards to the $L_{Aeq,\ 15\ min} \leq$ rating background level + 5 dB criterion, based upon the location of the subject site (i.e. possible Local Shops are located along Fraser Drive), the area is considered to be a Category R2 area (Areas with low density transportation) as defined in Australian Standard AS1055.2-1997. The background noise levels for a Category 2 are presented as an attachment in Appendix A (i.e. 45 dB(A) during the daytime, 40 dB(A) evening and 35 dB(A) night-time). These levels concur well with the measured RBLs at Logger Location A (i.e. possible Local Shops located along Fraser Drive).

By considering the above criteria, the measured daytime RBLs, we recommend the following noise limits for the proposed use:

- Daytime (7 am – 6 pm Mon-Sat; 8 am – 6 pm Sun) 51 (RBL 46 + 5) dB(A) Leq;
- Evening (6 pm – 10 pm) 46 (RBL 41 + 5) dB(A) Leq; and
- Night (remaining periods) 39 (RBL 34 + 5) dB(A) Leq.

Overall, the resulting $L_{Aeq,\ 15\ min} \leq$ rating background level + 5 dB criterion based upon the measured daytime RBLs are below the acceptable amenity criterion levels for an Urban area (refer to Table 5).

Further to the above criteria, we recommend applying a design target of 45 dB(A) L_{10} inside living areas and bedrooms from short term noise events. This level is within sleep disturbance prevention criteria set by the World Health Organisation.

[1] The rating background level is the overall single figure background level representing each assessment period (day/evening/night over the whole monitoring period.

5.0 RESULTS & CALCULATIONS

5.1 Modeled Road Traffic Noise Levels – Existing Situation

5.1.1 Existing and Future Traffic Volumes

The existing traffic volume and the percentage of heavy vehicles for Fraser Drive and Hillcrest Avenue were obtained from the Tweed Shire Council. We were advised that traffic data was collected in year 2008 and 2005 respectively. Predicted traffic volumes are based upon projections for the year 2009 and 2019 which assume a 4.47% compound growth per annum taking into account the Kirkwood Road interchange upgrade.

Fraser Drive:

- Surveyed Volume: 6,441 vpd volume, 2.4% heavy vehicles
- Predicted Exiting Volume: 6,729 vpd volume, 2.4% heavy vehicles
- Predicted Ultimate Volume: 10,420 vpd volume, 2.4% heavy vehicles

Hillcrest Avenue:

- Surveyed Volume: 1,055 vpd volume, 4% heavy vehicles

Peak hour traffic volumes for Merlot Drive and Ocean Street were obtained from the Cardno Eppell Olsen traffic count performed in 2006. Assuming peak hour rates are 10% of total volume the following daily traffic volumes apply:

Merlot Drive:: 335 vehicles per day

Ocean Street: 240 vehicles per day

Site Generated:

Trips generated by the residential lots are estimated to be at 9 trips per day for detached dwelling lots and 5 trips per day for medium density housing as per the *"RTA Guide to Traffic Generating Developments Version 2.2 (October 2002)"*. The possible Local Shops are estimated to generate 121 vehicles per day per 100m^2 GLFA.

As the proposed development is to contain 145 residential lots (132 attached lots and 13 detached lots, yielding 158 dwellings) and 2,500m^2 of GLFA local shops the following trip generation is predicted:

Development Site	Lots	Detached dwellings	Medium density dwellings	Daily Trips
Dwellings	145	132	26	1318
Local Shops	400m^2 GLFA			484
Total				**1802**

Table 6: Site Trip Generation.

5.1.2 Modeled Road Traffic Noise Levels – Existing Situation

Road traffic noise predictions were conducted using PEN3D, a CoRTN based model acceptable under the Environmental Protection (Noise) Policy. To verify the road traffic noise prediction model, the year 2009 $L_{Aeq\ 24hr}$ traffic noise level was calculated for the logger location and compared to the measured noise level. For PEN3D point calculation sheets refer to Appendix C of this report.

We note that road elevations for Fraser Drive at the location of the subject site were obtained from longitudinal section drawings provided by VKL Consulting Pty Ltd.

The calculated existing $L_{A10\ 18hr}$ noise level, approximately 20m from the nearest lane of Fraser Drive is 57.4 dB(A). Compared with the measured $L_{Aeq\ 24hr}$ level of 56.9 dB(A), the model is over-predicting by 0.5 dB(A), which is within the allowable 2 dB(A) deviation from measured levels.

5.1.3 Modeled Road Traffic Noise Levels – Year 2019

Based upon year 2019 traffic volumes, the PEN3D model predicts the following façade corrected traffic noise levels as detailed in Table 7. The following parameters were used in developing the PEN3D model for the development site:

- Recommended 2.0m high acoustic barrier treatments as detailed in Section 6.1.1.
- 80 km/hr posted speed limit on Fraser Drive.
- Dense graded asphalt surface (no road surface correction required).
- Ground Floor receiver heights taken at 1.8m above ground level.
- Ground Floor receiver heights taken at 4.6m above ground level.
- Lot numbering as per plans provided in Appendix B.
- Lots 1 and 3 designated for commercial use (i.e. retail centre).

Although PEN3D only calculates $L_{Aeq\ (24hr)}$ levels, the $L_{Aeq(1hr)}$ levels presented are based upon the measured relationship between the $L_{Aeq(24hr)}$ and the $L_{Aeq(1hr)}$ level at Logger Location A. For PEN calculations refer to Appendix C of this report.

Lot Receiver Location	**Predicted 2019 Traffic Noise – Façade Corrected dB(A)**				
	$L_{Aeq\ (24hr)}$	**$L_{Aeq\ (15hr)}$**	**$L_{Aeq\ (9hr)}$**	**$L_{Aeq\ (1hr)}$ Daytime**	**$L_{Aeq\ (1hr)}$ Night time**
Ground Floor Façades					
3	55	56	45	59	54
4	54	55	44	58	53
15	57	58	47	61	56
22	60	61	50	64	59
23	60	61	50	64	59
24	60	61	50	64	59
25	60	61	50	64	59
26	61	62	51	65	60
27	60	61	50	64	59
28	60	61	50	64	59
29	60	61	50	64	59
30	60	61	50	64	59
31	56	57	46	60	55
32	54	55	44	58	53
69	55	56	45	59	54
70	57	58	47	61	56
71	60	61	50	64	59
88	55	56	45	59	54
89	57	58	47	61	56
90	61	62	51	65	60
101	54	55	44	58	53

Note – Lot building façades presented in bold have TNR values at or less than 25 – refer to Section 6.

Table 7: Predicted traffic noise impact levels at the proposed development.

Receiver Location	Predicted 2019 Traffic Noise – Façade Corrected dB(A)				
	$L_{Aeq\ (24hr)}$	$L_{Aeq\ (15hr)}$	$L_{Aeq\ (9hr)}$	$L_{Aeq\ (1hr)\ Daytime}$	$L_{Aeq\ (1hr)\ Night\ time}$
Ground Floor Façades					
102	56	57	46	60	55
103	60	61	50	64	59
104	57	58	47	61	56
105	60	61	50	64	59
106	62	63	52	66	61
107	58	59	48	62	57
108	56	57	46	60	55
109	55	56	45	59	54
110	55	56	45	59	54
111	54	55	44	58	53
113	60	61	50	64	59
114	58	59	48	62	57
115	56	57	46	60	55
116	55	56	45	59	54
117	54	55	44	58	53
112	54	55	44	58	53
118	55	56	45	59	54
119	55	56	45	59	54
120	54	55	44	58	53
121	55	56	45	59	54
122	56	57	46	60	55
123	56	57	46	60	55
124	56	57	46	60	55
125	62	63	52	66	61
126	61	62	51	65	60
127	61	62	51	65	60
128	60	61	50	64	59
129	62	63	52	66	61
130	61	62	51	65	60
131	62	63	52	66	61
132	61	62	51	65	60
133	60	61	50	64	59
134	60	61	50	64	59
135	59	60	49	63	58
First Floor Façades					
3	58	59	48	62	57
4	56	57	46	60	55
5	54	55	44	58	53
15	59	60	49	63	58
19	54	55	44	58	53
20	55	56	45	59	54
21	56	57	46	60	55
22	68	69	58	72	67
23	68	69	58	72	67
24	67	68	57	71	66
25	67	68	57	71	66
26	67	68	57	71	66
27	67	68	57	71	66
28	68	69	58	72	67
29	68	69	58	72	67
30	67	68	57	71	66
31	62	63	52	66	61
32	58	59	48	62	57
33	55	56	45	59	54
49	55	56	45	59	54
50	55	56	45	59	54

Note – Lot building façades presented in bold have TNR values at or less than 25 – refer to Section 6.

Table 7: Predicted traffic noise impact levels at the proposed development.

Receiver Location	Predicted 2019 Traffic Noise – Façade Corrected dB(A)				
	$L_{Aeq\ (24hr)}$	$L_{Aeq\ (15hr)}$	$L_{Aeq\ (9hr)}$	$L_{Aeq\ (1hr)\ Daytime}$	$L_{Aeq\ (1hr)\ Night\ time}$
First Floor Façades					
51	55	56	45	59	54
68	55	56	45	59	54
69	58	59	48	62	57
70	62	63	52	66	61
71	67	68	57	71	66
87	55	56	45	59	54
88	58	59	48	62	57
89	61	62	51	65	60
90	66	67	56	70	65
101	55	56	45	59	54
102	56	57	46	60	55
103	65	66	55	69	64
104	65	66	55	69	64
105	65	66	55	69	64
106	64	65	54	68	63
107	59	60	49	63	58
108	57	58	47	61	56
109	56	57	46	60	55
110	55	56	45	59	54
111	55	56	45	59	54
113	66	67	56	70	65
114	63	64	53	67	62
115	60	61	50	64	59
116	59	60	49	63	58
117	57	58	47	61	56
112	57	58	47	61	56
118	57	58	47	61	56
119	57	58	47	61	56
120	56	57	46	60	55
121	57	58	47	61	56
122	57	58	47	61	56
123	57	58	47	61	56
124	57	58	47	61	56
125	67	68	57	71	66
126	68	69	58	72	67
127	68	69	58	72	67
128	68	69	58	72	67
129	68	69	58	72	67
130	68	69	58	72	67
131	68	69	58	72	67
132	67	68	57	71	66
133	68	69	58	72	67
134	67	68	57	71	66
135	65	66	55	69	64
154	55	56	45	59	54
155	55	56	45	59	54

Note – Lot building façades presented in bold have TNR values at or less than 25 – refer to Section 6.

Table 7: Predicted traffic noise impact levels at the proposed development.

We note that lots which are not presented in Table 7 above have predicted impact levels at or the below the adopted noise criterion. For PEN calculations refer to Appendix C of this report.

5.1.4 Predicted Noise Impacts from Additional Traffic on the Existing Road Network

Based upon the existing traffic volumes on the local roads and the trip generation rates expected from the completed development (as presented in Section 5.1.1) we present the following traffic noise increase predictions.

Based upon the Cardno Eppell Olsen traffic assessment dated December 2006, vehicles from the northern end of the development (Stages 1A, 2A and 3A) will enter and exit from Fraser Drive, with 75% of the traffic volume heading south and 25% heading north. We have assumed that 75% of the Local Shop patronage will come from the southern end of Fraser Drive and 25% from the northern end of Fraser Drive with all retail centre trips in addition to the residential trips calculated for the development (worst case). Refer to Table 8 below for existing traffic volumes on the local roads and predicted development traffic on the local roads.

For the southern end of the development (Stages 1B, 2B and 3B), 50% of the development traffic will enter and exit from Merlot Street and 25% from both Ocean Street and Hillcrest Avenue.

Existing Volumes on Local Roads	**Traffic Volume**				
	AADT	**15hr**	**9hr**	**Day 1hr Peak**	**Night 1hr Peak**
Volume Percentage	**100%**	**93%**	**7%**	**10%**	**3%**
Fraser Drive	**6729**	**6258**	**471**	673	202
Ocean Street	**240**	223	17	**24**	**7**
Hillcrest Avenue	**1055**	981	74	**106**	**32**
Merlot Street	**350**	326	25	**35**	**11**

Development Volumes on Local Roads	**Traffic Volume**				
	AADT	**15hr**	**9hr**	**Day 1hr Peak**	**Night 1hr Peak**
Volume Percentage	**100%**	**93%**	**7%**	**10%**	**3%**
Fraser Drive North	**286**	**266**	**20**	29	9
Fraser Drive South	**859**	**799**	**60**	86	26
Ocean Street	**164**	153	11	**16**	**5**
Hillcrest Avenue	**164**	153	11	**16**	**5**
Merlot Street	**329**	306	23	**33**	**10**

Table 8: Traffic volumes on local roads: existing and completed development generation.

Measurements from a similar previous site in NSW were taken of vehicles travelling along a local road with a posted speed limit of 50 km/hr. Table 9 below presents the measured noise levels.

Noise Level Descriptor	**Measured Level at 10m from Passing Vehicles dB(A)**
Road Traffic Noise Measurements	
Average $L_{Aeq\ passby}$	59
Average SEL_{passby}	71 (15 sec.)

Table 9: Measured vehicle bypass on a locale street.

Predicted L_{Aeq} levels for the local roads have been determined by multiplying the measured SEL of a vehicle pass-by by the number of car passes for each time period. Refer to Appendix C for calculations. We note that the above method has been applied due to the low traffic volumes anticipated upon the local road network, and to incorporate the local road environment (i.e. undertaking of attended measurements of vehicles using a local NSW road).

The predicted $L_{Aeq,15hr}$, $L_{Aeq,9hr}$, and $L_{Aeq,1hr}$ noise levels at existing offsite dwellings are presented in Table 10 over the page.

Receiver Location	Predicted Traffic Noise: Façade Corrected dB(A)			
	$L_{Aeq\ 15hr}$	$L_{Aeq\ 9hr}$	$L_{Aeq\ 1hr\ Daytime}$	$L_{Aeq\ 1hr\ Night\ time}$
Existing Scenario				
Dwellings along Fraser Drive Nth	64	55		
Dwellings along Fraser Drive Sth	64	55		
Dwellings along Ocean Street			52	46
Dwellings along Hillcrest Avenue			58	53
Dwellings along Merlot Street			53	48
Completed Development Scenario				
Dwellings along Fraser Drive Nth	64	55		
Dwellings along Fraser Drive Sth	64	55		
Dwellings along Ocean Street			54	49
Dwellings along Hillcrest Avenue			59	53
Dwellings along Merlot Street			56	51
Criterion	**60**	**55**	**55**	**50**

Table 10: Predicted noise impacts at existing streets.

5.2 Onsite Commercial Activity Noise: Impacting Noise Sensitive Receivers

All noise source levels used in the assessment have been collected from similar previous investigations. All noise levels have been corrected for impulsiveness or tonality as per Australian Standard AS 1055:1997 – *"Acoustics-Description and measurement of environmental noise*".

The following noise sources are typically associated with the operation of a commercial site and have been assessed within this report:

Activity/Noise Source	Noise Level, SPL L_{Aeq} dB(A)
Car door closure	58 dB(A) @ 1m
Car bypass at 5km/hr	57 dB(A) @ 3m
Patrons at alfresco dining area	70 dB(A) @ 1m
Goods delivery	85 dB(A) @ 1m
Waste collection	88 dB(A) @ 1m
Cluster of air-conditioning units Indicative level	58 dB(A) @ 1m (2 x 55 dB(A) units)

Table 11: Typical noise source levels associated with a commercial centre.

Based upon the location of the adjacent noise sensitive properties (façades and inside rooms assuming open windows), we predict the following noise impact levels from typically occurring activities at the subject site as presented in Tables 12 and 13 (ground and top floor level façades) over the page.

It is noted that the predicted level assume that the recommended acoustic treatments as detailed in Section 6.2 are incorporated into the development.

GROUND FLOOR LEVEL

Noise source	Predicted Noise Impact, SPL L_{Aeq} dB(A)		
	Nearest Façade to Development	Inside with Windows Open	Rw to Achieve Criteria Inside
Onsite Lot 22 Dwelling			
Car door closure	29	22	N/A
Car bypass at 5km/hr	44	37	N/A
Patrons alfresco dining area	41	34	N/A
Goods delivery	63	55	Refer Below
Waste collection	74	66	Refer Below
A/C Units	38	31	N/A
Onsite Lot 21 Dwelling			
Car door closure	29	22	N/A
Car bypass at 5km/hr	35	28	N/A
Patrons alfresco dining area	41	34	N/A
Goods delivery	60	52	Refer Below
Waste collection	71	63	Refer Below
A/C Units	47	39	N/A
Onsite Lot 3 Dwelling			
Car door closure	36	28	N/A
Car bypass at 5km/hr	44	37	N/A
Patrons alfresco dining area	46	39	N/A
Goods delivery	49	41	Refer Below
Waste collection	60	52	Refer Below
A/C Units	47	39	N/A
Bunkhouse Accommodation Due East			
Car door closure	<20	<20	
Car bypass at 5km/hr	26	<20	
Patrons alfresco dining area	28	21	
Goods delivery	44	36	
Waste collection	47	40	
A/C Units	<20	<20	
Existing Dwellings Due North			
Car door closure	<20	<20	
Car bypass at 5km/hr	27	20	
Patrons alfresco dining area	30	22	
Goods delivery	45	38	
Waste collection	49	41	
A/C Units	<20	<20	
Criterion dB(A)	**7am – 6pm: 51 / 6pm – 10pm: 46**	**Inside: 45**	

Table 12: Predicted noise impact from onsite noise sources at ground floor façades.

As waste collection and delivery activities are generally infrequent events (i.e. once or twice per week) and of short duration we have not based our Rw requirements on these predicted impact levels.

TOP FLOOR LEVEL

Noise source	Predicted Noise Impact, SPL L_{Aeq} dB(A)		
	Nearest Façade to Development	Inside with Windows Open	Rw to Achieve Criteria Inside
Onsite Lot 22 Dwelling			
Car door closure	37	30	N/A
Car bypass at 5km/hr	52	45	N/A
Patrons alfresco dining area	49	42	N/A
Goods delivery	71	63	Refer Below
Waste collection	74	66	Refer Below
A/C Units	38	31	N/A
Onsite Lot 21 Dwelling			
Car door closure	37	30	N/A
Car bypass at 5km/hr	43	36	N/A
Patrons alfresco dining area	49	42	N/A
Goods delivery	68	60	Refer Below
Waste collection	71	63	Refer Below
A/C Units	47	39	N/A
Onsite Lot 3 Dwelling			
Car door closure	44	36	N/A
Car bypass at 5km/hr	52	45	N/A
Patrons alfresco dining area	54	47	Within 2 dB(A)
Goods delivery	57	49	Refer Below
Waste collection	60	52	Refer Below
A/C Units	47	39	N/A
Criterion dB(A)	**7am – 6pm: 51 / 6pm – 10pm: 46**	**Inside: 45**	

Table 13: Predicted noise impact from onsite noise sources at top floor façades.

As the average person cannot typically detect a 3 dB variation in sound pressure levels a 1 dB exceedance is unlikely to cause annoyance.

6.0 RECOMMENDED ACOUSTIC TREATMENTS

6.1 Road Traffic Noise Acoustic Treatments:

6.1.1 Acoustic Barriers

For strict compliance at ground floor level facades at all lots an acoustic barrier fronting Fraser Drive would have to be in the order of 3.3m to 4.5m in height. For strict compliance at ground and first floor level facades at all lots an acoustic barrier fronting Fraser Drive would have to be in the order of 6m to 7m in height.

A 3.3m to 4.5m or a 6m to 7m high acoustic barrier along the Fraser Drive frontage would have negative impacts on other urban planning issues such as visual amenity, streetscape, loss of breezes, passive surveillance along Fraser Drive and the early morning and afternoon shadows cast by such barriers. A 6 to 7m high barrier would also not be achievable due to costs associated with its construction and engineering (i.e. footing depth and wind loadings). For these reasons an alternative barrier solution has been adopted.

In-keeping with the existing built environment along Fraser Drive (i.e. residential dwellings both to the north, south and southeast of the subject site) given that the proposed development is an infill site we have recommended a maximum acoustic barrier height of 2.0m along the Fraser Drive frontage.

The recommended location of the 2.0m high acoustic barriers is presented in Sketch 2 of Appendix A. Barriers are to be constructed above the finished ground or existing ground, whichever is higher and be free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlap), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of 11kg/m^2 is required).

6.1.2 Building Treatments

Based upon the noise modelling (Refer to Table 7 of Section 5.1.3), traffic noise is predicted to exceed the external noise criterion at the nearest proposed lots; hence further acoustic treatments are required.

To determine the extent of acoustic treatments, assessment of habitable spaces (i.e. bedrooms and living/dining/kitchen areas) should be undertaken in accordance with Australian Standard AS3671:1989 *"Acoustics – Road traffic noise intrusion – Building Siting and Construction"* to achieve the *"maximum"* internal noise levels prescribed in AS/NZS 2107:1987 *"Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors"* – refer to Section 4.1.

Based upon predicted impact levels at lot building façades (refer to Table 7 of Section 5.1.3), the TNR values (Traffic Noise Reduction) as defined in AS3671:1989 are as follows:

Receiver	Space	Impact dB(A)	Criteria dB(A)	TNR dB(A)
First Floor Living Areas	Lots 22 to 30, 71 and 125 to 134	72.0	45	27.0
First Floor Bedrooms	Lots 22 to 30, 71 and 125 to 134	67.0	40	27.0

Table 14: TNR values for noise affected habitable rooms.

TNR values between 10 and 25 (Lot building façades which are presented in Bold within in Table 7 of Section 5.1.3) are considered as Construction Category 2 within AS3671:1989, which is defined as follows:

> *"Standard construction, except for lightweight elements such as fibrous cement or metal cladding or all glass façades."*

Australian Standard AS3671:1989 also provides guidance on standard building construction for those lots with TNR values between 10 and 25:

Fraser Drive Space	Building Component	Rw	Indicative Acoustic Treatment **Verify with supplier proposed element achieves required Rw**
Standard Building Construction:			
Lots predicted to have TNR values up to 25	Glazing	**24**	4mm glass in a standard grade frame
	External Wall	**33 - 35**	Conventional timber stud framed wall, clad externally with 9mm thick timber or hardboards or flat cellulose-cement sheets, and internally with 10mm thick plasterboard; or conventional brick veneer construction
	Roof / Ceiling	**33 - 35**	Conventional pitched roof with tiles or corrogated metal, over 10mm thick plasterbaord

Table 15: Standard Building Shell Treatments.

TNR values between 25 and 35 (refer to Table 14 on the previous page) are considered as Construction Category 3 within AS3671:1989, which is defined as follows:

> *"Special construction, chosen in accordance with Clause 3.4. Windows, doors and other openings must be closed."*

Hence, to achieve the internal noise criterion at habitable rooms of future dwellings on lots with a TNR values greater than 25 (refer to Table 14 on the previous page), we recommend that additional noise assessments be conducted once building plans are finalised.

Assessment of habitable rooms should be undertaken in accordance with Australian Standard AS3671:1989 *'Acoustics – Road traffic noise intrusion – Building Siting and Construction'* to achieve the maximum internal noise levels prescribed in AS/NZS 2107:1987 *'Acoustics – Recommended Design Sound Level and Reverberation Times for Building Interiors'*. To allow occupants to close windows and doors and still have a supply of fresh air, provision of air conditioning or sealed mechanical ventilation is required to noise affected habitable rooms.

We note that lots requiring upgraded building shell treatments are limited to approximately 12% of the overall number of lots proposed (i.e. 20 of 163 lots); hence 88% of the proposed lots require standard building shell treatments only due to setback buffer distance providing sufficient noise mitigation.

6.1.3 External Private Open Spaces

An option to achieve the criterion at private open spaces on lots affected by traffic noise above the external daytime criterion of 55 dB(A) (refer to Table 7 of Section 5.1.3) is to locate such areas at ground level and along the western facing dwelling façades allowing for partial or full physical screening of traffic noise by the building envelope.

Hence, for noise affected lots, the additional acoustic assessments (discussed in Section 6.1.2 above) would also need to consider the location of external private open spaces to ensure the external noise criterion can be achieved at these areas.

6.2 Recommended Acoustic Treatments for Onsite Commercial Activity

Based upon the assumed commercial noise source levels, the following acoustic treatments and management principles are recommended to mitigate onsite commercial noise emissions should Local Shop development proceed:

- Construction of the 1.8m high acoustic barriers as detailed in Sketch 1 of Appendix A. Barriers are to be constructed above the finished ground or existing ground, whichever is higher and be free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlap), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of 11kg/m^2 is required).

- Awnings above alfresco dining areas be of a solid construction, and be free of holes or gaps to mitigate noise intrusion to unit dwellings above.

- Commercial hours of operation be limited to 7am to 10pm.

- Waste collection and deliveries be limited to the daytime period of 7am to 6pm.

- Driveway and carpark areas of the Local Shops be finished with surface coatings which prevent tyre squeal (an uncoated surface is acceptable). Drainage grating over trafficable areas be well secured to prevent rattling.

- Mechanical plant at the general store be designed and installed to comply with the noise criterion presented in Section 4.2. As final plant selection has not been completed, additional acoustic assessment/s should be undertaken once plant selections are finalised. Such assessments should be undertaken prior to Building Approval; and be conditioned within the Development Approval.

7.0 DISCUSSION

7.1 Road Traffic Noise

Road traffic noise has been assessed against the ten year planning horizon after the completion of the development, and takes into account the impact of traffic on Fraser Drive. Based upon year 2019 traffic volumes, traffic noise levels are predicted to impact the proposed subdivision at levels above the adopted road traffic noise criterion; hence acoustic treatments are required.

The adopted criterion has been sourced from the NSW EPA "*Environmental Criteria for Road Traffic Noise*" (ECRTN) and relates to *"new residential developments affected by freeway / arterial traffic noise"*. We note that the above criterion as presented in the ECRTN refers to internal layouts, building materials and construction as methods for minimising road traffic noise impacts (for when the noise criteria is already exceeded).

This assessment has explored available acoustic treatment options which are suitable (reasonable and achievable) for the development site and has provided recommendations for a balanced acoustic treatment outcome as a balanced treatment strategy is supported by both the ECRTN (refer to Section 3.6 of the document); and the NSW Department of Planning document *"Development near Rail Corridors and Busy Roads – Interim Guideline"* (refer to Section 3.8 of the document).

Final acoustic recommendations which include acoustic barriers, acoustic building shell treatments and appropriate locations of private open recreation spaces not only provide a balance of reasonable and achievable options but is also considered the preferred option for the following site specific reasons:

- The lot layout is constrained due to the site topography and the parcel of land is an infill site.
- We note that lots requiring upgraded building shell treatments are limited to approximately 12% of the overall number of lots proposed (i.e. 20 of 163 lots); hence 88% of the proposed lots require standard building shell treatments only due to setback buffer distance providing sufficient noise mitigation.
- The topography of the site (land rises up from Fraser Drive) limits the overall performance of acoustic barriers; with barriers able to provide screening to top floor levels of dwellings (if constructed) would need to be in the order of 8m in height.
- A 3.3m to 4.5m or a 6m to 7m high acoustic barrier along the Fraser Drive frontage would have negative impacts on other urban planning issues such as visual amenity, streetscape, loss of breezes, passive surveillance along Fraser Drive and the early morning and afternoon shadows cast by such a barrier.
- A 6m to 7m high barrier would also not be achievable due to costs associated with its construction and engineering (i.e. footing depth and wind loadings).
- The recommended treatments are in-keeping with the existing built environment along Fraser Drive (i.e. residential dwellings both to the north, south and southeast of the subject site) given that the proposed development is an infill site. Such built forms include a limitation of barrier height to 2m (i.e. a residential sub-division to the southeast of the subject site) and no acoustic barrier for those dwellings directly to the north and south of the site.
- CRG Traffic and Acoustical Consultants have undertaken a number of similar developments in Northern New South Wales which have had similar approved recommended acoustic treatments.

The increases in traffic volume on the local roads due to the completed development are predicted to increase noise levels by at or less then 2 dB(A) on Fraser Drive, Ocean Street and Hillcrest Avenue; and are within the allowable 2 dB(A) increase as presented in Table 3 of Section 4.1.

Traffic noise impacts at existing dwellings along Fraser Drive and Hillcrest Avenue are predicted to be above the daytime and night-time noise criterion for both the existing scenario and the scenario with the completed development at the subject site; however as mentioned above, impact levels (completed development) have not increased by more then 2 dB(A) from the existing scenario.

The increases in traffic volume on Merlot Street due to the completed development are predicted to increase by 3 dB(A); however the impact levels are within 1 dB(A) of the external noise criterion for "local roads" of 55 dB(A) for daytime and 50 dB(A) for the night-time. As the average person cannot typically detect a 3 dB variation in sound pressure levels a 1 dB exceedance is unlikely to cause annoyance.

We note that the development has five vehicle access points to the local roads to ensure development traffic is distributed and not limited to any single local road.

7.2 Commercial Noise

Based upon the assumed noise source levels and recommended acoustic treatments, noise impacts at the ground floor level residential building façades are predicted to be within 1 dB of the evening-time "Background +" external criterion and the adopted internal limit of 45 dB(A) with the exception of waste collection and deliveries.

Noise impacts at the first floor level residential building façades are predicted to be within 2 dB of the adopted internal limit of 45 dB(A) with the exception of waste collection and deliveries. We note that for most dwellings private recreation space is provided at ground floor level; therefore, only internal rooms of first floor levels have been assessed.

As the average person cannot typically detect a 3 dB variation in sound pressure level, we submit a 1 dB exceedance is unlikely to cause annoyance and is considered an acceptable outcome.

8.0 CONCLUSIONS

This report is in response to a request by VKL Consulting Pty Ltd on behalf of Greenview Developments Pty Ltd for an environmental noise impact assessment of a proposed residential subdivision situated on Fraser Drive, Tweed Heads.

Overall, the proposed development will generally be within acceptable levels of the adopted criterion, subject to the acoustic treatments recommended in Section 6 being integrated into the design, construction and operation of the development.

Report Reviewed By:

JAY CARTER BSc
Director

Report Compiled by:

Matthew Lopez BEng
Consultant

APPENDIX A

Attachments, Subject Site, Noise Measurement Locations and Recommended Acoustic Barriers

Attachment A: NSW Department of Planning Acoustic Condition:

B2 Noise Attenuation

A revised acoustic assessment must be submitted to the Department for approval prior to the issue of a Construction Certificate for any stage of the subdivision to demonstrate that the following noise criteria can be achieved at the eastern boundary of all residential allotments without the use of residential dwelling construction standards (architectural treatment) to ameliorate road traffic noise:

- Day (7am – 10pm): $L_{Aeq(15hr)}$55
- Night (10pm – 7am): $L_{Aeq(9hr)}$50

APPENDIX A

ESTIMATED AVERAGE BACKGROUND A-WEIGHTED SOUND PRESSURE LEVELS ($L_{A90,T}$) FOR DIFFERENT AREAS CONTAINING RESIDENCES IN AUSTRALIA

(Informative)

This Appendix may only be used as a guideline. Whenever possible values of $L_{A90,T}$ shall be measured in accordance with Clause 4.2.1. Where the measured values are obtainable, this Appendix shall not be used.

Noise area category (Notes 1 and 2)	Description of neighbourhood	Average background A-weighted sound pressure level, $L_{A90,T}$					
		Monday to Saturday			Sundays and public holidays		
		0700–1800	1800–2200	2200–0700	0900–1800	1800–2200	2200–0900
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45
R5 (See Note 3)	Areas with very dense transportation or in commercial districts or bordering industrial districts	60	55	50	60	55	50
R6 (See Note 3)	Areas with extremely dense transportation or within predominantly industrial districts	65	60	55	65	60	55

NOTES:

1 The division into noise area categories is necessary in order to accommodate existing sound levels encountered at residential sites in predominantly commercial or industrial districts, or in areas located close to main land transport routes, i.e. road and rail.

2 The noise area category most appropriate should be selected irrespective of metropolitan or rural zoning and will vary from location to location.

3 Some industrial and commercial sites are not predominant sources of high background sound levels.

Figure 1: Subject site and Logger Locations (Google Maps)

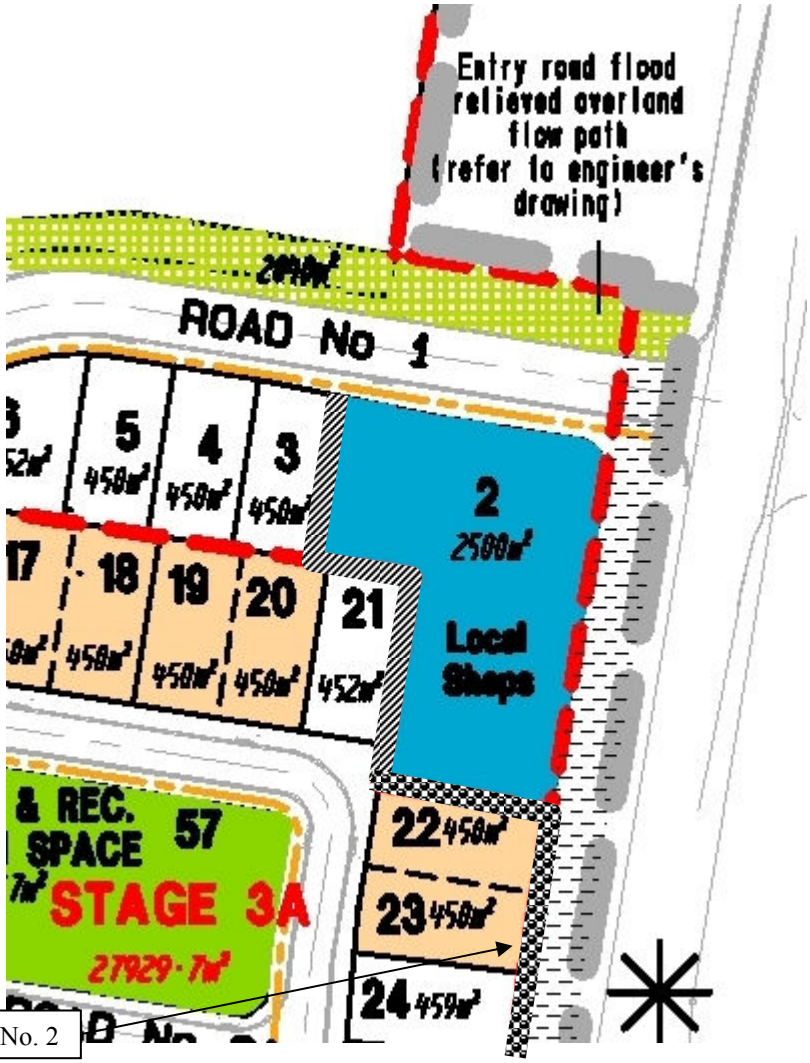
Figure 2: Subject site and Locale (Google Earth)

Sketch No. 1: Local Shop Site Recommended Acoustic Barriers (Not to Scale)

RETAIL CENTRE ACOUSTIC BARRIER LEGEND

Recommended 1.8m high acoustic barrier constructed above the finished ground or existing ground, whichever is higher.

Barriers are to be constructed free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlap), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of 11kg/m^2 is required).



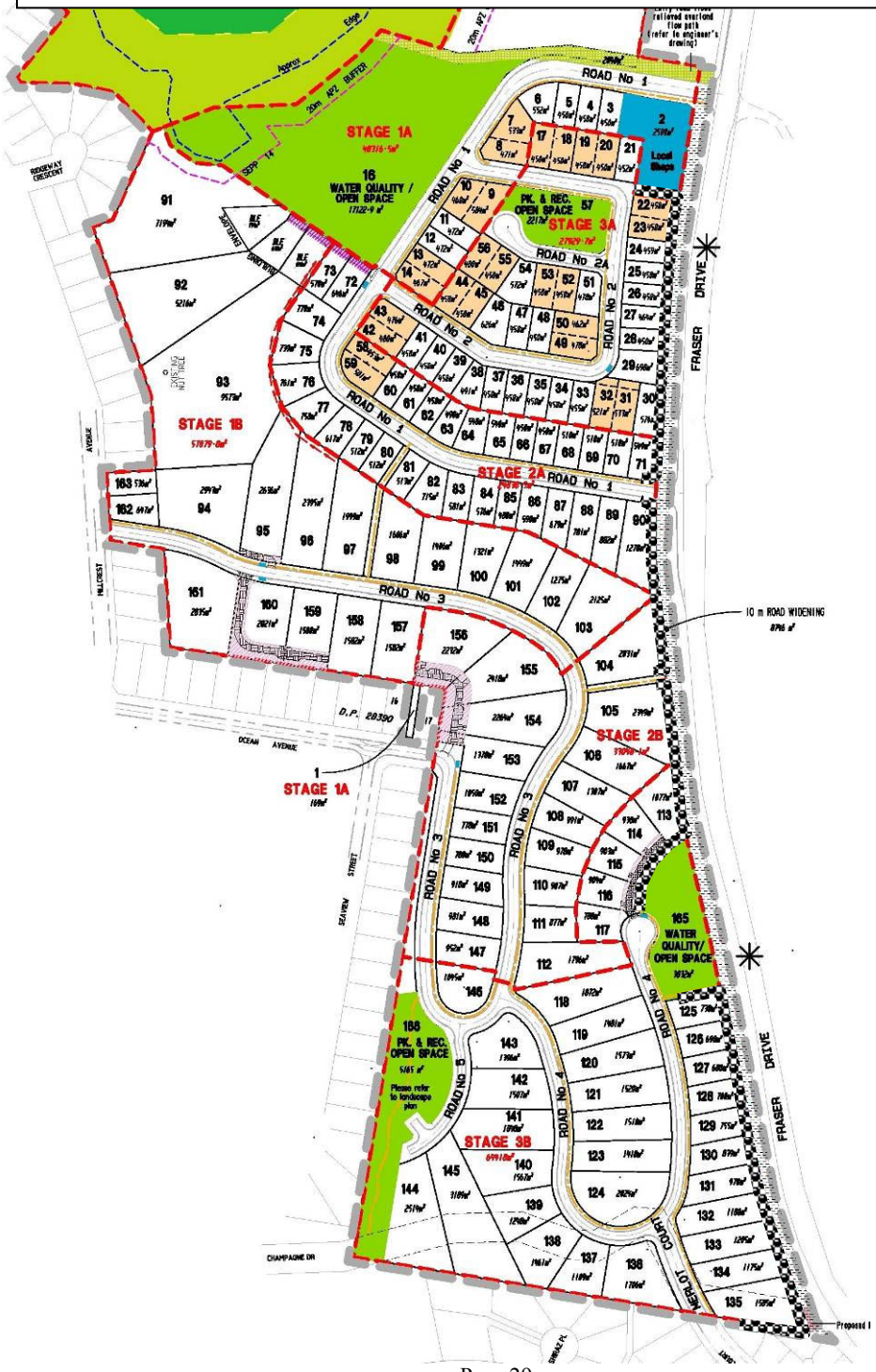
Refer to Sketch No. 2

Sketch No. 2: Development Site Layout and Recommended Acoustic Barriers (Not to Scale)

ROAD TRAFFIC NOISE ACOUSTIC BARRIER LEGEND

Recommended 2.0m high acoustic barrier constructed above the finished ground or existing ground, whichever is higher.

Barriers are to be constructed free of gaps and holes. Typical materials include earth berms, 19mm lapped timber fence (40% overlap), 6mm FC sheet, masonry, or a combination of the above (a minimum surface mass of 11kg/m^2 is required).



APPENDIX B

Development Plan

DEVELOPMENT STATISTICS

STAGE 1A (LOTS 1 - 16)

Total Stage Area	4.53 ha
Area of Open Space	
Water Quality (Lot 16)	1.712 ha
Flood Relieved Overland Flow Path	2040m²
Total No. of Residential Allotments	9
450 - 479m²	5
540m² +	1
duplex 600m² +	3 (6 Dwellings)
Future Integrated Housing Site	1
Local Shops Site	1
Battleaxe Handle Lot (Ocean Avenue)	1
Area of New Road	5064m²
Length of New Road	
18.0m Wide Road	291 m
15.0m Wide Road	44 m

STAGE 1B (LOTS 91-103 & 167-183)

Total Stage Area	5.71 ha
Total No. of Residential Allotments	20
510 - 539m²	1
540m² +	19
Area of New Road	4836.4m²
Length of New Road	
13.0m Wide Road	334 m

STAGE 2A (LOTS 58 - 90)

Total Stage Area	2.48 ha
Total No. of Residential Allotments	32
450 - 479m²	5
480 - 509m²	2
510 - 539m²	6
540m² +	18
duplex 600 m. +	1 (2 Dwellings)
Area of New Road	4544m²
Length of New Road	
15.0m Wide Road	333 m

STAGE 2B (LOTS 104-112 & 147-166 & 184)

Total Stage Area	9.79 ha
SEPP 14 Wetland Conservation (Lot 164)	6.48 ha
Total No. of Residential Allotments	19
540m² +	19
Area of New Road	6568.4m²
Length of New Road	
13.0m Wide Road	392 m

STAGE 3A (LOTS 17 - 57)

Total Stage Area	2.79 ha
Area of Open Space	
Park and Recreation (Lot 57)	2217m²
Total No. of Residential Allotments	31
450 - 479m²	17
480 - 509m²	1
510 - 539m²	0
540m² +	4
duplex 600 m. +	9 (18 Dwellings)
Area of New Road	6443m²
Length of New Road	
13.0m Wide Road	81.6 m
15.0m Wide Road	349 m

STAGE 3B (LOTS 113 - 146 & 165 - 166)

Total Stage Area	6.44 ha
Area of Open Space	
Park and Recreation (Lot 166)	5165m²
Water Quality (Lot 165)	3532m²
Total No. of Residential Allotments	34
540m² +	34
Area of New Road	9750m²
Length of New Road	
13.0m Wide Road	616 m
15.0m Wide Road	69 m

10m ROAD WIDENING 8746m²

LEGEND

- Stage Boundaries
- Building Location Envelope
- Park and Recreation / Water Quality
- SEPP 14 Wetland Conservation
- SEPP 14 Wetland 50m Buffer
- SEPP 14 Wetland 20m APZ Buffer
- 10m Wide Road Widening
- Right of Way Access
- Proposed Bin Pad Locations
- Proposed Bus Stop
- Proposed Footpath
- Entry Road Flood Relieved Overland Flow Path
- Duplex Lots
- Proposed Midden Site

NOTES: RESIDENTIAL LOT SUMMARY

Type	No Lots	No of Dwellings
Detached	132	132
Duplex	13	26
TOTAL	145	158

Note
All dimensions and areas are approximate only, and are subject to survey and Council approval.

Dimensions have been rounded to the nearest 0.1 metres.

The boundaries shown on this plan should not be used for final detailed engineers design.

Contours and SEPP 14 Wetland information sourced from B&P Surveys, Plan T14245-12045 E

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Proposed Subdivision
Fraser Drive, Tweed Heads South

Parish: Terranora	Our Ref: T14246	Scale: 1:2000 @ A1	
County: Rous	Date: 16/10/2009	Drawing No: 17900B-A	

APPENDIX C

Measurement Results and Model Calculations / Predictions

Coolangatta, Queensland
August 2009 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Sa	7.6	21.0	0			ESE	26	14:26	17.6	50		SSW	7	1025.1	19.8	47		ESE	17	1022.5
2	Su	8.2	21.6	0			ESE	26	12:53	16.9	74		SW	6	1027.1	20.0	56		E	17	1024.5
3	Mo	7.8	23.8	0			NNE	35	15:44	18.4	61		NW	15	1023.8	21.4	60		NNE	26	1019.8
4	Tu	8.9	21.8	0			N	22	18:47	17.7	70		SSW	9	1023.1	19.9	59		NE	13	1019.3
5	We	8.9	21.7	0			SE	26	15:35	17.4	79			Calm	1021.4	20.2	60		E	15	1019.7
6	Th	10.5	22.3	0			S	28	09:51	18.3	65		SSW	19	1023.7	20.5	55		SE	19	1020.4
7	Fr	8.8	22.0	0			NNE	28	16:15	18.2	69		WNW	2	1021.1	20.9	61		NNE	22	1016.5
8	Sa	10.3	20.0	0			S	46	09:59	17.4	55		S	26	1019.9	18.2	46		SSE	30	1017.8
9	Su	10.0	21.0	0			SW	28	04:07	17.5	56		SSW	11	1020.8	19.5	46		NE	15	1018.1
10	Mo	8.5	21.9	0			NNE	31	12:49	18.7	61		NW	9	1022.4	20.1	56		NNE	24	1019.7
11	Tu	7.8	22.5	0			NNE	37	14:55	19.8	58		WNW	17	1021.8	20.8	60		NNE	28	1017.7
12	We	15.5	23.0	0			NNW	52	14:08	19.0	64		NNW	20	1017.7	21.0	66		N	37	1012.3
13	Th	14.3	24.6	0			NNW	39	00:10	21.0	58		N	22	1015.5	22.8	61		ENE	13	1012.3
14	Fr	9.5	23.9	0			SE	37	14:46	20.5	36		SSW	13	1017.6	21.5	49		SE	24	1015.6
15	Sa	8.9	22.4	0			N	35	16:17	18.9	57		SSW	7	1021.3	21.2	57		N	26	1017.8
16	Su	8.6	23.7	0			N	41	15:35	19.0	68		N	17	1021.3	21.9	60		N	28	1016.8
17	Mo	15.4	27.7	0			N	46	12:59	21.2	62		NNW	24	1017.4	24.6	60		NNW	26	1013.5
18	Tu	15.7	22.4	0			S	46	02:22	18.7	46		S	26	1025.3	19.5	46		SSE	26	1024.3
19	We	14.3	22.6	0			ESE	30	15:41	19.0	60		SSW	13	1027.7	20.3	52		SE	22	1023.7
20	Th	8.8	21.9	0			NE	28	13:26	18.0	69		WSW	9	1022.8	20.1	55		NNE	19	1018.0
21	Fr	13.6	23.3	0			N	48	16:34	20.5	53		NNW	19	1017.1	22.0	70		N	33	1012.0
22	Sa	18.0	29.1	0			NNW	41	00:59	23.1	54		NNW	22	1013.0	24.1	58		N	28	1010.1
23	Su	11.8	28.3	0			N	28	15:22	22.1	77		N	13	1015.7	22.4	79		NNE	19	1011.7
24	Mo	18.6	31.7	0			NW	39	09:58	27.9	46		NNW	20	1012.9	24.7	65		N	26	1008.6
25	Tu	14.4	30.2	0			N	41	12:32	25.3	50		N	19	1010.8	24.6	65		N	28	1007.6
26	We	12.7	27.1	0			ENE	26	15:31	23.7	30		SSE	4	1016.1	24.5	42		NE	17	1013.6
27	Th	7.3	25.0	0			E	22	11:43	19.8	57		SE	6	1020.2	22.2	63		NE	17	1016.7
28	Fr	15.7	24.6	0			ENE	24	14:22	21.9	57		NNE	9	1018.2	22.7	75		NE	17	1014.7
29	Sa	13.9	24.3	0			N	52	15:42	20.4	85		N	20	1016.0	23.4	74		NNW	37	1009.9
30	Su	18.5	28.3	0			NE	31	13:16	23.7	54		WSW	6	1013.4	25.7	45		NNE	20	1011.3
31	Mo	13.2	21.2	1.4			N	24	12:31	15.4	67		WNW	7	1018.5	19.5	43		NE	15	1016.2
Statistics for August 2009																					
Mean		11.8	24.0							19.9	59			13	1019.6	21.6	57			22	1016.2
Lowest		7.3	20.0							15.4	30			Calm	1010.8	18.2	42		#	13	1007.6
Highest		18.6	31.7	1.4			#	52		27.9	85		S	26	1027.7	25.7	79		#	37	1024.5
Total				1.4																	

Observations were drawn from Coolangatta (station 040717)
Averages for Southport should be used as a guide only.

IDCJDW4036.200908 Prepared at 13:21 GMT on 2 Sep 2009

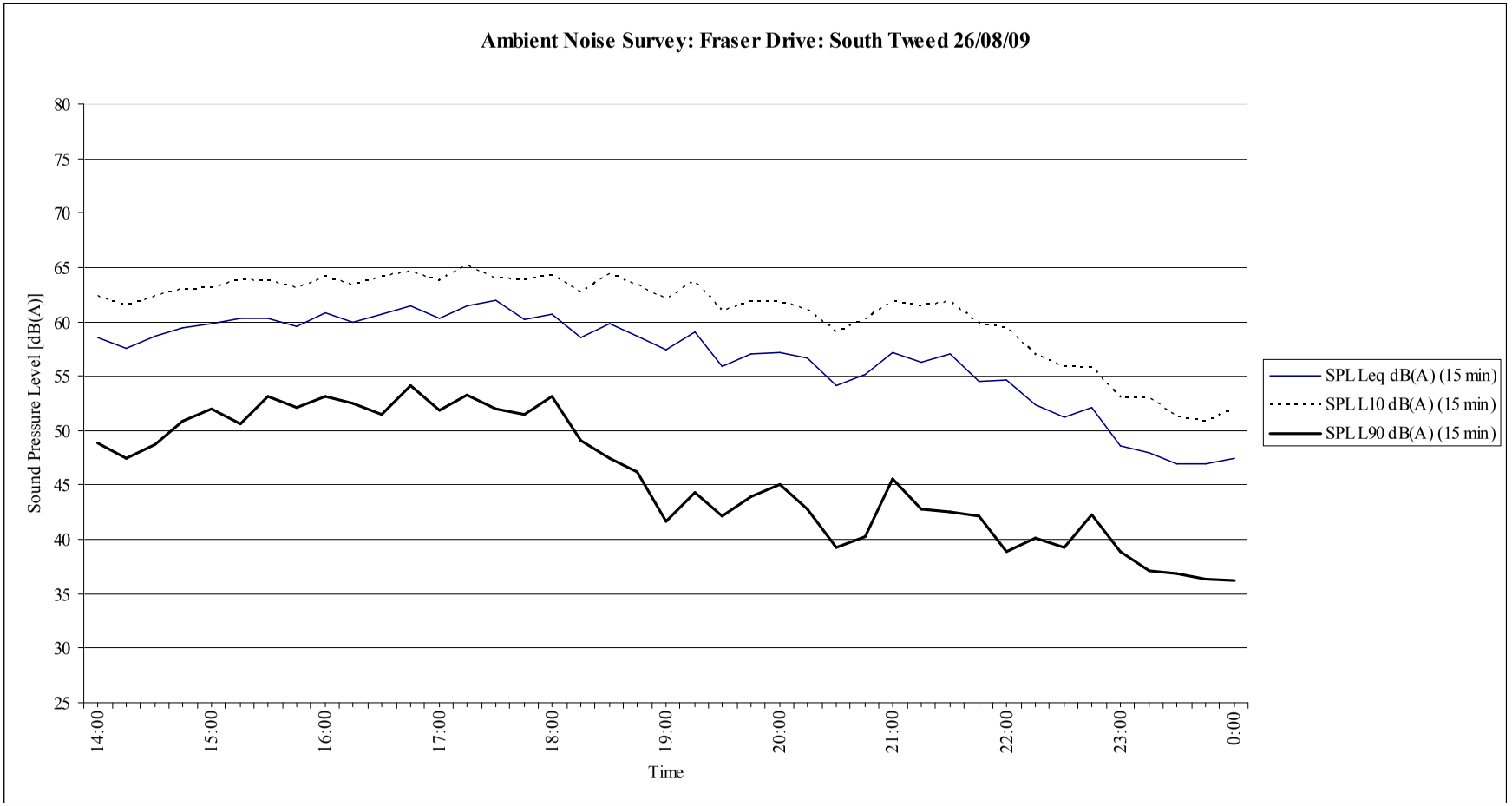
Coolangatta, Queensland
September 2009 Daily Weather Observations

Australian Government
Bureau of Meteorology

Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am						3pm					
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP
		°C	°C	mm	mm	hours		km/h	local	°C	%	eighths		km/h	hPa	°C	%	eighths		km/h	hPa
1	Tu	6.0	23.0	0.2			ESE	33	11:15	19.3	48		S	15	1022.0	21.2	54		ESE	19	1019.9
2	We	10.8	22.9	0			ENE	22	09:03	20.6	57		S	6	1024.4	21.3	58		NE	15	1021.9
3	Th	10.6	22.9	0			NNE	24	11:32	20.9	51		NE	9	1024.2	21.5	51		NE	13	1021.1
4	Fr	13.0	21.9	0.8			N	35	11:27	19.4	81		NW	13	1020.6	20.8	78		N	28	1016.1
5	Sa	15.1	24.2	3.0			SE	37	15:08	16.9	86		WSW	7	1013.5	22.1	61		SE	26	1012.8
6	Su	12.1		0.2						21.2	60		S	15	1018.4	21.8	63		ENE	19	1015.5
Statistics for the first 6 days of September 2009																					
	Mean	11.3	23.0							19.7	63			10	1020.5	21.5	60			20	1017.9
	Lowest	6.0	21.9							16.9	48		S	6	1013.5	20.8	51		NE	13	1012.8
	Highest	15.1	24.2	3.0			SE	37		21.2	86		S	15	1024.4	22.1	78		N	28	1021.9
	Total			4.2																	

Observations were drawn from Coolangatta (station 040717)
Averages for Southport should be used as a guide only.

IDCJDW4036.200909 Prepared at 06:26 GMT on 6 Sep 2009


Ambient Noise Survey: Fraser Drive: South Tweed 26/08/09
Sound Pressure Level [dB(A)]
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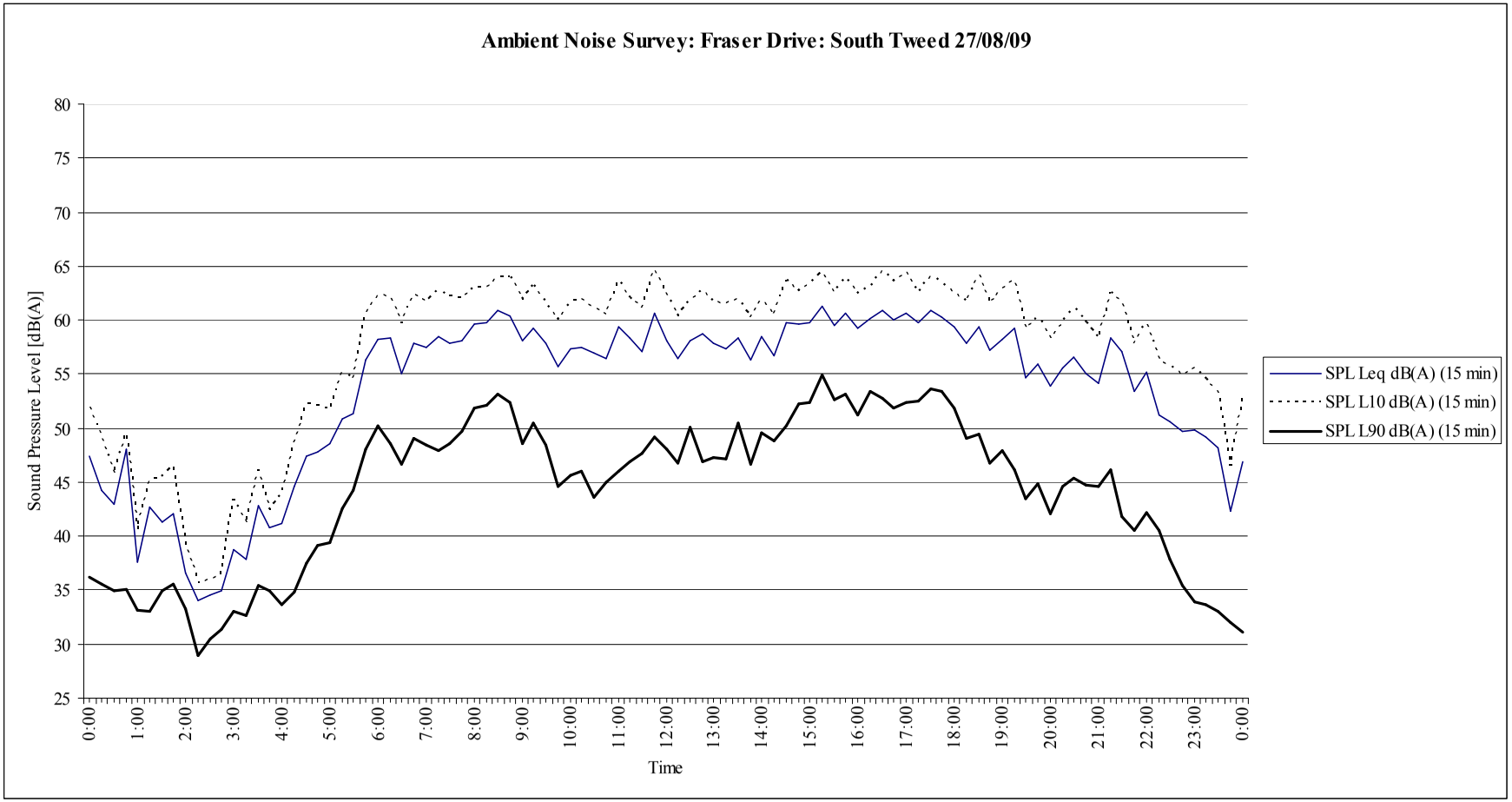
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 27/08/09
Sound Pressure Level [dB(A)]
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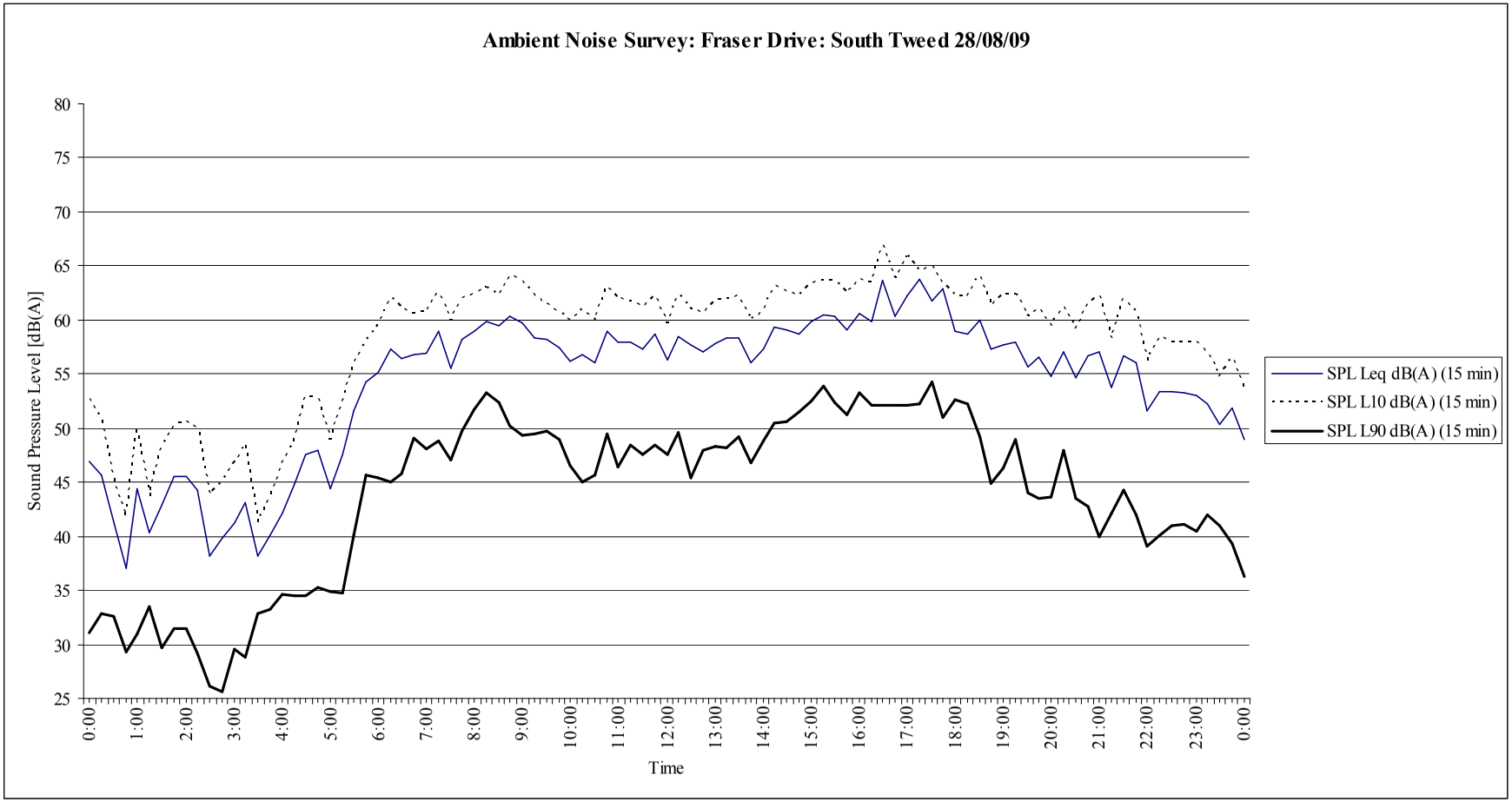
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 28/08/09
Sound Pressure Level [dB(A)]
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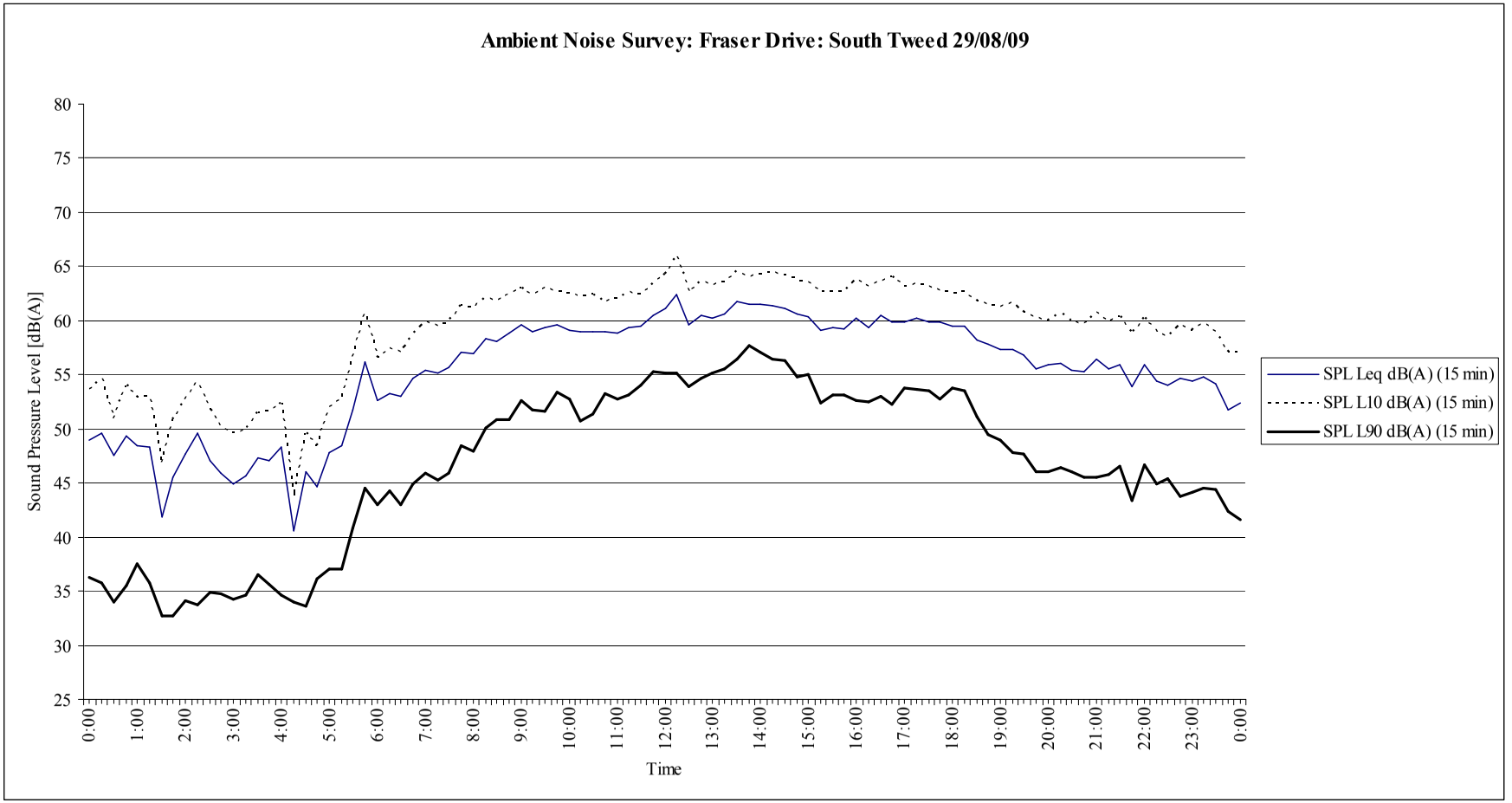
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 29/08/09
Sound Pressure Level [dB(A)]
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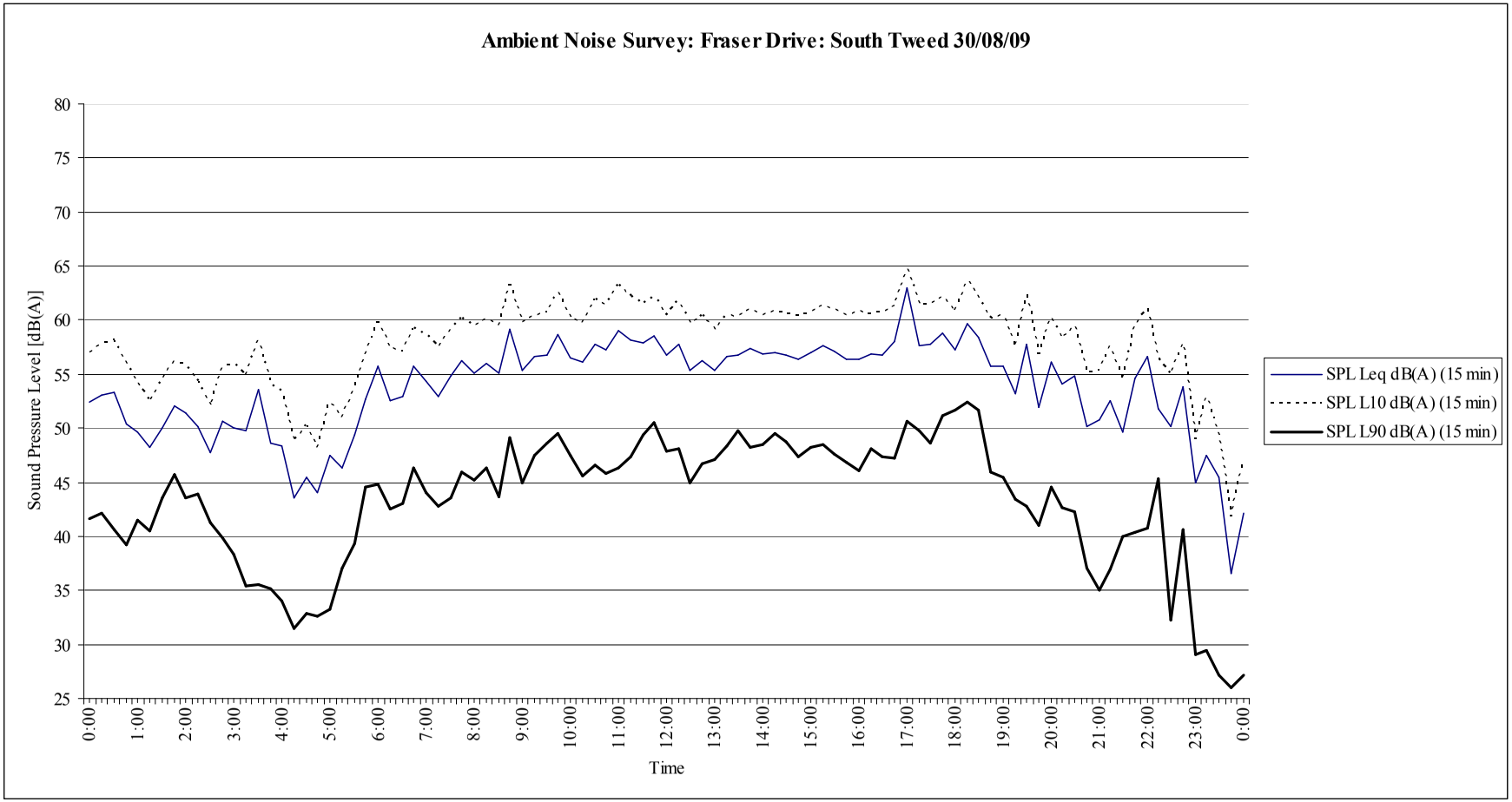
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 30/08/09
Sound Pressure Level [dB(A)]
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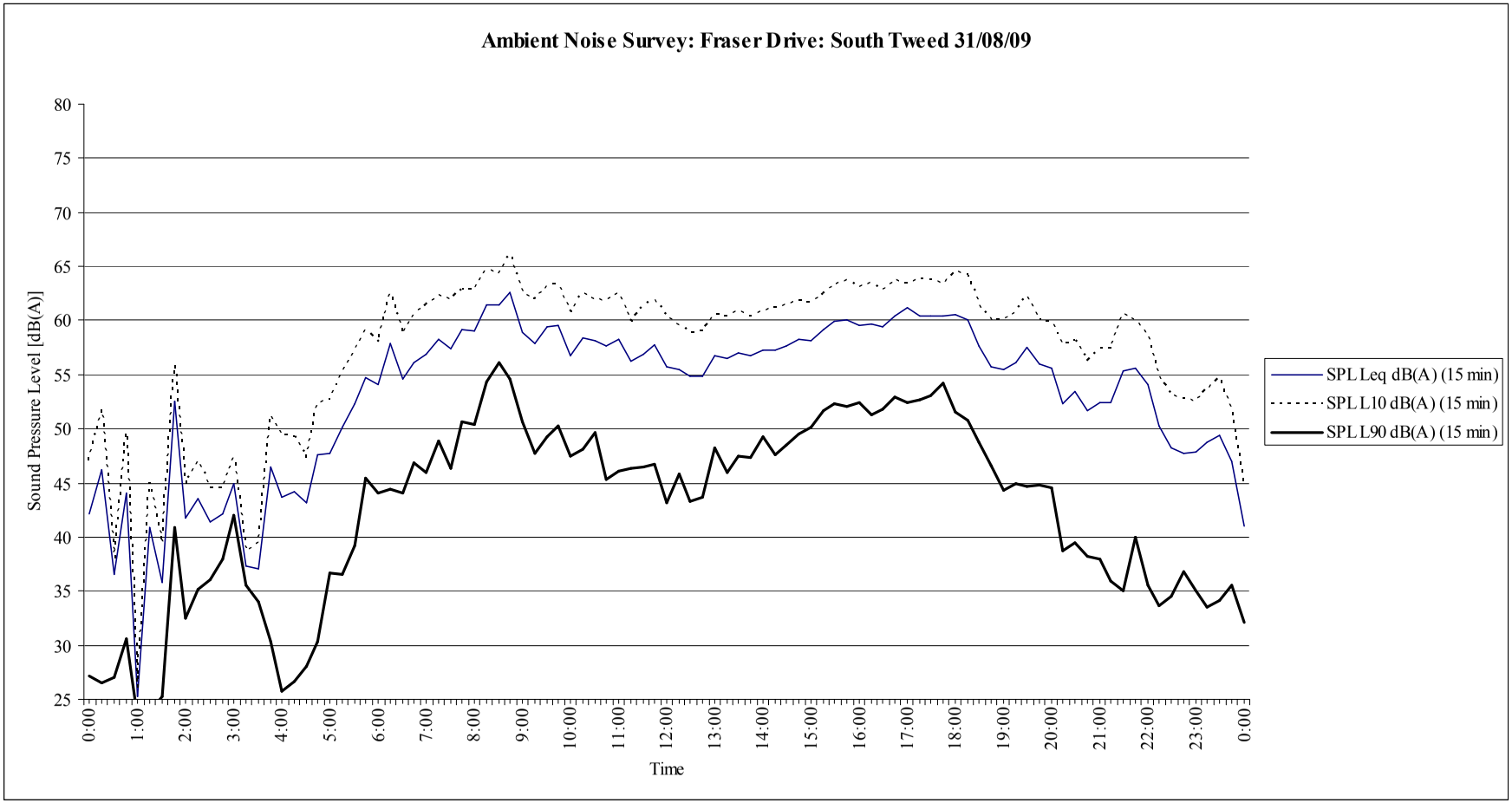
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 31/08/09
Sound Pressure Level [dB(A)]
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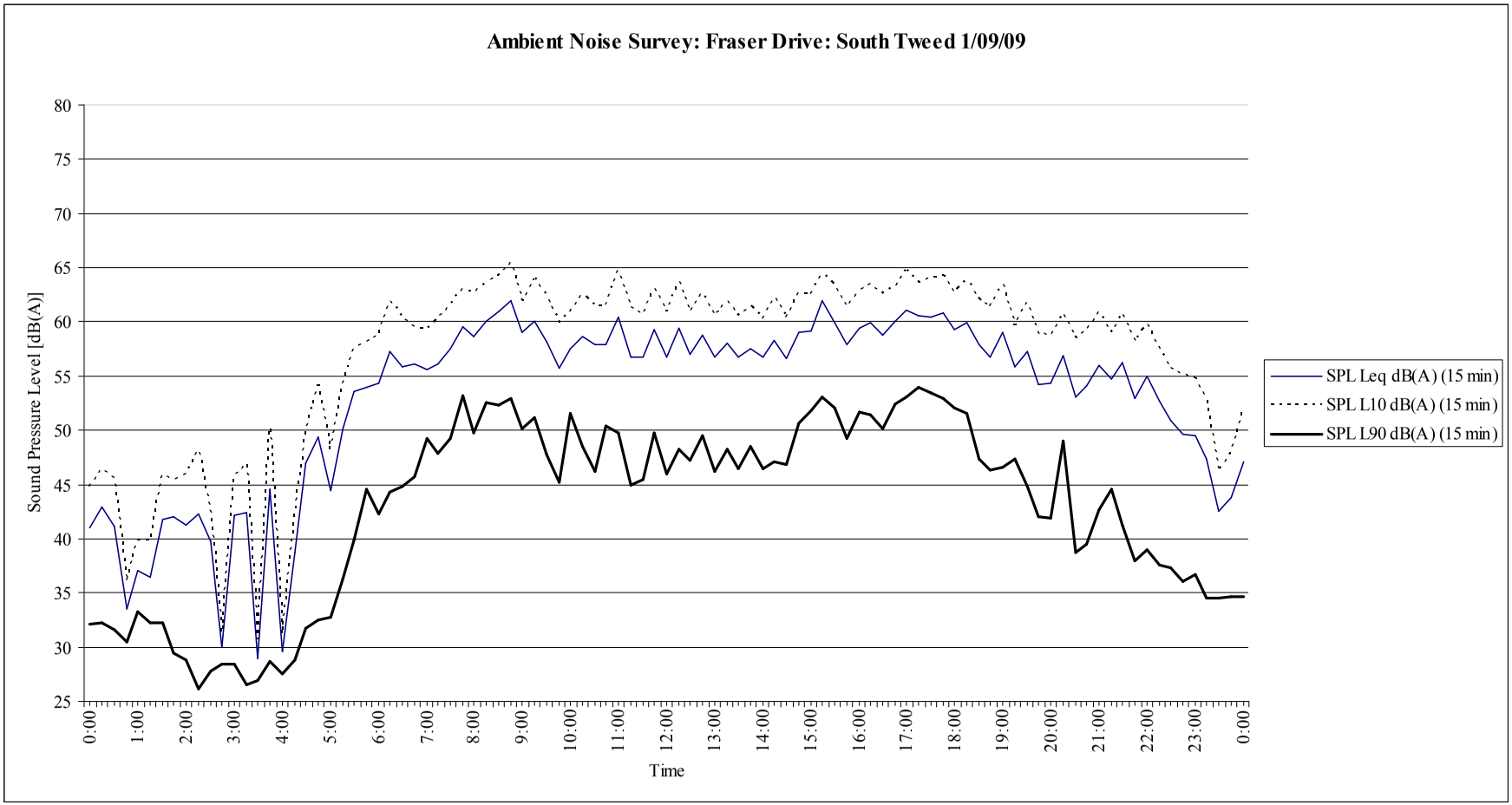
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 1/09/09
Sound Pressure Level [dB(A)]
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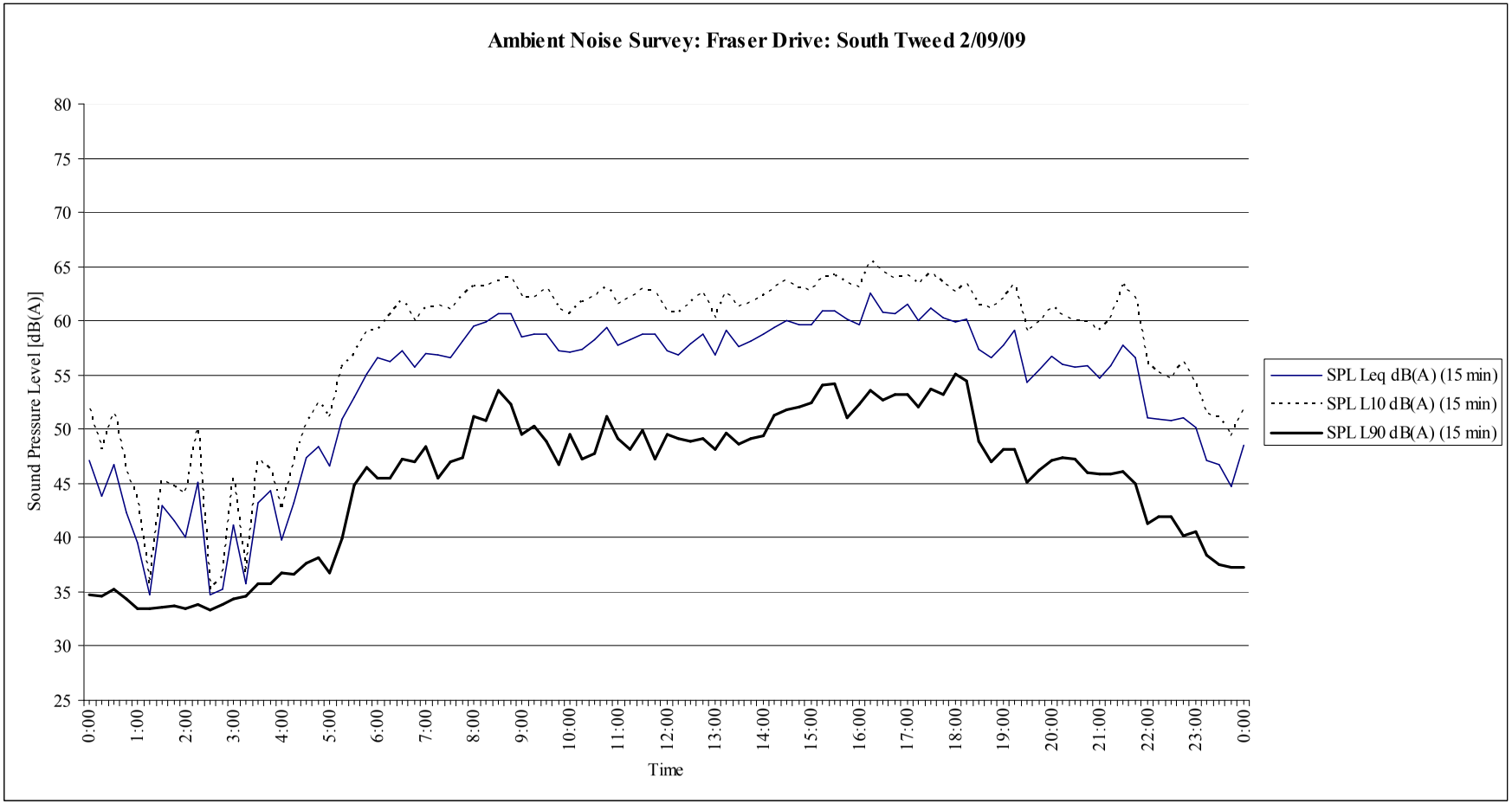
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 2/09/09
Sound Pressure Level [dB(A)]
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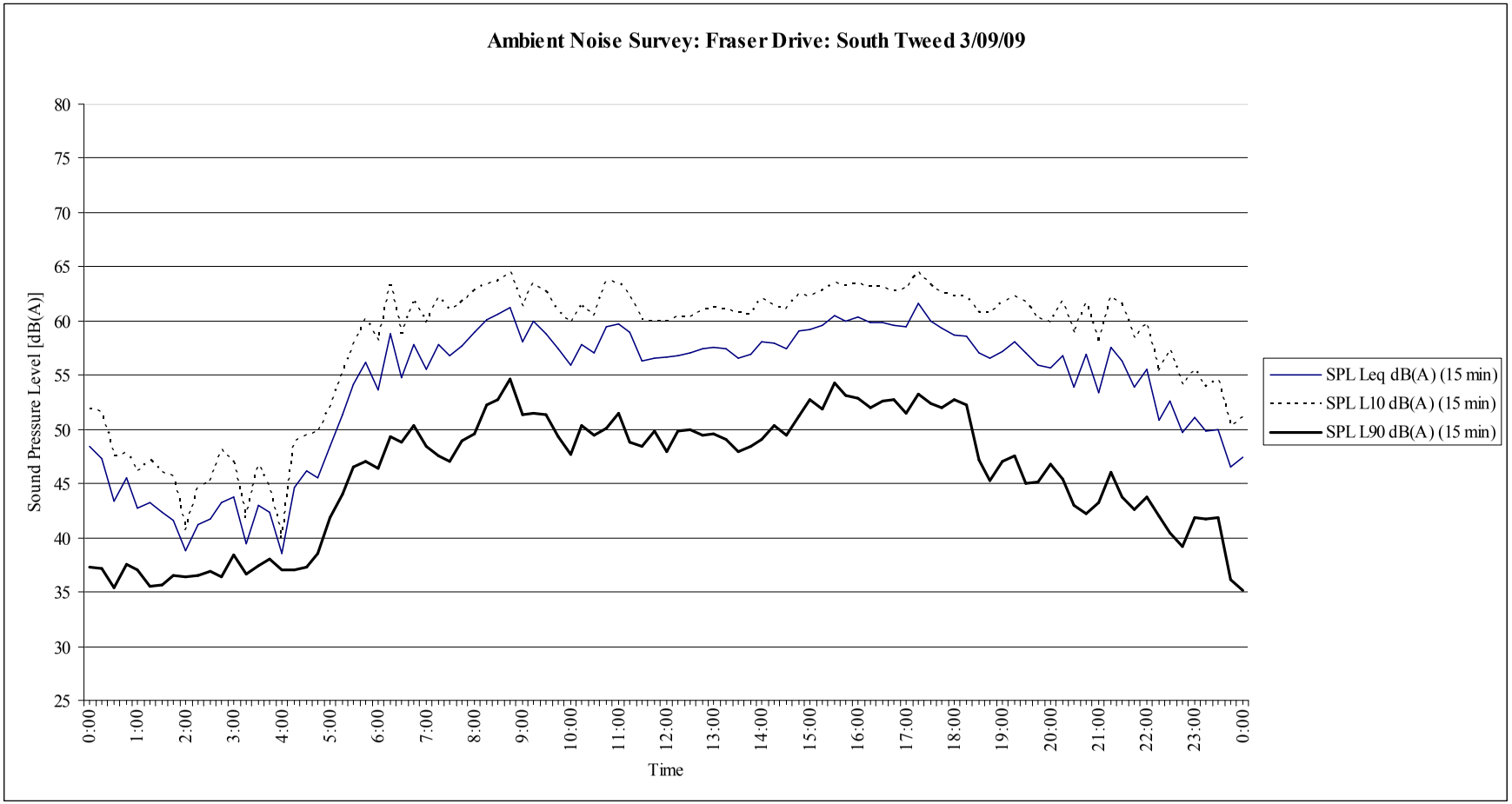
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 3/09/09
Sound Pressure Level [dB(A)]
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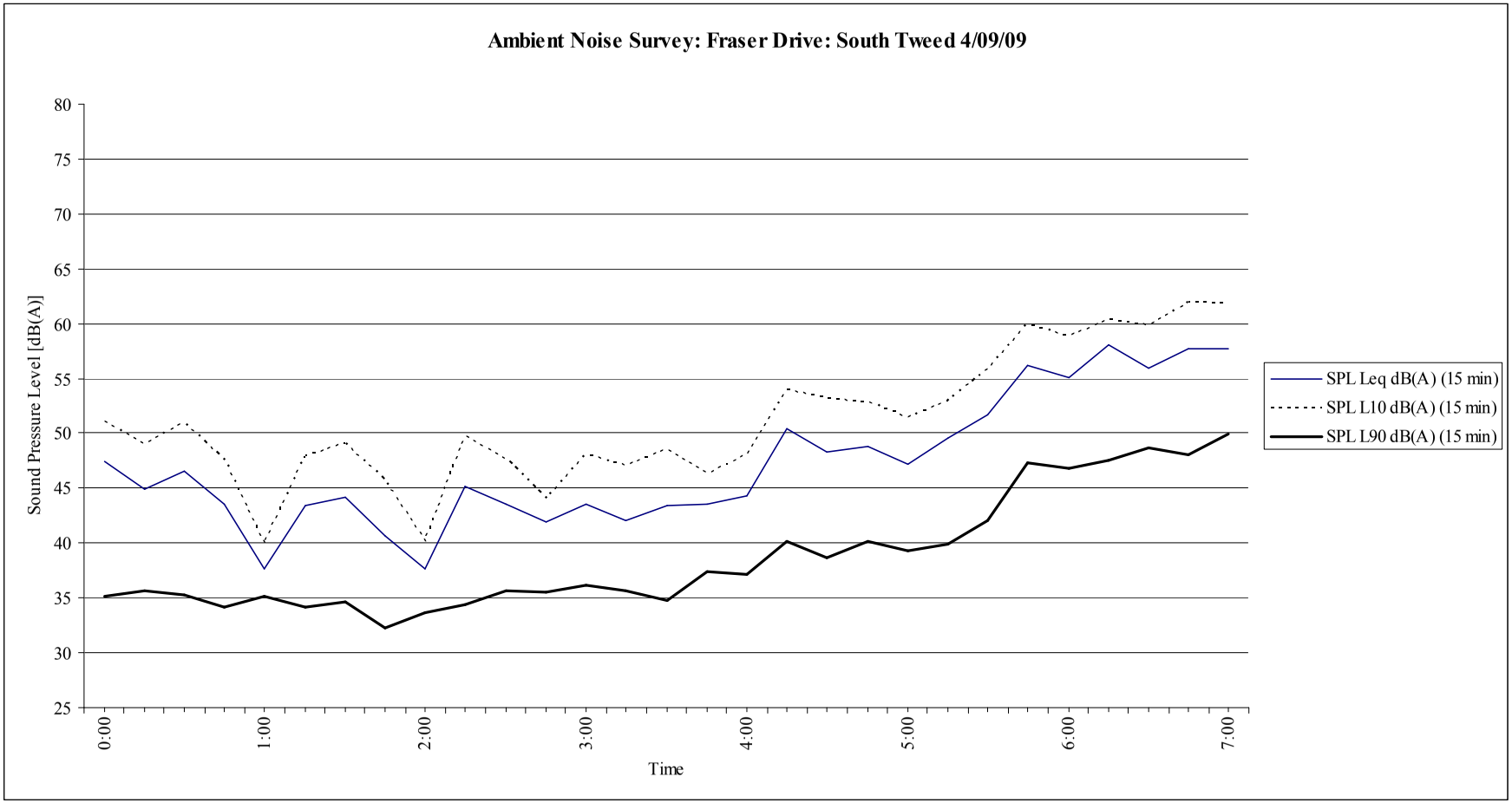
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Fraser Drive: South Tweed 4/09/09
Sound Pressure Level [dB(A)]
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Time
SPL Leq dB(A) (15 min)
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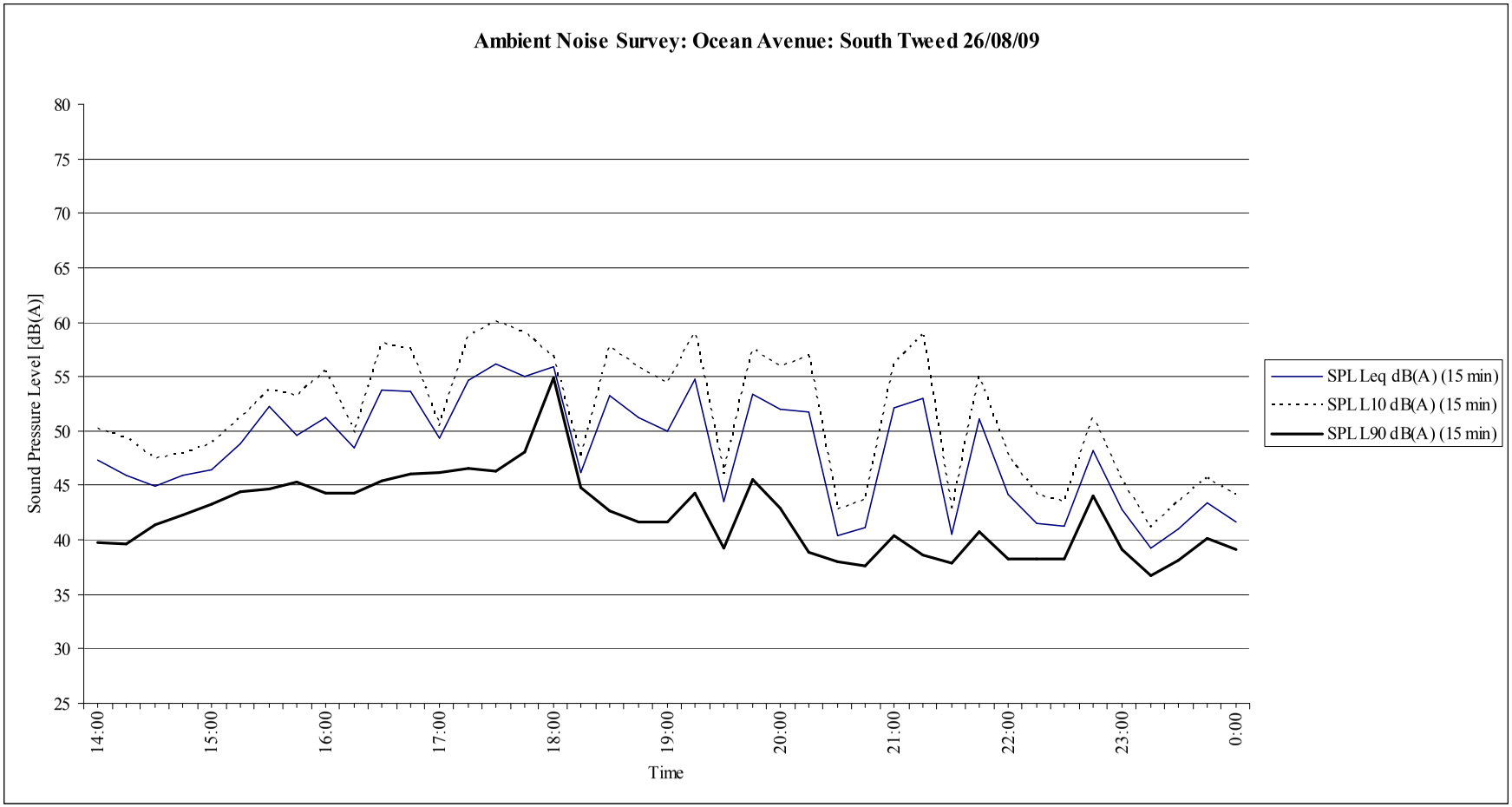
Ambient Noise Survey: Ocean Avenue: South Tweed 26/08/09
Sound Pressure Level [dB(A)]
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Time
SPL Leq dB(A) (15 min)
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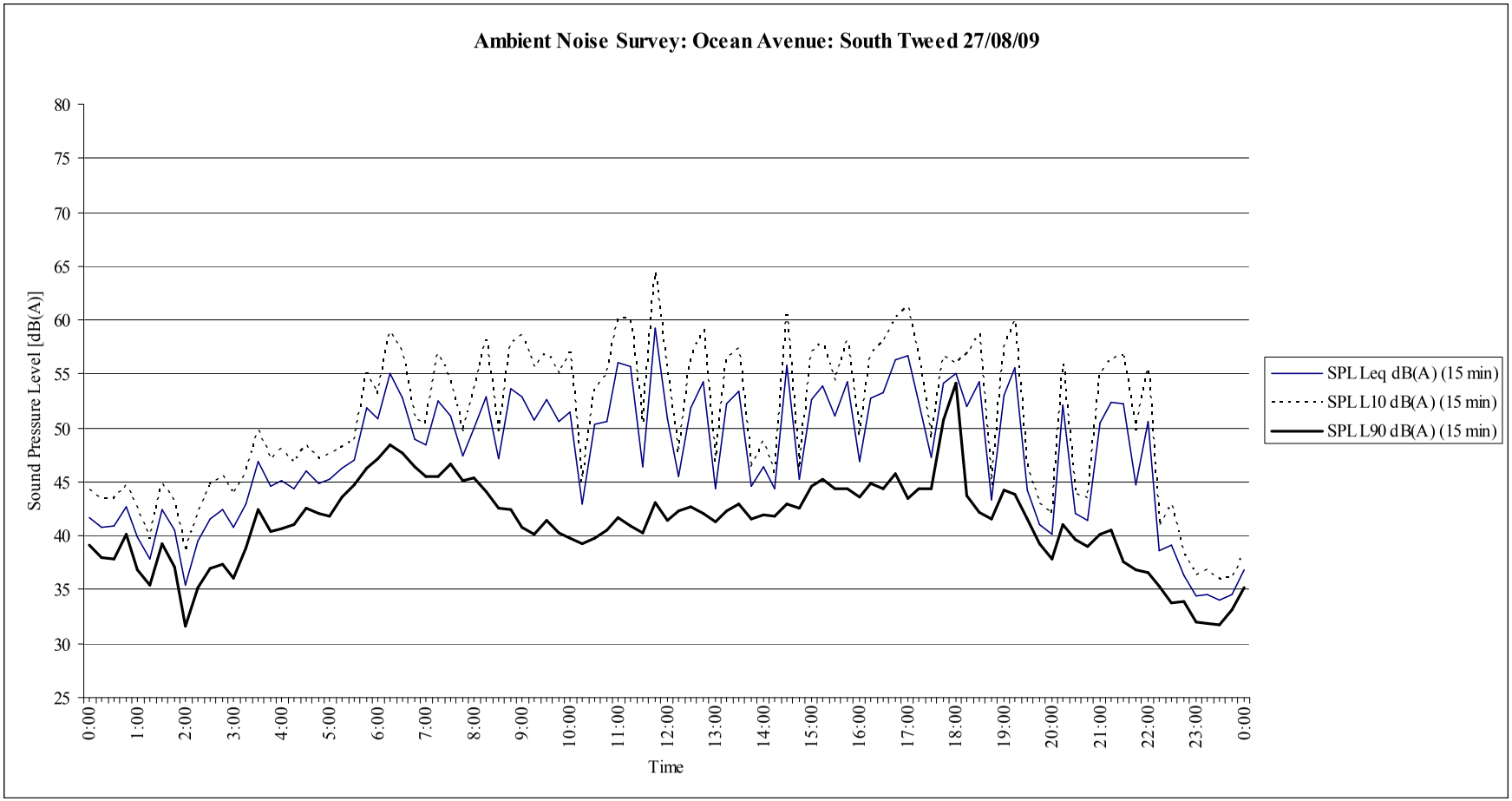
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Ocean Avenue: South Tweed 27/08/09
Sound Pressure Level [dB(A)]
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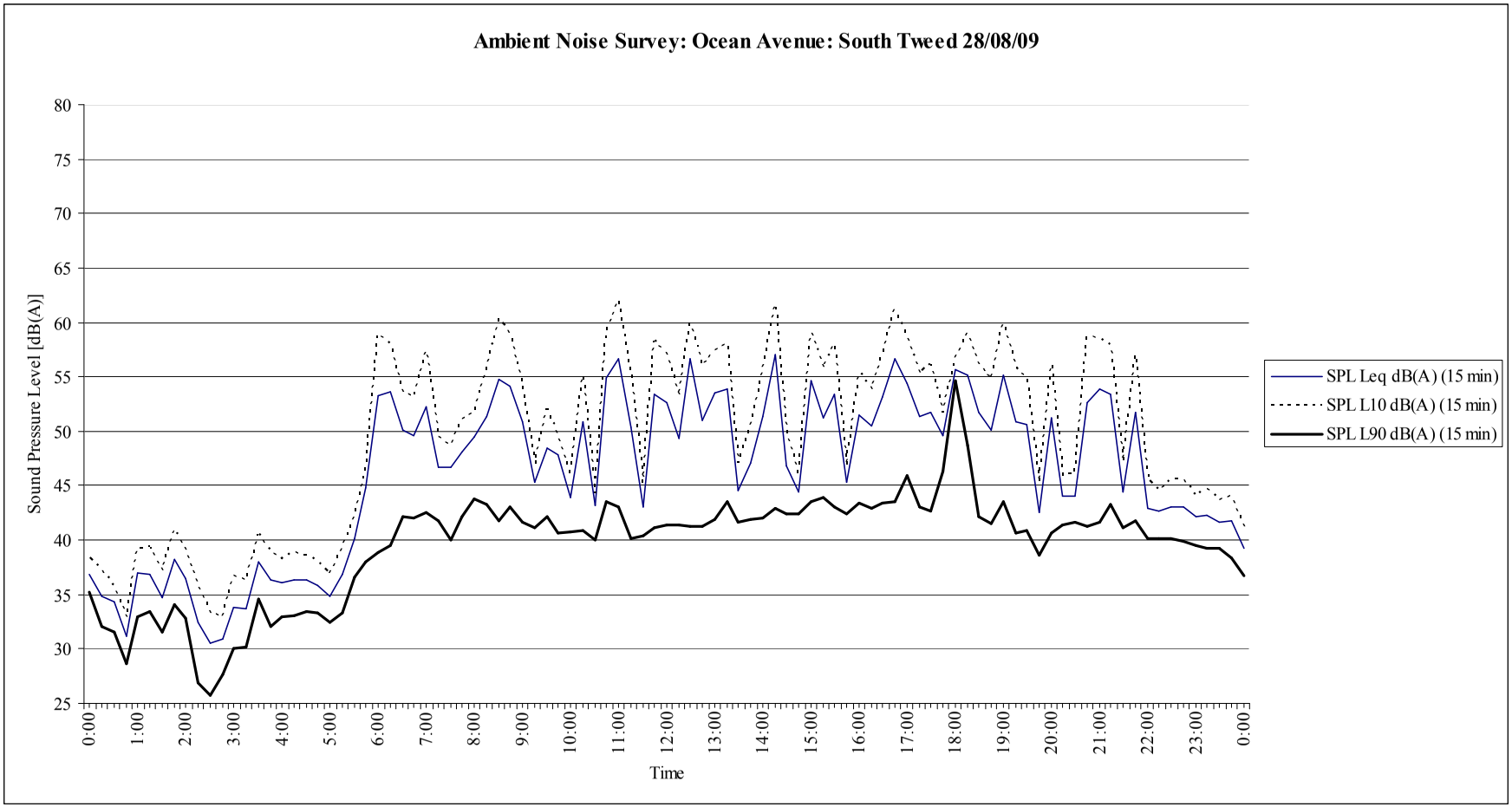
Ambient Noise Survey: Ocean Avenue: South Tweed 28/08/09
Sound Pressure Level [dB(A)]
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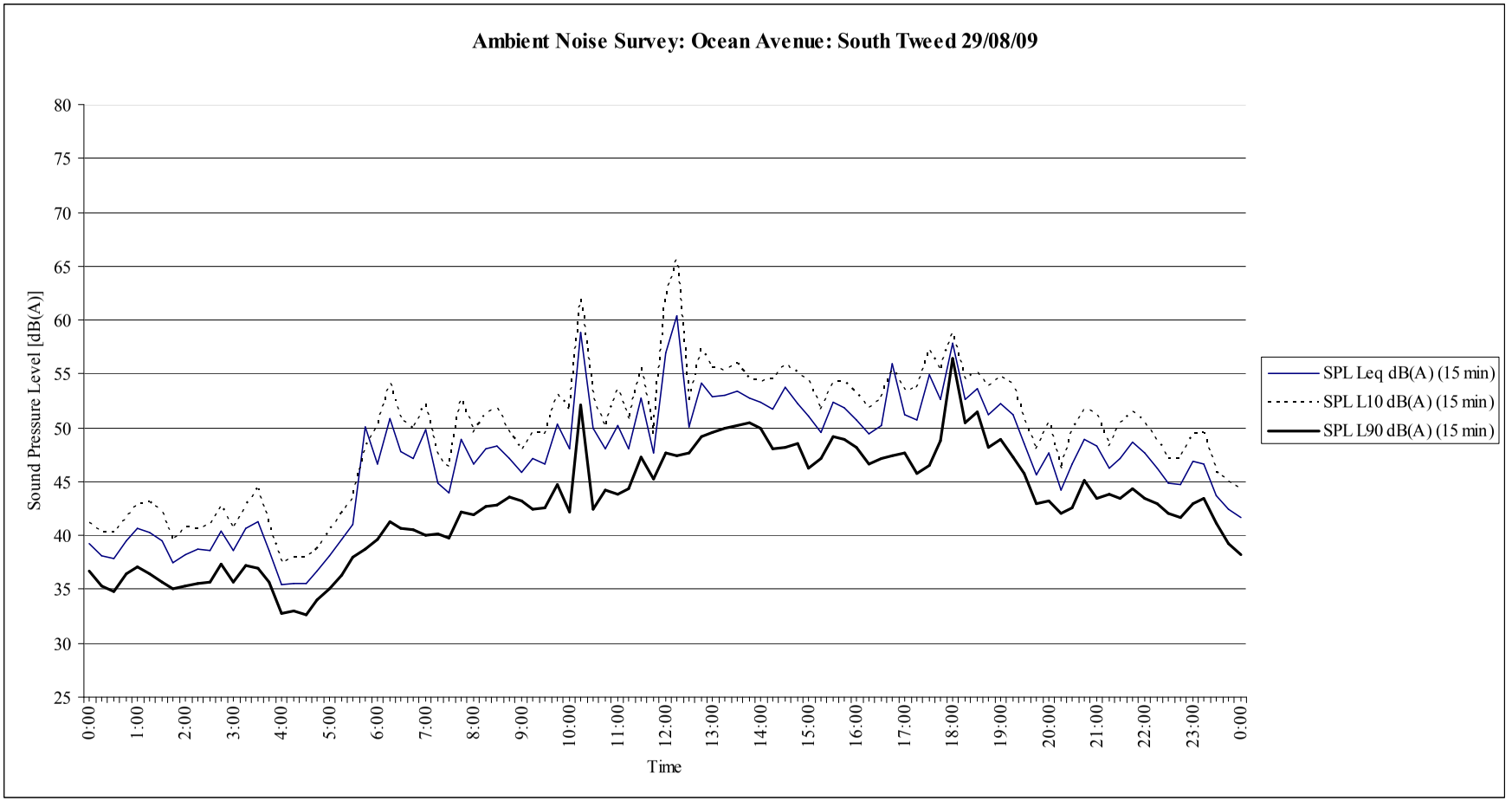
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Ocean Avenue: South Tweed 29/08/09
Sound Pressure Level [dB(A)]
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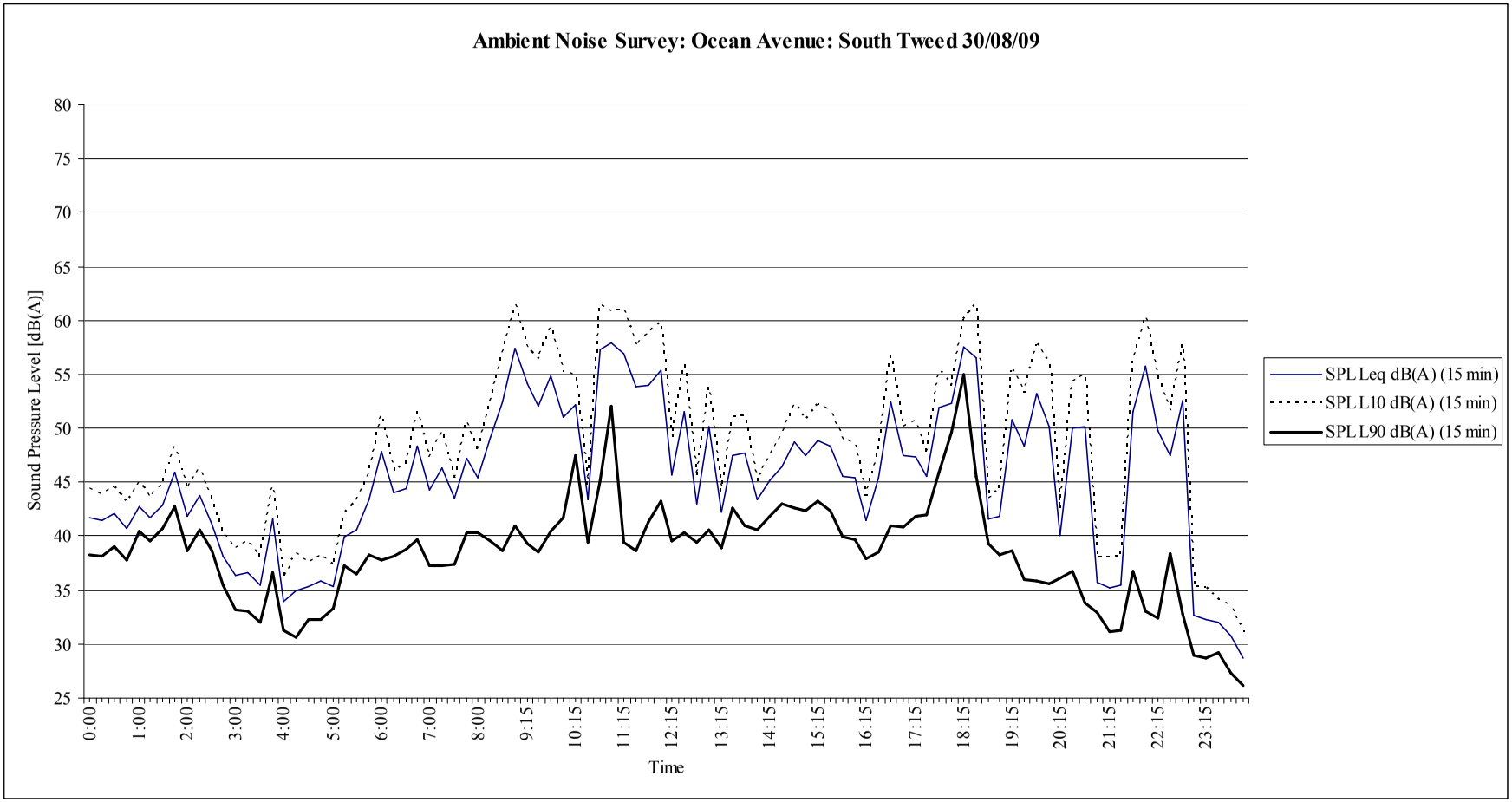
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Ocean Avenue: South Tweed 30/08/09
Sound Pressure Level [dB(A)]
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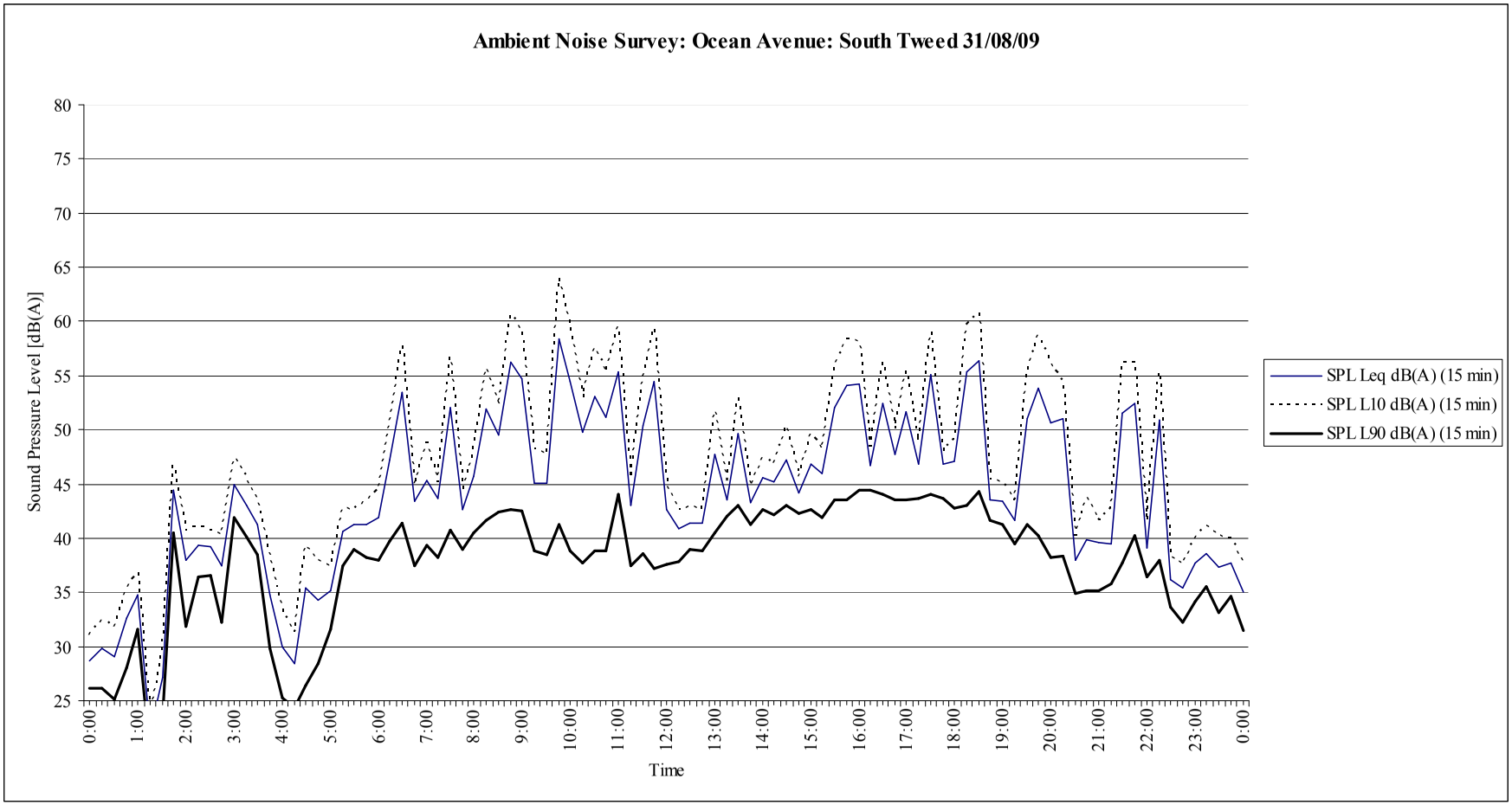
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Ocean Avenue: South Tweed 31/08/09
Sound Pressure Level [dB(A)]
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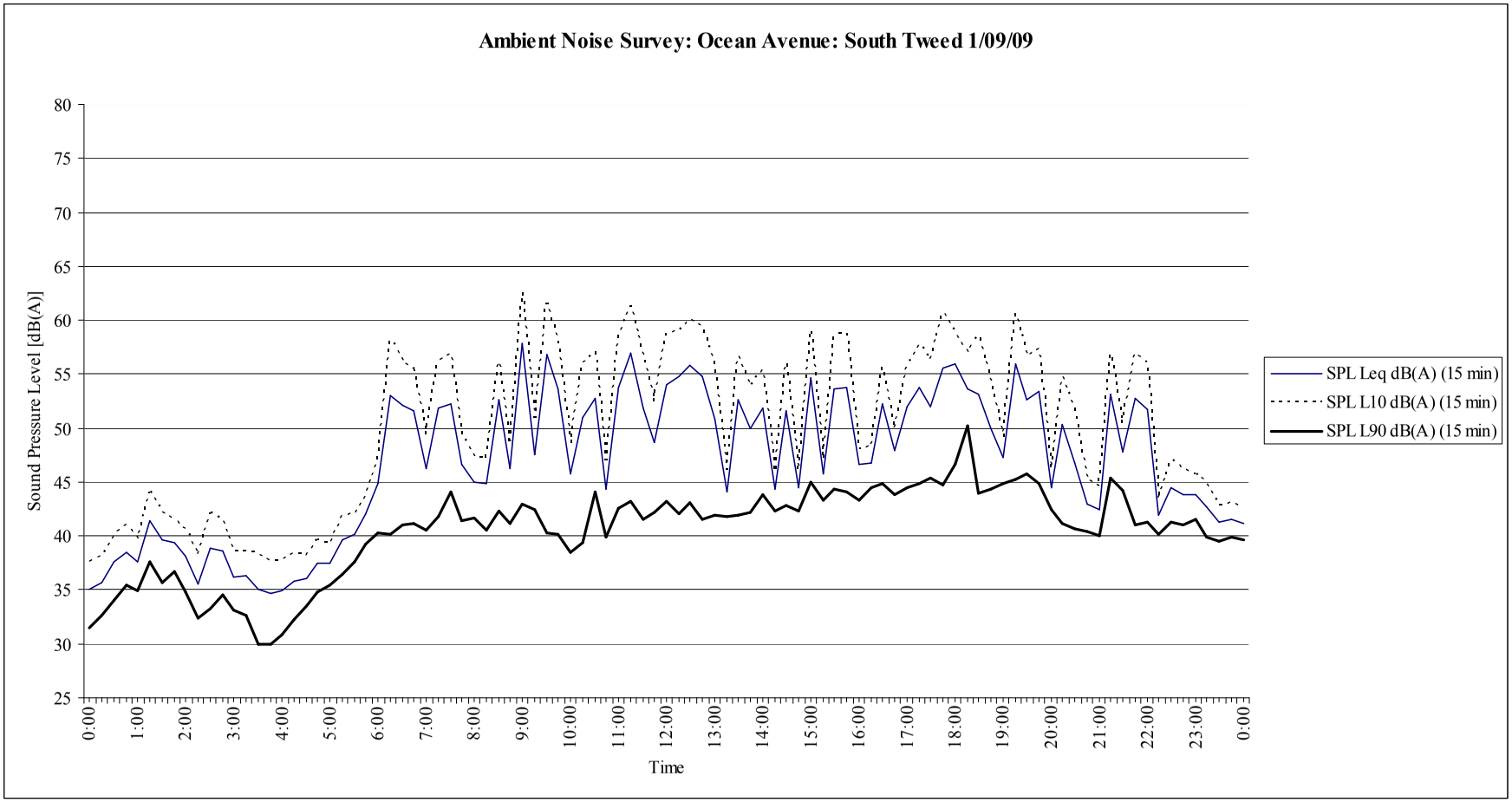
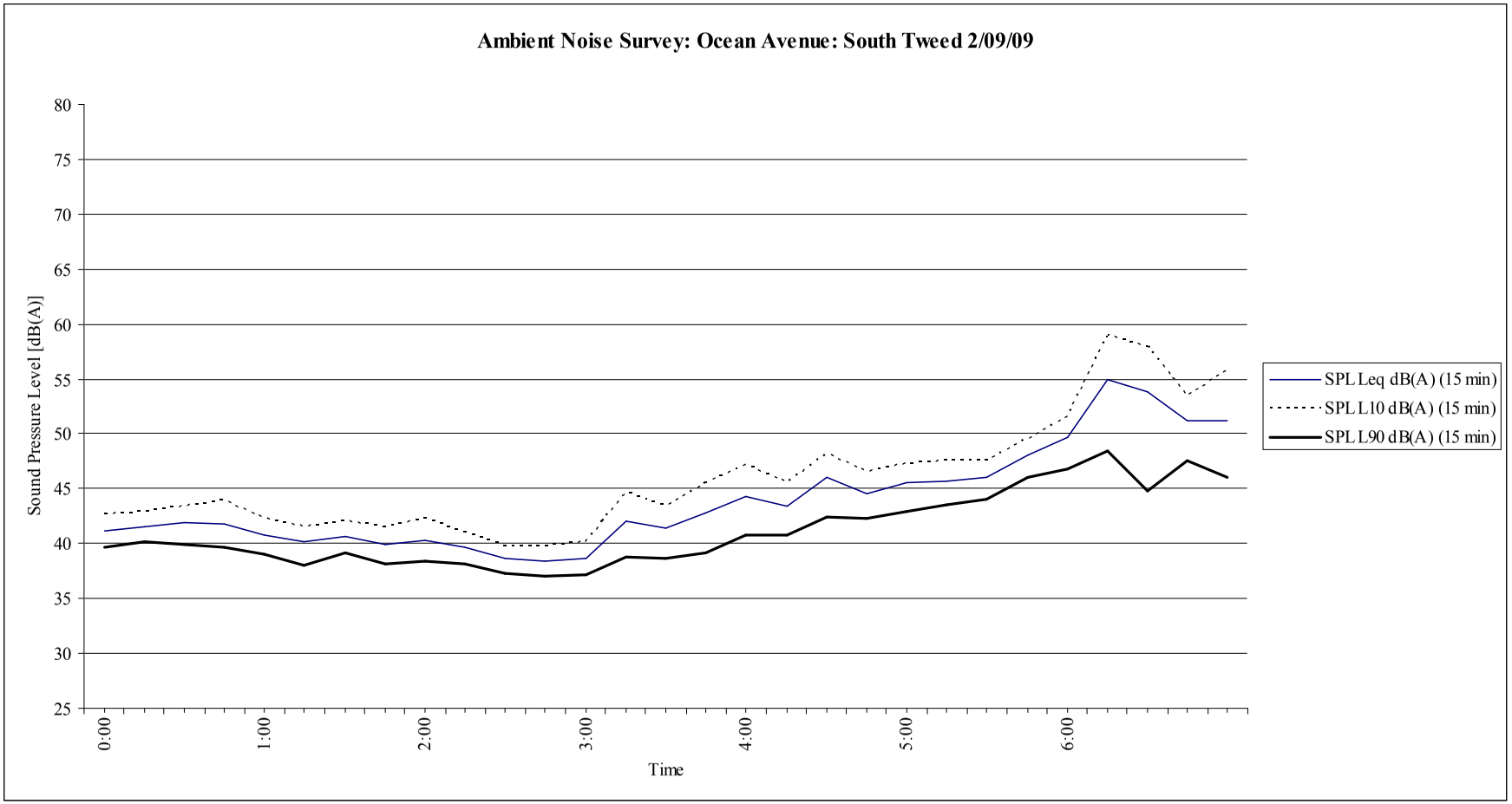
19:00
20:00
21:00
22:00
23:00
0:00
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Ocean Avenue: South Tweed 1/09/09
Sound Pressure Level [dB(A)]
80
75
70
65
60
55
50
45
40
35
30
25
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)


Ambient Noise Survey: Ocean Avenue: South Tweed 2/09/09
Sound Pressure Level [dB(A)]
80
75
70
65
60
55
50
45
40
35
30
25
0:00
1:00
2:00
3:00
4:00
5:00
6:00
Time
SPL Leq dB(A) (15 min)
SPL L10 dB(A) (15 min)
SPL L90 dB(A) (15 min)

POINT CALCULATIONS
Pen3D2000 V1.9.8.1
Project Code:09097a
Project Description:Noise assessment: Fraser Dr - Tweed Heads, NSW
File:Z:\ACOUSTICS\09097a Frasers Dve Tweed Heads South RTN\PEN\09097a_existing.PEN
File Description:Data file covering existing

Monday 07 Sep, 2009 at 16:17:12
CoRTN Calculations
All road segments included. Segmentation angle: 1degrees. Road elevations apply.

Receptor	X Posn (m)	Y Posn (m)	Height (m)	Leq(24hour) (dB(A))
logger a	987.5	4990.5	1.2	57.4 free-field

POINT CALCULATIONS
Pen3D2000 V1.9.8.1
Project Code:09097a
Project Description:Noise assessment: Fraser Dr - Tweed Heads, NSW
File:Z:\ACOUSTICS\09097a Frasers Dve Tweed Heads South RTN\PEN\09097a_ultimate 2m barrier feb2010.PEN
File Description:Data file covering ultimate 2m barrier

Tuesday 16 Feb, 2010 at 14:02:30
CoRTN Calculations
All road segments included. Segmentation angle: 1degrees. Road elevations apply.

Receptor	X Posn (m)	Y Posn (m)	Height (m)	Leq(24hour) (dB(A))
3	872.9	5807.3	1.8	54.9
4	858.2	5809.5	1.8	53.6
5	843.8	5811.7	1.8	52.3
6	828.4	5813.6	1.8	51.3
7	810.6	5795.7	1.8	50.1
8	808.5	5782.9	1.8	49.8
9	785.4	5742.8	1.8	48.5
10	771.7	5750	1.8	48
11	770.6	5720.7	1.8	48
12	762.1	5709.2	1.8	47.7
13	754.6	5696.6	1.8	47.4
14	747.2	5686	1.8	47.1
15	890	5909.4	1.8	56.6
16	738.8	5760.9	1.8	46.5
17	824	5784.1	1.8	50.7
18	838.5	5783	1.8	51.2
19	854.2	5781	1.8	51.7
20	868.1	5778.1	1.8	50.5
21	882.6	5777.1	1.8	47.8
22	907.8	5741.4	1.8	59.8
23	905.5	5726.8	1.8	59.8
24	903.2	5713	1.8	59.8
25	902.2	5698.9	1.8	60.1
26	900.6	5683.5	1.8	61.1
27	899.6	5669.2	1.8	59.5
28	899.1	5653.9	1.8	59.5
29	898	5634.7	1.8	59.7
30	896.2	5605	1.8	60.2
31	879.6	5606.3	1.8	55.9
32	865.9	5606.7	1.8	54.3
33	849.9	5609.9	1.8	52.7

34	835.5	5611.9	1.8	51.3
35	820.7	5614	1.8	50.2
36	805.6	5616.5	1.8	49.3
37	791.3	5619.9	1.8	48.5
38	776.4	5621.2	1.8	48
39	763.9	5631.2	1.8	47.6
40	751.3	5639.6	1.8	47.1
41	738.8	5648.3	1.8	46.7
42	722	5649.4	1.8	46.2
43	725.3	5656	1.8	46.3
44	764.9	5684.1	1.8	47.7
45	776.7	5677	1.8	48.2
46	792.6	5666	1.8	48.9
47	807.9	5663.4	1.8	49.5
48	822.8	5659.8	1.8	50.3
49	854.2	5646.4	1.8	52.7
50	853.8	5656	1.8	52.5
51	855.3	5685.7	1.8	52.5
52	839.5	5689	1.8	51.1
53	825.9	5689.9	1.8	50.5
54	809.5	5691.3	1.8	49.7
55	794.4	5700.8	1.8	49
56	781.8	5708.7	1.8	48.4
57	860.8	5729.6	1.8	52.5
58	715.5	5635.3	1.8	45.9
59	710.4	5629.9	1.8	45.7
60	723.4	5622.2	1.8	46.1
61	736.5	5614.7	1.8	46.7
62	749.6	5607.1	1.8	47.2
63	763.1	5600.2	1.8	47.6
64	779	5594.8	1.8	48.3
65	796.9	5590.7	1.8	49.1
66	811.3	5587.6	1.8	50
67	826.1	5585.5	1.8	51.2
68	843	5582.7	1.8	52.9
69	860.1	5579.6	1.8	54.8
70	876.5	5577.3	1.8	56.9
71	893.9	5574.5	1.8	59.6
72	691	5689	1.8	45.4
73	677.1	5697.8	1.8	45.4
74	674.3	5664	1.8	44.8
75	665.1	5645.8	1.8	44.5
76	666.1	5630.1	1.8	44.4
77	680.7	5609.9	1.8	44.8
78	695	5600.7	1.8	45.3
79	708.3	5591.5	1.8	45.7
80	721.9	5582.5	1.8	46.2
81	739.3	5570.8	1.8	46.7
82	751	5556.2	1.8	47.3
83	768.2	5549.2	1.8	48.1
84	785.6	5545.6	1.8	49
85	800.2	5543.1	1.8	49.9
86	818.7	5539.7	1.8	51.4

87	835.8	5534.3	1.8	53.1
88	853.2	5529	1.8	55
89	870.1	5523.3	1.8	57.4
90	891.1	5512.3	1.8	60.8
91	644.9	5740.5	1.8	44.8
92	657.2	5732.1	1.8	44.9
93	639.5	5608.4	1.8	45.1
94	614.6	5537.8	1.8	46.2
95	644	5540.3	1.8	46.5
96	672.2	5537.7	1.8	46.8
97	698.9	5529.8	1.8	47.1
98	732.9	5519	1.8	48.3
99	762.3	5510.1	1.8	50.2
100	790.2	5505.4	1.8	52
101	817.6	5495.2	1.8	53.9
102	839.4	5482.9	1.8	55.6
103	892.1	5480.3	1.8	60.2
104	896.7	5449.1	1.8	57.3
105	903.1	5397.1	1.8	60.1
106	900.2	5364.6	1.8	61.9
107	876.4	5343.1	1.8	58.3
108	858.2	5322.9	1.8	56
109	850	5307.3	1.8	55.3
110	841.6	5281.7	1.8	54.5
111	839.2	5257.4	1.8	54
113	909.9	5340.8	1.8	60.1
114	901.2	5310.9	1.8	57.5
115	890.5	5298.1	1.8	55.8
116	882.2	5275	1.8	54.8
117	870.5	5255.8	1.8	54.1
112	873.5	5236.6	1.8	54.4
118	880.2	5218.4	1.8	55
119	888.1	5197.2	1.8	54.9
120	895.8	5173.4	1.8	54.2
121	901.7	5147.3	1.8	54.6
122	903.7	5122.4	1.8	55.6
123	903.2	5099.6	1.8	55.8
124	901.9	5079.9	1.8	55.6
125	938.8	5201.3	1.8	61.5
126	943.1	5182.3	1.8	60.9
127	946.5	5162.1	1.8	60.6
128	950.3	5142.6	1.8	60.4
129	954.1	5123.2	1.8	61.5
130	958	5104	1.8	61.3
131	962	5083.5	1.8	61.6
132	965.9	5065.3	1.8	60.7
133	972.5	5046.1	1.8	60.3
134	978.7	5026.9	1.8	59.6
135	987.4	5000.6	1.8	58.6
136	900.5	5017.2	1.8	50.7
137	859.1	5021.9	1.8	48.6
138	842.5	5045.7	1.8	49.4
139	828.9	5060.8	1.8	49.9

140	823	5080.8	1.8	50.2
141	824.3	5114.6	1.8	50.7
142	820.7	5145.8	1.8	50.2
143	811.5	5177.3	1.8	50.5
144	747.2	5056.2	1.8	44.1
145	780.5	5061.3	1.8	45.6
146	781.6	5213.6	1.8	50.6
147	786.8	5236.4	1.8	49.5
148	789.6	5258.7	1.8	49.9
149	789.3	5279.9	1.8	50.4
150	790.1	5301.2	1.8	50.4
151	792.9	5321.4	1.8	50.5
152	799.6	5342.9	1.8	51.1
153	811.4	5367	1.8	51.1
154	830.6	5397.7	1.8	52
155	822.7	5437.1	1.8	52.5
156	794.3	5456.1	1.8	51.6
157	734.6	5455.8	1.8	49.7
158	704.1	5456.1	1.8	48.3
159	673.7	5458.9	1.8	47.6
160	644.5	5463.5	1.8	47.2
161	606.7	5472.8	1.8	46.6
162	554.2	5541.2	1.8	45.2
163	553.4	5558.3	1.8	44.3
166	748.9	5155.7	1.8	50.0
3	872.9	5807.3	4.6	57.5
4	858.2	5809.5	4.6	55.9
5	843.8	5811.7	4.6	54.4
6	828.4	5813.6	4.6	53.2
7	810.6	5795.7	4.6	51.8
8	808.5	5782.9	4.6	51.6
9	785.4	5742.8	4.6	50
10	771.7	5750	4.6	49.5
11	770.6	5720.7	4.6	49.2
12	762.1	5709.2	4.6	48.9
13	754.6	5696.6	4.6	48.5
14	747.2	5686	4.6	48.2
15	890	5909.4	4.6	58.7
16	738.8	5760.9	4.6	48.1
17	824	5784.1	4.6	52.5
18	838.5	5783	4.6	53.3
19	854.2	5781	4.6	54.1
20	868.1	5778.1	4.6	54.6
21	882.6	5777.1	4.6	56.3
22	907.8	5741.4	4.6	67.8
23	905.5	5726.8	4.6	67.6
24	903.2	5713	4.6	67.3
25	902.2	5698.9	4.6	67.4
26	900.6	5683.5	4.6	67.4
27	899.6	5669.2	4.6	67.4
28	899.1	5653.9	4.6	67.5
29	898	5634.7	4.6	67.5
30	896.2	5605	4.6	67.3

31	879.6	5606.3	4.6	61.9
32	865.9	5606.7	4.6	57.5
33	849.9	5609.9	4.6	54.9
34	835.5	5611.9	4.6	53.2
35	820.7	5614	4.6	51.8
36	805.6	5616.5	4.6	50.7
37	791.3	5619.9	4.6	49.8
38	776.4	5621.2	4.6	49.1
39	763.9	5631.2	4.6	48.6
40	751.3	5639.6	4.6	48.2
41	738.8	5648.3	4.6	47.8
42	722	5649.4	4.6	47.2
43	725.3	5656	4.6	47.3
44	764.9	5684.1	4.6	48.9
45	776.7	5677	4.6	49.4
46	792.6	5666	4.6	50.1
47	807.9	5663.4	4.6	50.8
48	822.8	5659.8	4.6	51.8
49	854.2	5646.4	4.6	55.1
50	853.8	5656	4.6	54.9
51	855.3	5685.7	4.6	55.1
52	839.5	5689	4.6	53.1
53	825.9	5689.9	4.6	52
54	809.5	5691.3	4.6	51.1
55	794.4	5700.8	4.6	50.2
56	781.8	5708.7	4.6	49.7
57	860.8	5729.6	4.6	55.4
58	715.5	5635.3	4.6	46.9
59	710.4	5629.9	4.6	46.7
60	723.4	5622.2	4.6	47.1
61	736.5	5614.7	4.6	47.7
62	749.6	5607.1	4.6	48.2
63	763.1	5600.2	4.6	48.7
64	779	5594.8	4.6	49.5
65	796.9	5590.7	4.6	50.5
66	811.3	5587.6	4.6	51.6
67	826.1	5585.5	4.6	53
68	843	5582.7	4.6	55.1
69	860.1	5579.6	4.6	57.6
70	876.5	5577.3	4.6	61.5
71	893.9	5574.5	4.6	67
72	691	5689	4.6	46.4
73	677.1	5697.8	4.6	46.3
74	674.3	5664	4.6	45.8
75	665.1	5645.8	4.6	45.4
76	666.1	5630.1	4.6	45.4
77	680.7	5609.9	4.6	45.7
78	695	5600.7	4.6	46.2
79	708.3	5591.5	4.6	46.6
80	721.9	5582.5	4.6	47.1
81	739.3	5570.8	4.6	47.7
82	751	5556.2	4.6	48.3
83	768.2	5549.2	4.6	49.2

84	785.6	5545.6	4.6	50.3
85	800.2	5543.1	4.6	51.4
86	818.7	5539.7	4.6	53
87	835.8	5534.3	4.6	55
88	853.2	5529	4.6	57.5
89	870.1	5523.3	4.6	60.7
90	891.1	5512.3	4.6	65.8
91	644.9	5740.5	4.6	45.7
92	657.2	5732.1	4.6	45.9
93	639.5	5608.4	4.6	45.7
94	614.6	5537.8	4.6	46.6
95	644	5540.3	4.6	47
96	672.2	5537.7	4.6	47.3
97	698.9	5529.8	4.6	47.8
98	732.9	5519	4.6	49.1
99	762.3	5510.1	4.6	51.1
100	790.2	5505.4	4.6	52.8
101	817.6	5495.2	4.6	54.8
102	839.4	5482.9	4.6	56.4
103	892.1	5480.3	4.6	64.8
104	896.7	5449.1	4.6	65.2
105	903.1	5397.1	4.6	65.4
106	900.2	5364.6	4.6	63.9
107	876.4	5343.1	4.6	59.3
108	858.2	5322.9	4.6	57
109	850	5307.3	4.6	56.2
110	841.6	5281.7	4.6	55.4
111	839.2	5257.4	4.6	54.8
113	909.9	5340.8	4.6	65.8
114	901.2	5310.9	4.6	62.5
115	890.5	5298.1	4.6	60.2
116	882.2	5275	4.6	58.6
117	870.5	5255.8	4.6	56.6
112	873.5	5236.6	4.6	56.5
118	880.2	5218.4	4.6	56.7
119	888.1	5197.2	4.6	56.7
120	895.8	5173.4	4.6	56.4
121	901.7	5147.3	4.6	56.5
122	903.7	5122.4	4.6	57
123	903.2	5099.6	4.6	57
124	901.9	5079.9	4.6	56.7
125	938.8	5201.3	4.6	67.4
126	943.1	5182.3	4.6	67.6
127	946.5	5162.1	4.6	67.6
128	950.3	5142.6	4.6	67.7
129	954.1	5123.2	4.6	67.7
130	958	5104	4.6	67.6
131	962	5083.5	4.6	67.6
132	965.9	5065.3	4.6	67.4
133	972.5	5046.1	4.6	67.5
134	978.7	5026.9	4.6	66.8
135	987.4	5000.6	4.6	65.2
136	900.5	5017.2	4.6	52.6

137	859.1	5021.9	4.6	50.2
138	842.5	5045.7	4.6	50.7
139	828.9	5060.8	4.6	50.9
140	823	5080.8	4.6	51.2
141	824.3	5114.6	4.6	52.4
142	820.7	5145.8	4.6	52.8
143	811.5	5177.3	4.6	52.7
144	747.2	5056.2	4.6	45.8
145	780.5	5061.3	4.6	47.5
146	781.6	5213.6	4.6	51.7
147	786.8	5236.4	4.6	51.6
148	789.6	5258.7	4.6	51.6
149	789.3	5279.9	4.6	51.5
150	790.1	5301.2	4.6	51.5
151	792.9	5321.4	4.6	51.7
152	799.6	5342.9	4.6	52.3
153	811.4	5367	4.6	52.9
154	830.6	5397.7	4.6	55.1
155	822.7	5437.1	4.6	54.7
156	794.3	5456.1	4.6	53
157	734.6	5455.8	4.6	50.3
158	704.1	5456.1	4.6	48.8
159	673.7	5458.9	4.6	48.1
160	644.5	5463.5	4.6	47.6
161	606.7	5472.8	4.6	47
162	554.2	5541.2	4.6	45.7
163	553.4	5558.3	4.6	44.9

OCEAN STREET									MERLOT STREET								
Existing Daytime									**Existing Daytime**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m		Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds								15	seconds					
		3600	seconds per 1 hour								3600	seconds per 1 hour					
		24	number of cars per hour								35	number of cars per hour					
				SEL total									SEL total				
	SEL x number of cars =		285958164.5	84.563025						SEL x number of cars =		417022323.2	86.201593				
	LAeq 1hr	=	**51.5**	**dB(A)**	**at 10m**					**LAeq 1hr**	=	**53.1**	**dB(A)**	**at 10m**			
Existing Night-time									**Existing Night-time**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m		Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds								15	seconds					
		3600	seconds per 1 hour								3600	seconds per 1 hour					
		7	number of cars per hour								11	number of cars per hour					
				SEL total									SEL total				
	SEL x number of cars =		85787449.35	79.334238						SEL x number of cars =		125106697	80.972806				
	LAeq 1hr	=	**46.3**	**dB(A)**	**at 10m**					**LAeq 1hr**	=	**47.9**	**dB(A)**	**at 10m**			
Existing Daytime with Completed Development									**Existing Daytime with Completed Development**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m		Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds								15	seconds					
		3600	seconds per 1 hour								3600	seconds per 1 hour					
		40	number of cars per hour								68	number of cars per hour					
				SEL total									SEL total				
	SEL x number of cars =		481660783.3	86.827413						SEL x number of cars =		808427560.9	89.076411				
	LAeq 1hr	=	**53.8**	**dB(A)**	**at 10m**					**LAeq 1hr**	=	**56.0**	**dB(A)**	**at 10m**			
Existing Night-time with Completed Development									**Existing Night-time with Completed Development**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m		Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds								15	seconds					
		3600	seconds per 1 hour								3600	seconds per 1 hour					
		12	number of cars per hour								20	number of cars per hour					
				SEL total									SEL total				
	SEL x number of cars =		144498235	81.598625						SEL x number of cars =		242528268.3	83.847624				
	LAeq 1hr	=	**48.5**	**dB(A)**	**at 10m**					**LAeq 1hr**	=	**50.8**	**dB(A)**	**at 10m**			

HILLCREST AVENUE										FRASER DRIVE NORTH								
Existing Daytime										**Existing Daytime**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m			Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds									15	seconds					
		3600	seconds per 1 hour									54000	seconds per 15 hour					
		106	number of cars per hour									6258	number of cars per hour					
				SEL total										SEL total				
	SEL x number of cars =		1257024431	90.993437							SEL x number of cars =		74563233946	108.72525				
	LAeq 1hr	**=**	**57.9**	**dB(A)**	**at 10m**						**LAeq 15hr**	**=**	**63.9**	**dB(A)**	**at 10m**			
Existing Night-time										**Existing Night-time**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m			Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds									15	seconds					
		3600	seconds per 1 hour									32400	seconds per 9 hour					
		32	number of cars per hour									471	number of cars per hour					
				SEL total										SEL total				
	SEL x number of cars =		377107329.4	85.76465							SEL x number of cars =		5612286426	97.491398				
	LAeq 1hr	**=**	**52.7**	**dB(A)**	**at 10m**						**LAeq 9hr**	**=**	**54.9**	**dB(A)**	**at 10m**			
Existing Daytime with Completed Development										**Existing Daytime with Completed Development**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m			Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds									15	seconds					
		3600	seconds per 1 hour									54000	seconds per 15 hour					
		122	number of cars per hour									6524	number of cars per hour					
				SEL total										SEL total				
	SEL x number of cars =		1452727050	91.62184							SEL x number of cars =		77735135524	108.90617				
	LAeq 1hr	**=**	**58.6**	**dB(A)**	**at 10m**						**LAeq 15hr**	**=**	**64.1**	**dB(A)**	**at 10m**			
Existing Night-time with Completed Development										**Existing Night-time with Completed Development**								
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m			Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m	
		15	seconds									15	seconds					
		3600	seconds per 1 hour									32400	seconds per 9 hour					
		37	number of cars per hour									491	number of cars per hour					
				SEL total										SEL total				
	SEL x number of cars =		435818115.1	86.393053							SEL x number of cars =		5851031706	97.672325				
	LAeq 1hr	**=**	**53.3**	**dB(A)**	**at 10m**						**LAeq 9hr**	**=**	**55.1**	**dB(A)**	**at 10m**			

FRASER DRIVE SOUTH							
Existing Daytime							
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m
		15	seconds				
		54000	seconds per 15 hour				
		6258	number of cars per hour				
				SEL total			
	SEL x number of cars =		74563233946	108.72525			
	LAeq 15hr	**=**	**63.9**	**dB(A)**	**at 10m**		
Existing Night-time							
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m
		15	seconds				
		32400	seconds per 9 hour				
		471	number of cars per hour				
				SEL total			
	SEL x number of cars =		5612286426	97.491398			
	LAeq 9hr	**=**	**54.9**	**dB(A)**	**at 10m**		
Existing Daytime with Completed Development							
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m
		15	seconds				
		54000	seconds per 15 hour				
		7057	number of cars per hour				
				SEL total			
	SEL x number of cars =		84078938679	109.24687			
	LAeq 15hr	**=**	**64.4**	**dB(A)**	**at 10m**		
Existing Night-time with Completed Development							
Car pass	LAeq	59.0	794328.2347	11914924	70.8	SEL	at 10m
		15	seconds				
		32400	seconds per 9 hour				
		531	number of cars per hour				
				SEL total			
	SEL x number of cars =		6328522266	98.013023			
	LAeq 9hr	**=**	**55.4**	**dB(A)**	**at 10m**		

ONSITE ACTIVITIES IMPACTING:								
Onsite Lot 22 Dwelling			**Onsite Lot 21 Dwelling**			**Onsite Lot 3 Dwelling**		
Car door closure	58	dB(A) @ 1m	Car door closure	58	dB(A) @ 1m	Car door closure	58	dB(A) @ 1m
Distance source to receiver	15	m	Distance source to receiver	15	m	Distance source to receiver	7	m
Distance attenuation	-23.5	dB(A)	Distance attenuation	-23.5	dB(A)	Distance attenuation	-16.9	dB(A)
Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**29.0**	dB(A)	Impact at ground façade	**29.0**	dB(A)	Impact at ground façade	**35.6**	dB(A)
Impact inside open window	**21.5**	dB(A)	Impact inside open window	**21.5**	dB(A)	Impact inside open window	**28.1**	dB(A)
Impact at top floor façade	**37.0**	dB(A)	Impact at top floor façade	**37.0**	dB(A)	Impact at top floor façade	**43.6**	dB(A)
Impact inside open window	**29.5**	dB(A)	Impact inside open window	**29.5**	dB(A)	Impact inside open window	**36.1**	dB(A)
Car bypass	57	dB(A) @ 3m	Car bypass	57	dB(A) @ 3m	Car bypass	57	dB(A) @ 3m
Distance source to receiver	7	m	Distance source to receiver	20	m	Distance source to receiver	7	m
Distance attenuation	-7.4	dB(A)	Distance attenuation	-16.5	dB(A)	Distance attenuation	-7.4	dB(A)
Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**44.1**	dB(A)	Impact at ground façade	**35.0**	dB(A)	Impact at ground façade	**44.1**	dB(A)
Impact inside open window	**36.6**	dB(A)	Impact inside open window	**27.5**	dB(A)	Impact inside open window	**36.6**	dB(A)
Impact at top floor façade	**52.1**	dB(A)	Impact at top floor façade	**43.0**	dB(A)	Impact at top floor façade	**52.1**	dB(A)
Impact inside open window	**44.6**	dB(A)	Impact inside open window	**35.5**	dB(A)	Impact inside open window	**44.6**	dB(A)
Patrons dining	70	dB(A) @ 1m	Patrons dining	70	dB(A) @ 1m	Patrons dining	70	dB(A) @ 1m
Distance source to receiver	15	m	Distance source to receiver	15	m	Distance source to receiver	8	m
Distance attenuation	-23.5	dB(A)	Distance attenuation	-23.5	dB(A)	Distance attenuation	-18.1	dB(A)
Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**41.0**	dB(A)	Impact at ground façade	**41.0**	dB(A)	Impact at ground façade	**46.4**	dB(A)
Impact inside open window	**33.5**	dB(A)	Impact inside open window	**33.5**	dB(A)	Impact inside open window	**38.9**	dB(A)
Impact at top floor façade	**49.0**	dB(A)	Impact at top floor façade	**49.0**	dB(A)	Impact at top floor façade	**54.4**	dB(A)
Impact inside open window	**41.5**	dB(A)	Impact inside open window	**41.5**	dB(A)	Impact inside open window	**46.9**	dB(A)
Goods Delivery	85	dB(A) @ 1m	Goods Delivery	85	dB(A) @ 1m	Goods Delivery	85	dB(A) @ 1m
Distance source to receiver	7	m	Distance source to receiver	10	m	Distance source to receiver	35	m
Distance attenuation	-16.9	dB(A)	Distance attenuation	-20.0	dB(A)	Distance attenuation	-30.9	dB(A)
Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)	Barrier screening	-8	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**62.6**	dB(A)	Impact at ground façade	**59.5**	dB(A)	Impact at ground façade	**48.6**	dB(A)
Impact inside open window	**55.1**	dB(A)	Impact inside open window	**52.0**	dB(A)	Impact inside open window	**41.1**	dB(A)
Impact at top floor façade	**70.6**	dB(A)	Impact at top floor façade	**67.5**	dB(A)	Impact at top floor façade	**56.6**	dB(A)
Impact inside open window	**63.1**	dB(A)	Impact inside open window	**60.0**	dB(A)	Impact inside open window	**49.1**	dB(A)
Waste Collection	88	dB(A) @ 1m	Waste Collection	88	dB(A) @ 1m	Waste Collection	88	dB(A) @ 1m
Distance source to receiver	7	m	Distance source to receiver	10	m	Distance source to receiver	35	m
Distance attenuation	-16.9	dB(A)	Distance attenuation	-20.0	dB(A)	Distance attenuation	-30.9	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**73.6**	dB(A)	Impact at ground façade	**70.5**	dB(A)	Impact at ground façade	**59.6**	dB(A)
Impact inside open window	**66.1**	dB(A)	Impact inside open window	**63.0**	dB(A)	Impact inside open window	**52.1**	dB(A)
Impact at top floor façade	**73.6**	dB(A)	Impact at top floor façade	**70.5**	dB(A)	Impact at top floor façade	**59.6**	dB(A)
Impact inside open window	**66.1**	dB(A)	Impact inside open window	**63.0**	dB(A)	Impact inside open window	**52.1**	dB(A)
A/C Plant	58	dB(A) @ 1m	A/C Plant	58	dB(A) @ 1m	A/C Plant	58	dB(A) @ 1m
Distance source to receiver	13	m	Distance source to receiver	5	m	Distance source to receiver	5	m
Distance attenuation	-22.3	dB(A)	Distance attenuation	-14.0	dB(A)	Distance attenuation	-14.0	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**38.2**	dB(A)	Impact at ground façade	**46.5**	dB(A)	Impact at ground façade	**46.5**	dB(A)
Impact inside open window	**30.7**	dB(A)	Impact inside open window	**39.0**	dB(A)	Impact inside open window	**39.0**	dB(A)
Impact at top floor façade	**38.2**	dB(A)	Impact at top floor façade	**46.5**	dB(A)	Impact at top floor façade	**46.5**	dB(A)
Impact inside open window	**30.7**	dB(A)	Impact inside open window	**39.0**	dB(A)	Impact inside open window	**39.0**	dB(A)

ONSITE ACTIVITIES IMPACTING:					
Dwellings due East			**Dwellings due North**		
Car door closure	58	dB(A) @ 1m	Car door closure	58	dB(A) @ 1m
Distance source to receiver	155	m	Distance source to receiver	130	m
Distance attenuation	-43.8	dB(A)	Distance attenuation	-42.3	dB(A)
Building Screening	0	dB(A)	Building Screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**16.7**	dB(A)	Impact at ground façade	**18.2**	dB(A)
Impact inside open window	**9.2**	dB(A)	Impact inside open window	**10.7**	dB(A)
Car bypass	57	dB(A) @ 3m	Car bypass	57	dB(A) @ 3m
Distance source to receiver	145	m	Distance source to receiver	125	m
Distance attenuation	-33.7	dB(A)	Distance attenuation	-32.4	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**25.8**	dB(A)	Impact at ground façade	**27.1**	dB(A)
Impact inside open window	**18.3**	dB(A)	Impact inside open window	**19.6**	dB(A)
Patrons dining	70	dB(A) @ 1m	Patrons dining	70	dB(A) @ 1m
Distance source to receiver	160	m	Distance source to receiver	135	m
Distance attenuation	-44.1	dB(A)	Distance attenuation	-42.6	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**28.4**	dB(A)	Impact at ground façade	**29.9**	dB(A)
Impact inside open window	**20.9**	dB(A)	Impact inside open window	**22.4**	dB(A)
Goods Delivery	85	dB(A) @ 1m	Goods Delivery	85	dB(A) @ 1m
Distance source to receiver	155	m	Distance source to receiver	130	m
Distance attenuation	-43.8	dB(A)	Distance attenuation	-42.3	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**43.7**	dB(A)	Impact at ground façade	**45.2**	dB(A)
Impact inside open window	**36.2**	dB(A)	Impact inside open window	**37.7**	dB(A)
Waste Collection	88	dB(A) @ 1m	Waste Collection	88	dB(A) @ 1m
Distance source to receiver	145	m	Distance source to receiver	120	m
Distance attenuation	-43.2	dB(A)	Distance attenuation	-41.6	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**47.3**	dB(A)	Impact at ground façade	**48.9**	dB(A)
Impact inside open window	**39.8**	dB(A)	Impact inside open window	**41.4**	dB(A)
A/C Plant	58	dB(A) @ 1m	A/C Plant	58	dB(A) @ 1m
Distance source to receiver	165	m	Distance source to receiver	140	m
Distance attenuation	-44.3	dB(A)	Distance attenuation	-42.9	dB(A)
Building screening	0	dB(A)	Building screening	0	dB(A)
Façade reflection	2.5	dB(A)	Façade reflection	2.5	dB(A)
Impact at ground façade	**16.2**	dB(A)	Impact at ground façade	**17.6**	dB(A)
Impact inside open window	**8.7**	dB(A)	Impact inside open window	**10.1**	dB(A)