Lloyd George Acoustics
PO Box 717
Hillarys WA 6923
T: 9401 7770
www.lgacoustics.com.au

Stage 1B & 2 Noise Management Plan

Cranwood Crescent Subdivision

Reference: 20085657-03c Stages 1B and 2

Prepared for:
Hesperia

Report: 20085657-03c Stages 1B and 2

Lloyd George Acoustics Pty Ltd

ABN: 79 125 812 544

PO Box 717
Hillarys WA 6923

www.lgacoustics.com.au

Contacts	General	Daniel Lloyd	Terry George	Matt Moyle
E:	info@lgacoustics.com.au	daniel@lgacoustics.com.au	terry@lgacoustics.com.au	matt@lgacoustics.com.au
P:	9401 7770	0439 032 844	0400 414 197	0412 611 330
Contacts	**Accounts**	**Rob Connolly**	**Daryl Thompson**	**Hao Tran**
E:	lisa@lgacoustics.com.au	rob@lgacoustics.com.au	daryl@lgacoustics.com.au	hao@lgacoustics.com.au
P:	9401 7770	0410 107 440	0420 364 650	0438 481 207

Date:	Rev	Description	Prepared By	Verified
21-Oct-20	0	Issued to Client as Draft	Terry George	Olivier Mallié
28-Oct-20	1	Updated with Emerge Comments	Terry George	-
2-Dec-20	A	Updated truck routes and noise wall drawings	Terry George	Olivier Mallié
14-Dec-21	B	Wording change for quiet house design	Terry George	-
27-Apr-22	C	Updated to include a Kiln 11 Scenario and Stage 1B	Terry George	-

Table of Contents

List of Tables

List of Figures

Appendices

A Stage 1 Noise Wall Drawings

B Stage 2 Noise Wall Drawing

C Terminology

1 INTRODUCTION

Hesperia Pty Ltd is the Development Manager for the owners of the land east of Cranwood Crescent in Viveash that has received WAPC approval (Application No: 158848) to create 60 residential lots. The approved subdivision area will be delivered in three separate stages, comprising Stages 1, 1B and 2 as generally located in *Figure 1-1*. This report forms the Noise Management Plan (NMP) for Stages 1B and 2, which comprises 26 residential lots plus the extension of Eveline Road through to Cranwood Crescent.

Figure 1-1 Project Locality

The approved subdivision plan is shown in *Figure 1-2*. Green shaded lots are Stage 1, orange shaded lots are Stage 1B and Pink shaded lots are Stage 2. The Stage 1B and Stage 2 land is currently within the Midland Brick site boundary and is zoned residential.

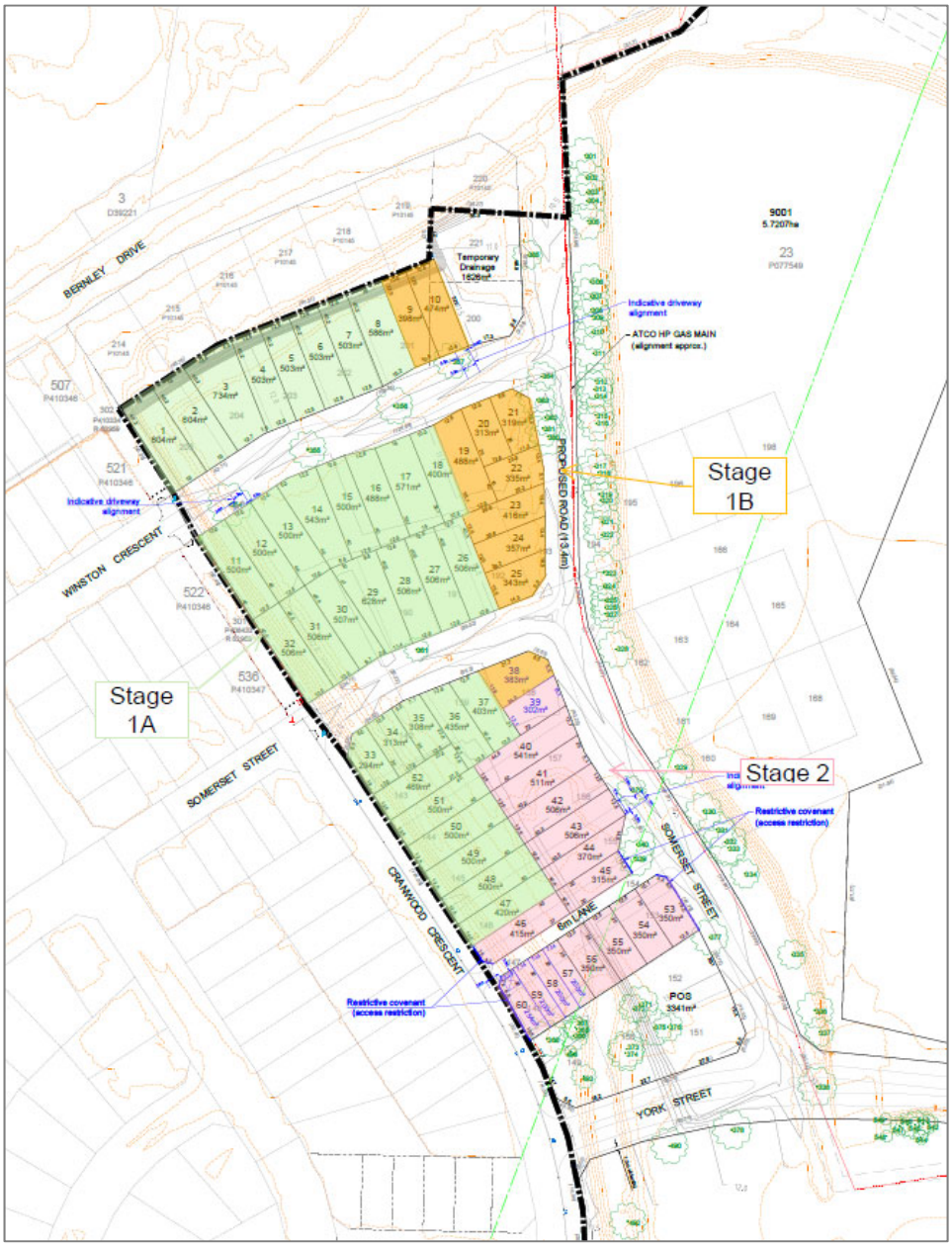


Figure 1-2 Proposed Subdivision and Staging

The relevant WAPC conditions are:

2. *A noise management plan outlining the recommended type and specification of physical noise barrier to achieve acceptable noise levels at surrounding sensitive land uses, and the extent of proposed lot(s) requiring Quiet House design and notification on title, where applicable, is to be:*

   a) prepared by the landowner/applicant and approved prior to the commencement of subdivisional works to the satisfaction of the local government on advice of the Department of Water and Environmental Regulation; and

   b) implemented during subdivisional works; to the satisfaction of the local government.

   (Local Government)

3. *A notification, pursuant to Section 165 of the Planning and Development Act 2005 is to be placed on the certificates of title of the proposed lots advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:*

   "This lot is in close proximity to an existing bricks works and may be adversely affected by virtue of gaseous, odour, noise and/or dust emissions from that facility."

   (Western Australian Planning Commission)

5. *Prior to endorsement of a diagram or plan of survey (deposited plan) for the creation of the lots proposed by this application, the applicant is to demonstrate to the satisfaction of the Western Australian Planning Commission and the Department of Water and Environmental Regulations that it has scoped, designed, implemented and validated noise mitigation measures from the brickworks and demonstrate that noise emissions comply with the EP (Noise) Regulations 1997. (The Department of Water and Environmental Regulations)*

6. *A notification, pursuant to Section 165 of the Planning and Development Act 2005 is to be placed on the certificates of title of the proposed Lots 53, 54, 55 and 56 advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:*

   "This lot is situated in the vicinity of Perth Airport, and is currently affected, or may in the future, be affected by aircraft noise. Noise exposure levels are likely to increase in the future as a result of increases in numbers of aircraft using the airport, changes in aircraft type or other operational changes. Further information about aircraft noise, including development restrictions and noise insulation requirements for noise affected properties, are available on request from the relevant local government offices."

   (Western Australian Planning Commission)

16. *Local Development Plan(s) being prepared and approved for lots shown on the approved plan of subdivision that address the following:*

    a) *"Quiet House" design requirements for lots affected by noise as identified in an approved Noise Management Plan; and,*

    b) *Building setbacks and orientation, including major openings, outdoor living areas and fencing for passive surveillance, vehicle access and servicing requirements (bin pads) for lots abutting public open space;*

    to the satisfaction of the Western Australian Planning Commission.

    (Local Government)

Condition 3 will be satisfied with the relevant notifications on the Deposited Plan.

Condition 6 relates to specific lots within Stage 2, although will be applied to all Stages 1B and 2 lots.

Condition 16 will be satisfied by the preparation and approval of a Local Development Plan (LDP) prepared by the project Town Planner (element) and approved by the City of Swan.

This NMP responds to the requirements of Conditions 2 and 5.

Specifically, this report considers:

- Midland Brick noise against the prescribed standards of the *Environmental Protection (Noise) Regulations 1997*.
- Aircraft noise against *State Planning Policy 5.1 Land Use Planning in the Vicinity of Perth Airport* and *Australian Standard 2021:2015 Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*.

It is relevant to note that the new owners of the Midland Brick site have a vision to progress the orderly staged contraction of the brickworks footprint to an area north of Bassett Road. This consolidation has commenced and in the short term will include the removal of Kilns 7 and 8 from the current Part V Licence (Condition 4 of the subdivision approval). Brick storage has now been removed from south of Bassett Road, eliminating the early morning truck movements immediately east of the subdivision and Kiln 11 will be decommissioned by mid 2023.

Appendix C contains a description of some of the terminology used throughout this report.

2 CRITERIA

2.1 Industrial Noise

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997* (the Regulations).

Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or significantly contribute to, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

A "…noise emission is taken to significantly contribute to a level of noise if the noise emission … exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard prescribed under regulation 7 after the adjustments of *Table 2-1* are made to the noise emission as measured at the point of reception.

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

Where Noise Emission is Not Music			Where Noise Emission is Music	
Tonality	Modulation	Impulsiveness	No Impulsiveness	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB	+ 10 dB	+ 15 dB

Note: The above are cumulative to a maximum of 15dB.

The baseline assigned levels (prescribed standards) are specified in Regulation 8 and are shown in *Table 2-2*.

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

The influencing factor at existing and future residences varies depending on the receiver's proximity to industrial land. For the nearest existing (west of Cranwood Crescent) and future (east of Cranwood Crescent) receivers, the influencing factor varies from 2-8 dB on the basis of Stage 1, 1B and 2 being zoned residential and the remaining Midland Brick site (east of Stages 1B and 2) being industrial. *Table 2-3* shows the assigned noise levels, including the influencing factor at the receiving locations shown on *Figure 2-1*, noting the aerial imagery is slightly outdated.

In the future it is planned for more of the Midland Brick land to be zoned residential such that the influencing factor for Stages 1, 1B and 2 will ultimately approach 0 dB. When this occurs, all of the brickworks operations, and therefore noise sources, will have either moved substantially further east or have been decommissioned as discussed in *Section 1*.

Table 2-3 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
71 Bernley Drive 42 Winston Crescent	0700 to 1900 hours Monday to Saturday (Day)	47	57	67
	0900 to 1900 hours Sunday and public holidays (Sunday)	42	52	67
	1900 to 2200 hours all days (Evening)	42	52	57
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	37	47	57
36 Harford Avenue	0700 to 1900 hours Monday to Saturday (Day)	48	58	67
	0900 to 1900 hours Sunday and public holidays (Sunday)	43	53	68
	1900 to 2200 hours all days (Evening)	43	53	58
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	38	48	58
52 Cranwood Crescent New Lot 46 (Stage 2)	0700 to 1900 hours Monday to Saturday (Day)	50	60	70
	0900 to 1900 hours Sunday and public holidays (Sunday)	45	55	70
	1900 to 2200 hours all days (Evening)	45	55	60
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	40	50	60
New Lot 10 (Stage 1B)	0700 to 1900 hours Monday to Saturday (Day)	49	59	69
	0900 to 1900 hours Sunday and public holidays (Sunday)	44	54	69
	1900 to 2200 hours all days (Evening)	44	54	59
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	39	49	59

Table 2-3 continued on following page

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
New Lot 22 (Stage 1B)	0700 to 1900 hours Monday to Saturday (Day)	52	62	72
	0900 to 1900 hours Sunday and public holidays (Sunday)	47	57	72
	1900 to 2200 hours all days (Evening)	47	57	62
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	42	52	62
New Lot 38 (Stage 1B)	0700 to 1900 hours Monday to Saturday (Day)	51	61	71
	0900 to 1900 hours Sunday and public holidays (Sunday)	46	56	71
	1900 to 2200 hours all days (Evening)	46	56	61
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	41	51	61
New Lot 53 (Stage 2)	0700 to 1900 hours Monday to Saturday (Day)	53	63	73
	0900 to 1900 hours Sunday and public holidays (Sunday)	48	58	73
	1900 to 2200 hours all days (Evening)	48	58	63
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	43	53	63

1. ***highly sensitive area*** means that area (if any) of noise sensitive premises comprising —
   (a) a building, or a part of a building, on the premises that is used for a noise sensitive purpose; and
   (b) any other part of the premises within 15 metres of that building or that part of the building.

With regard to the existing residences, two of those west of Stage 1 are double storey (71 Bernley Drive and 42 Winston Crescent), whilst the remainder are single storey dwellings. For the future residences, the noise levels at the ground floor and any potential upper floor are given consideration.

The assigned noise levels in *Table 2-3* apply outside the receiving premises and at a point at least 3 metres away from any substantial reflecting surfaces. However, for the purpose of this assessment and given the relatively high residential density, the noise emissions were assessed at a point within 1 metre from building facades and a -2 dB adjustment was made to the predicted noise levels to account for reflected noise. For the future receivers in Stage 1B and 2, no façade correction was applied to the upper floor as the buildings were modelled at only 3.5 metres high.

It is further noted that although the assigned noise levels apply outside of the premises receiving the noise, the noise emissions can be assessed indoors. In such a case, and in accordance with regulation 19(4), an adjustment of +10 dB is to be made to the noise levels where external windows and doors are open, and +15 dB where external windows and doors are shut.

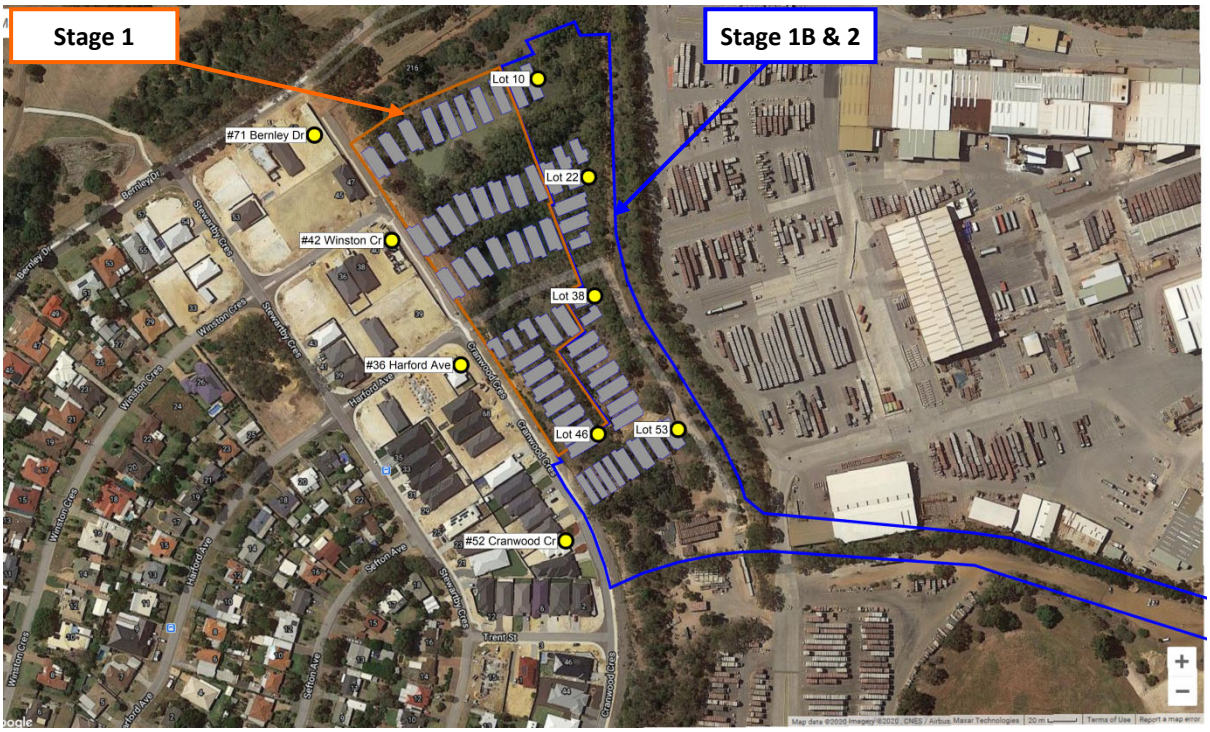


Figure 2-1 Assessment Locations

2.2 Aircraft Noise

The relevant planning policy in Western Australia in relation to aircraft noise is *State Planning Policy 5.1: Land Use Planning in the Vicinity of Perth Airport*; July 2015, Western Australian Planning Commission (SPP 5.1). SPP 5.1 applies to any land within ANEF 20 and separates land into three zones:

- Areas below 20 ANEF;
- Areas between 20 ANEF and 25 ANEF; and
- Areas above 25 ANEF.

In this instance, part of Stage 2 falls within ANEF 20, with the majority outside ANEF 20 (refer *Figure 2-2* where the pink shading is the 20-25 ANEF zone).

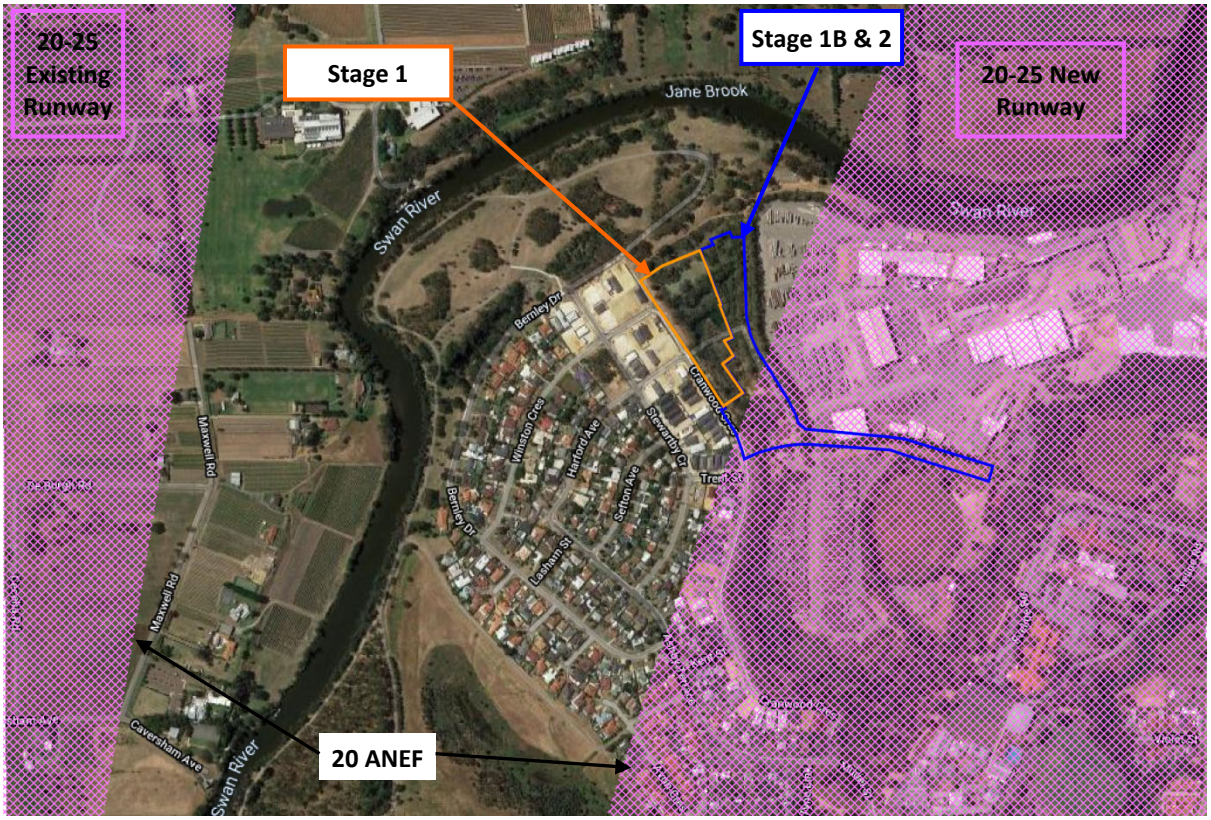


Figure 2-2 Site Locality in Relation to ANEF Contours

There are 4 lots (Lots 53-56) that fall within ANEF 20 such that for these lots, the requirements of SPP 5.1 are applicable as below:

Noise insulation is not mandatory for residential development within this noise exposure zone. Some areas however, may experience peak aircraft noise levels in excess of the Indoor Design Sound Levels specified in AS2021, and noise insulation is recommended in such cases. Guidance on noise insulation measures are contained within the Western Australian Planning Commission report, Aircraft Noise Insulation for Residential Development in the vicinity of Perth Airport, 2004.

Closure of windows and other openings to habitable rooms can significantly reduce the intrusion of aircraft noise. This will normally require forced ventilation, and may also necessitate some form of active cooling, such as refrigerative air conditioning. The operational management of buildings however, is outside the ambit of this policy, and will therefore be subject only to advice.

For the remaining lots that fall outside ANEF 20, SPP 5.1 is not applicable.

3 METHODOLOGY

3.1 Industrial Noise Modelling

Lloyd George Acoustics was commissioned in October 2018 to model and assess the noise impact of scaling down Midland Brick operations on the surrounding land. This model has been reused for consideration of noise impacts to the proposed Stage 1B and Stage 2 subdivision. The model was updated with more recent truck noise level measurements and routes.

The following scenarios have been given consideration, representing the proposed changes over time:

1. Existing – This scenario considers noise to the existing residences (i.e. west of Cranwood Crescent) from Midland Brick, as it existed prior to the construction of Stage 1. As such, this includes noise from all noise sources and in particular early morning trucks (6.00am to 7.00am) to the east of Stage 1B and 2 and Kilns 9, 10 and 11 operating. There is an existing bund along Cranwood Crescent in place, which can be seen in *Figure 3-2*, noting the top of the bund is at RL 16-17.5 depending on the location;
2. Stage 1B and 2 (Transition Period) – There are now no trucks south of Bassett Road in the night-time period. At the time of Stage 1B and potentially Stage 2 clearances, Kiln 11 may still be operating. As part of the Stage 1 subdivision, a noise wall (comprising 2x stacked shipping containers) was provided on the Midland Brick site (refer *Appendix A*). This scenario assumes this wall is mostly still present, as shown in *Figure 3-1* with the southern containers removed (refer *Appendix B*) and the existing bund removed. Consideration is also given to noise levels at the existing receivers. To be conservative, it is assumed future Area 3 of the overall development has been rezoned for residential, lowering the assigned noise level.
3. Stage 1B and 2 – It is expected that by mid 2023, Kiln 11 will be decommissioned. After this time is most likely when Stage 1B and Stage 2 dwellings will begin to become occupied. This scenario examines noise levels to the proposed subdivision as well as existing receivers. The container wall (refer *Appendix B*) is still in place.
4. Stage 1B and 2 No Wall – This scenario is the same as before, but considers the implications of removing the shipping container wall. Consideration is given to noise levels at the existing receivers and the subdivision.

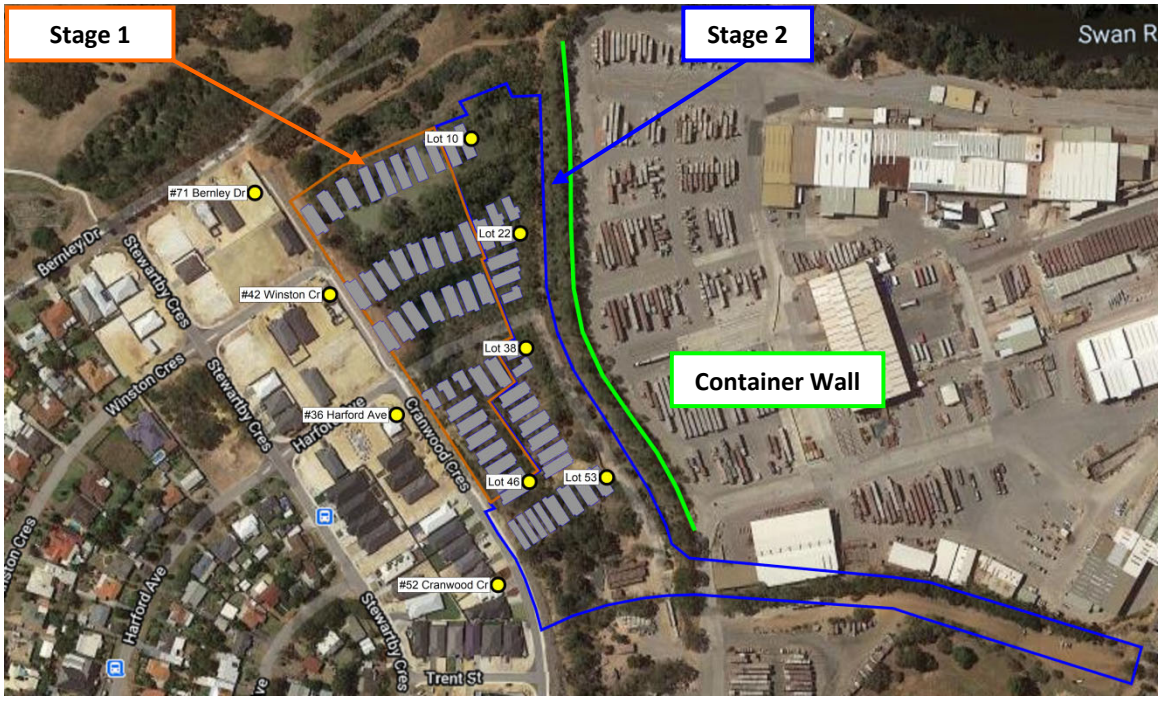


Figure 3-1 Container Wall Location

3.1.1 Meteorological Information

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation. The algorithm used was Nord2000 industry, which was selected as it allowed for improved modelling of the truck movements within the site.

Table 3-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)
Temperature (°C)	15
Humidity (%)	50
Wind Speed (m/s)	3
Temperature Inversion (°C/100m)	2
Wind Direction*	All

* Note that the modelling package used allows for the wind direction to be always from source to receiver.

At wind speeds greater than those shown, sound propagation may be further enhanced, however background noise from the wind itself and from local vegetation is likely to be elevated and dominate the ambient noise levels.

It is generally considered that compliance with the assigned noise levels needs to be demonstrated for 98% of the time, during the day and night periods, for the month of the year in which the worst-case weather conditions prevail. In most cases, the above conditions occur for more than 2% of the time and therefore must be satisfied.

3.1.2 Topographical Data

Topographical data for the industrial site was based on that provided by the client in October 2018 in the form of contours. The Stage 1, 1B and 2 subdivision levels and that of the existing eastern most residences in Viveash were provided by TABEC Consulting Engineers. Survey data for the wider area was based on that publicly available from *Google* in the form of spot heights and observations made on site. It is noted the topography is relatively flat within the Midland Brick site with the exception of a significant depression between the approved subdivision and clay shed. An image of the 3D noise model for the existing scenario is provided in *Figure 3-2*, which shows the existing topography including the earth bund. Also shown are the Stage 1 and Stage 1B and 2 subdivision outlines for context.

With regard to the shipping containers that are used to form the noise wall (refer *Figure 3-1* and *Appendix A*) as required in the Stage 1 Noise Management Plan, each is a 'high cube' container at 2.90 metres stacked height. The containers are located such that the top of the containers is no lower than 17.0 AHD, which is approximately 5 metres above the future subdivision road level. To form the noise wall, the shipping containers are stacked and pushed tightly together. An inspection of the noise wall has been undertaken and acoustically approved.

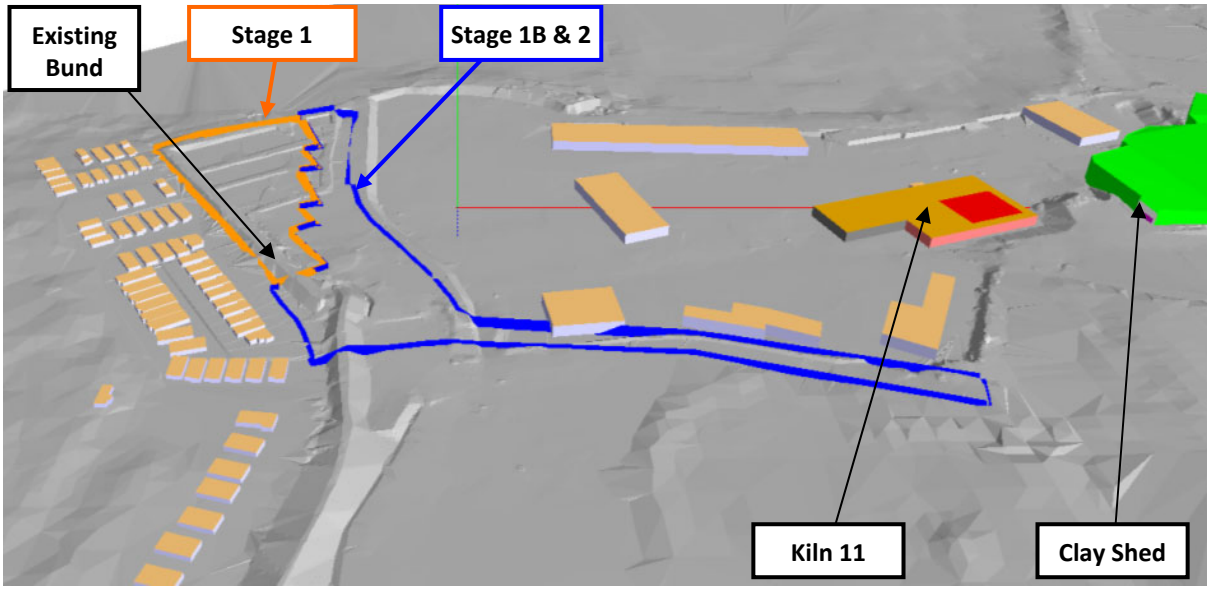


Figure 3-2 3D Image of Noise Model (Existing Topography)

3.1.3 Ground Absorption

Ground absorption varies from a value of 0 to 1, with 0 being for an acoustically reflective ground such as water or bitumen, and 1 for acoustically absorbent ground such as grass. The Midland Brick site was modelled as hard surfaces (roads, stock yards, car parks), the existing residential area and new subdivision as mostly reflective, while public open spaces and scrub areas were modelled as fully absorbent.

3.1.4 Source Sound Levels

Site surveys were carried out in 2018 to determine the noise levels from various plant and equipment. The data recorded during those site surveys was also used to calibrate the noise model. In addition, noise data from previous studies and equipment supplier information were used to determine theoretical source noise levels for input into the model where these could not be measured.

In essence, the various sources of noise include:

- Bag house ventilation fans and motors - it is noted the fans on all three kilns are insulated while the motors are not, therefore the motor noise tends to dominate the overall noise emissions i.e. fan casing noise break out is minimal.
- Stack noise emissions – the kilns' stacks are approximately 40 metres high and feature an internally insulated flue. The fan exhaust side also incorporates a silencer. Noise data for the fan was obtained from the supplier and therefore the noise levels at the stack exhaust point were estimated based on fan in-duct noise levels, estimated insertion loss of silencer and stack's flue with 3-dimensional source directivity also applied, based on empirical data and the stack diameter.
- Kiln buildings – noise levels within each kiln building were estimated based on site surveys and previous studies. These internal noise levels were used in the modelling software as input, along with the building construction properties, to calculate the noise break out from the walls, roof or any ventilation openings in the walls.
- Clay shed – noise levels within the clay shed are not uniform given it is such a large work area. Survey data indicate that noise breaking out from the open sides of the shed are dominated by trucks entering/leaving the shed in the south-west corner and mobile plant within.
- Truck movements – noise from trucks driving on site and being loaded were updated based on a survey in September 2020 of vehicles pass by noise. The existing truck numbers used in this assessment were as follows:
    - Pre-loaded trucks, up to 10 per hour from 6.00am (no trucks after 7pm) Monday to Friday and occasionally on Saturday and not on Sundays or public holidays, and
    - Trucks to be loaded, up to 6 per hour from 6.00am Monday to Friday and occasionally on Saturday and not on Sundays or public holidays.

    Based on the number of trucks above, it was considered that truck noise is assessable against the L_{A10} criteria.

It should be further noted that the industrial noise model can only accommodate stationary noise sources. As such, to determine the L_{10} parameter from trucks, a series of point sources are placed in the noise model on the assumed path of travel. In this case, two main truck movement paths were considered, relevant for the existing scenario and are shown in *Figure 3-3*. One path represents the trucks that were pre-loaded the previous afternoon leaving the site (from south to north) commencing at approximately 6.00am on weekdays, whilst the other represents a truck arriving to be loaded and then departing (typically arriving after 6.00am and leaving 15 minutes after loading).

Figure 3-3 Truck Routes Modelled Using Multiple Point Sources: Existing

For the Stage 1B and Stage 2 scenarios, the 6.00am to 7.00am truck movements occur north of Bassett Road and have been modelled in the vicinity of the masonry plant (refer *Figure 3-4*), with up to 16 trucks per hour assumed.

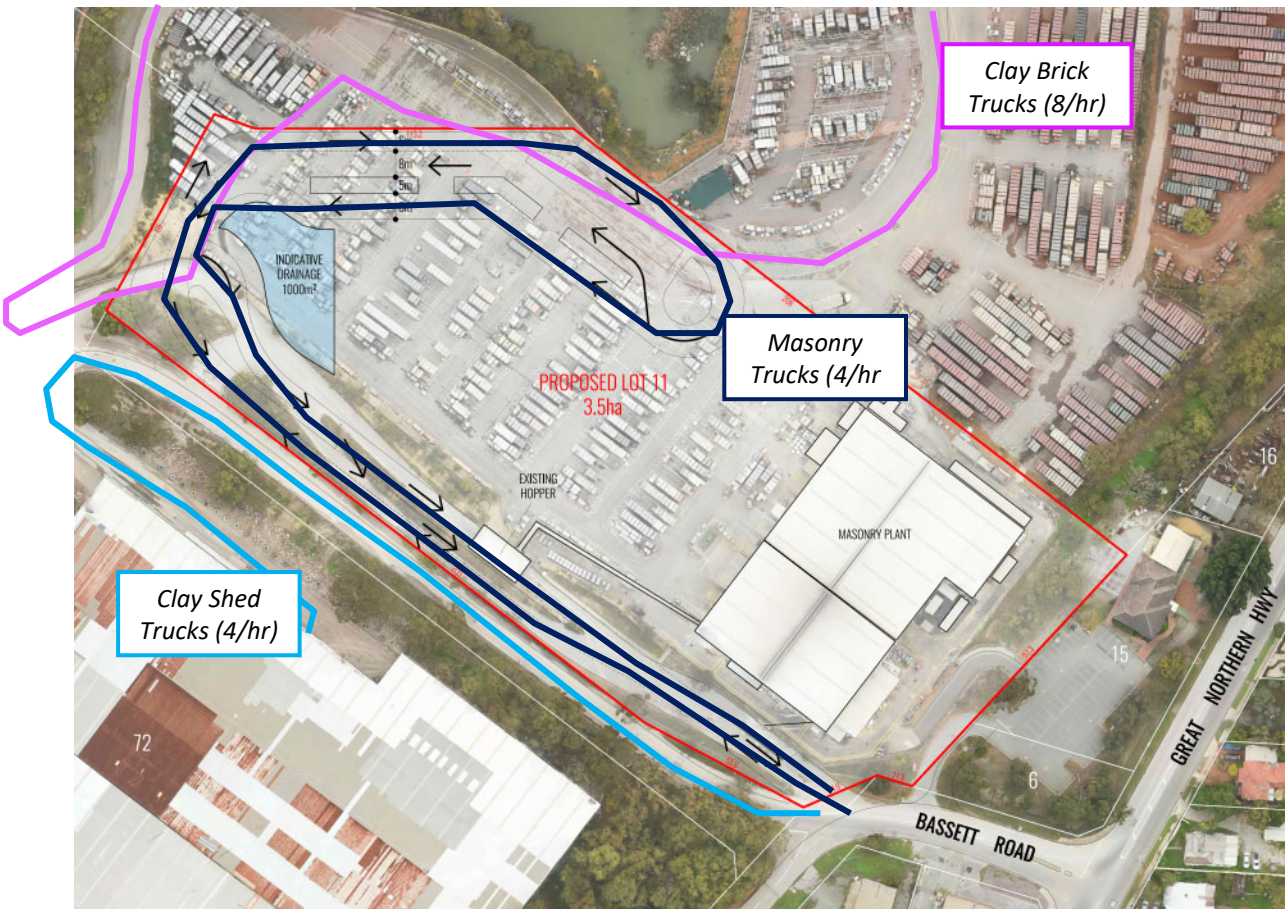


Figure 3-4 Truck Routes Modelled Using Multiple Point Sources: Future

The noise level from these individual point sources is then plotted against time for each receiver so that the L_{10} can be calculated within a spreadsheet. The noise from each path of travel was then combined to simulate several trucks on site over the same time period. Two example time history plots are provided in *Figure 3-5* and *Figure 3-6* over the first 30 minutes, for existing and future truck scenarios respectively.

Because of this modelling methodology, the results are presented in tabular format as single point calculations, as noise contour plots cannot be provided for a moving point source scenario.

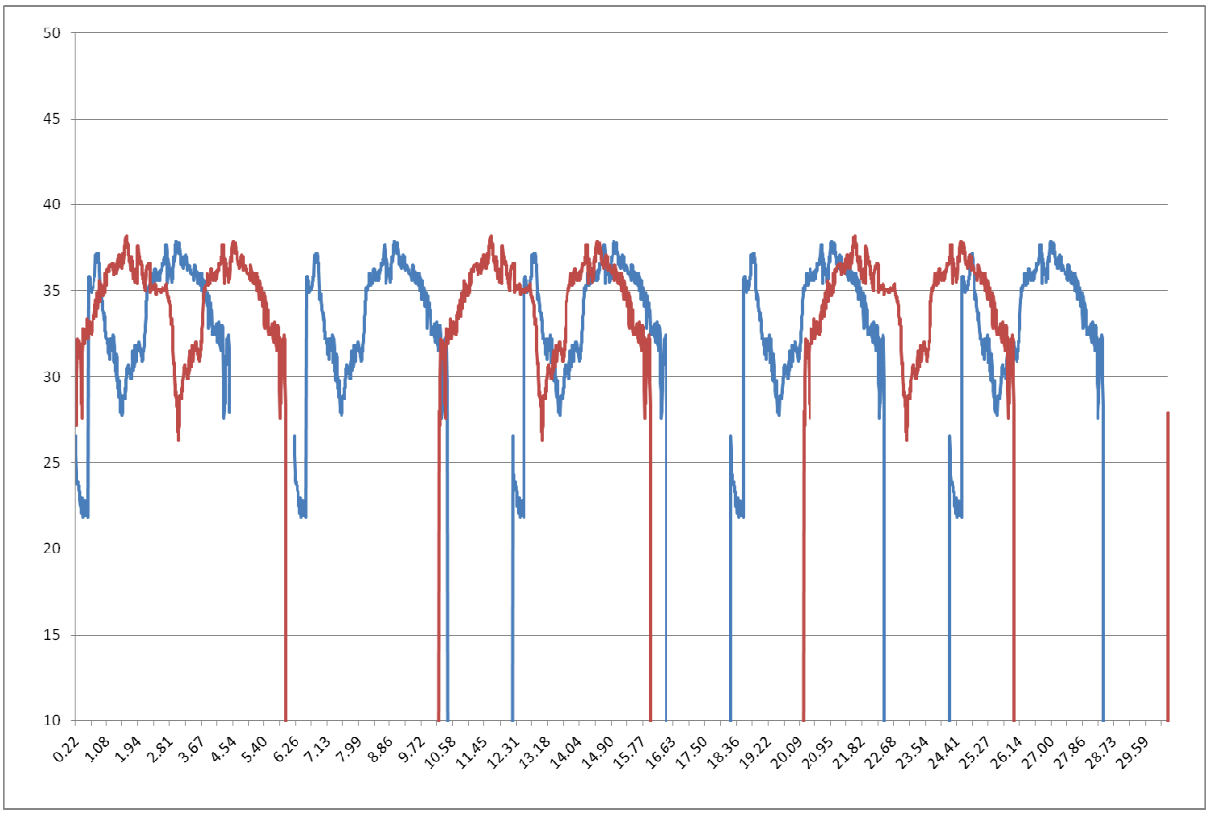


Figure 3-5 Example Time History Plot of Existing Truck Movement at New Lot 10

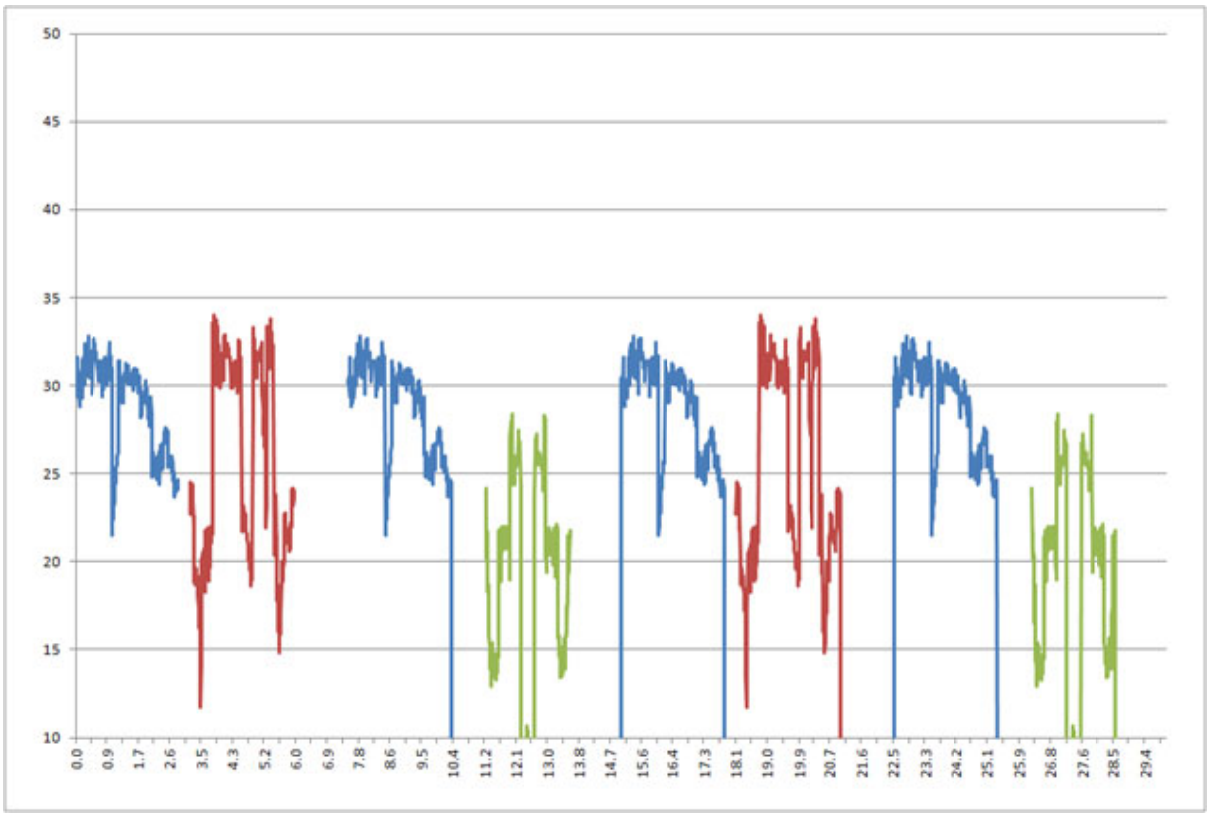


Figure 3-6 Example Time History Plot of Future Truck Movement at New Lot 46

The source noise levels used in the modelling are summarised in *Table 3-2*.

Table 3-2 Source Sound Noise Levels, dB

Description	Octave Band Centre Frequency (Hz)									Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	8k	
Kiln 9										
AC units east	-	101	100	93	102	91	88	84	78	**100**
Bag house fan motor	-	93	95	87	83	83	80	85	79	**90**
Dryer fan exhaust east and west (with silencer)	-	92	90	87	79	79	80	78	70	**86**
East and west walls	-	103	105	101	96	93	88	82	75	**99**
East wall top opening	-	97	101	96	93	89	87	82	76	**96**
Roof	-	105	105	97	84	69	59	49	42	**92**
Stack	-	99	90	69	44	34	51	64	62	**77**
South facade	-	101	102	98	94	90	85	79	72	**96**
South facade louvres	-	93	97	92	89	86	83	78	72	**92**
Kiln 10										
Bag house fan motor	-	88	85	98	84	85	83	86	80	**88**
Conveyors	-	94	96	95	94	93	86	79	71	**96**
Dehacker vacuum fan	-	98	100	96	96	90	88	86	84	**97**
East wall	-	100	101	90	84	82	81	80	71	**90**
Oil cooler fan	-	94	96	98	97	95	90	84	75	**94**
Roof mid-section	-	101	99	89	77	69	56	51	45	**101**
Roof south-section	-	98	97	86	74	66	53	49	42	**98**
Roof north-section	-	100	99	88	76	68	55	50	44	**100**
South wall	-	93	93	83	76	75	73	73	63	**82**
Stack	-	99	90	69	44	34	51	64	62	**99**
West wall	-	98	98	88	81	80	78	78	68	**88**

Table 3-2 continued on following page

Description	Octave Band Centre Frequency (Hz)									Overall dB(A)
	31.5	63	125	250	500	1k	2k	4k	8k	
Kiln 11 (Existing Scenario Only)										
Bag house fan motor	-	95	90	98	92	87	87	90	84	**96**
East wall	-	92	88	88	82	79	77	71	64	**85**
Roof	-	111	99	99	91	84	79	73	68	**94**
South wall	-	92	88	88	82	79	77	71	64	**85**
Clay Shed										
Northern opening	116	104	101	98	93	87	84	78	71	**95**
South wall (steel clad)	115	103	94	-	-	-	-	-	-	**82**
West entry open area	105	90	92	89	88	86	83	77	71	**91**
Masonry Plant										
East Wall (Door Closed)	53	68	79	79	84	81	78	73	63	**88**
South Wall (Door Closed)	57	73	83	83	88	85	83	77	68	**92**
Roof	63	78	88	88	94	91	88	82	73	**98**
Other Sources										
Trucks, Driving Slowly	108	111	101	95	95	98	95	90	84	**101**
Brick Forklift	-	100	102	99	98	93	89	85	80	**99**

3.2 Background Noise Monitoring

Background noise monitoring was undertaken at 2 locations as shown in *Figure 3-7* and pictured in *Figure 3-8*. The loggers were placed immediately to the west of the existing noise bund so as to be significantly shielded from Midland Brickworks site noise. The equipment used were:

1. 01dB Type Duo (S/N10747)
2. Acoustic Research Laboratories Type Ngara (S/N: 8781CA)

All equipment holds current laboratory certificates of calibration that are available upon request. The equipment was also field calibrated before and after and found to be within +/- 0.5 dB. Each microphone was fitted with a standard wind screen and was at least 1.2 metres above ground level and at least 3.0 metres from reflecting facades (other than the ground plane).

The monitoring was undertaken between 01 October 2020 and 08 October 2020, coinciding with the school holiday period, that can be quieter due to reduced road traffic volumes than other periods.

Figure 3-7 Background Noise Monitoring Locations

Location 1

Location 2

Figure 3-8 Photographs of Noise Monitoring Equipment

3.3 Aircraft Noise Levels

Section 2.2 showed that Stage 1B is outside of ANEF 20 and Stage 2 is mostly the same, with 4 lots within ANEF 20. Whether within ANEF 20 or not, SPP 5.1 states that some areas may experience, currently or in the future, maximum aircraft noise levels in excess of the Indoor Design Sound Levels specified in AS2021[1], and noise insulation is recommended in such cases.

The ANEF contours are a planning tool and do not represent noise levels. As such, Perth Airport also produce N65 Contours, which represent the average number of daily aircraft above a noise level of 65 dB L_{Amax}, considered to represent a point at which normal conversation may be disturbed. An extract of these contours is provided in *Figure 3-9* with the approximate location of the subdivision. This shows that whilst the majority of Stage 1B and Stage 2 are outside ANEF 20, in the future the site may be subjected to 100-200 events per day above a noise level of 65 dB L_{Amax}.

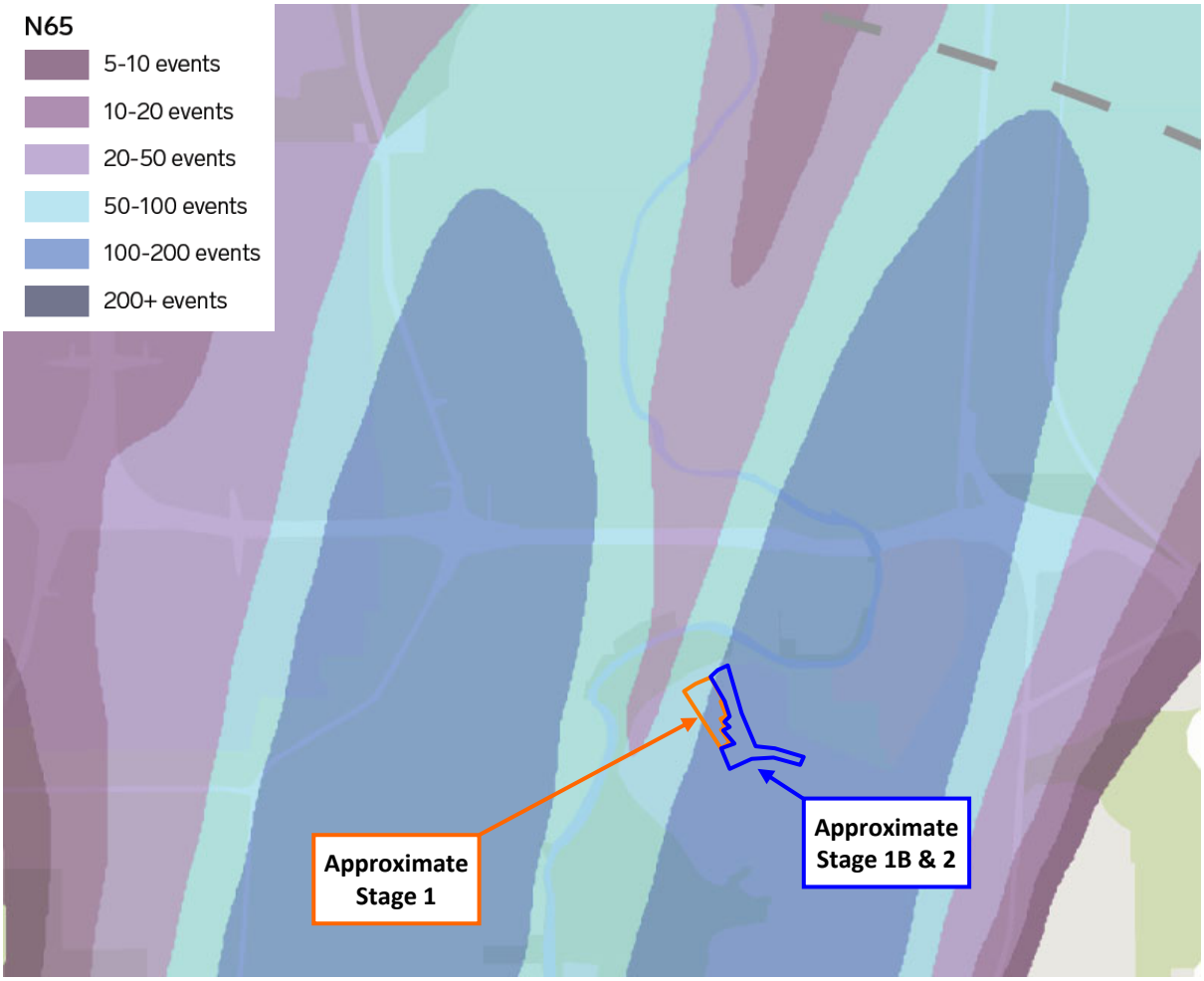


Figure 3-9 Site Locality in Relation to Ultimate N65 Contours

[1] Indoor design sound levels for residences are 50 dB L_{Amax} in bedrooms and 55 dB L_{Amax} in living areas.

Aircraft noise levels can be further explored by using the AS2021:2015 look-up tables. An example of this is shown in *Figure 3-10* for an Airbus A330 departing, with noise levels shown from each runway. This shows that the future runway would result in higher noise levels. *Table 3-3* and *Table 3-4* provide the noise levels using these look-up tables for various aircraft for the existing and future runway respectively.

NOISE LEVELS FOR AIRBUS A330-301 DEPARTURES

Centre-line distance (*DT*), m	Noise levels, dB(A) Sideline distance (*DS*), m																		
	0	100	200	300	400	500	600	700	800	900	1000	1200	1400	1600	1800	2000	2200	2400	2600
4000	91	91	90	88	86	84	82	80	78	76	75	72	70	68	66	64	62	60	59
4250	91	90	89	87	85	83	81	80	78	76	75	72	70	68	66	64	62	60	59
4500	90	90	89	87	85	83	81	80	78	76	75	72	70	68	66	64	62	60	59
4750	90	89	88	87	85	83	81	79	78	76	75	72	70	68	66	64	62	60	59
5000	89	89	88	87	85	83	81	79	78	76	75	72	70	68	66	64	62	60	59
5500	88	88	87	86	84	83	81	79	77	76	75	72	70	68	66	64	62	60	59
6000	88	87	87	85	84	82	80	79	77	76	75	72	70	68	66	64	62	60	59
6500	87	87	86	85	83	82	80	79	77	76	74	72	70	68	66	64	62	61	59
7000	83	83	82	81	80	79	78	77	75	74	73	71	69	67	65	63	62	60	59
7500	82	82	81	80	79	78	77	75	74	73	71	69	67	65	64	62	61	59	58
8000	81	81	80	79	79	77	76	75	74	72	71	69	67	65	63	61	59	58	57
8500	80	79	79	79	78	77	76	75	73	72	71	69	67	65	63	61	60	58	57
9000	79	78	78	78	77	76	75	74	73	72	71	69	67	65	63	62	60	58	57
9500	78	78	77	77	76	76	75	74	73	72	71	69	67	65	63	62	60	59	57
10 000	77	77	76	76	76	75	74	73	72	72	71	69	67	65	63	62	60	59	57
10 500	76	76	76	75	75	74	74	73	72	71	70	68	67	65	63	62	61	59	58
11 000	75	75	75	75	74	74	73	73	72	71	70	68	67	65	63	62	61	59	58
11 500	75	75	75	74	74	74	73	72	72	71	70	68	67	65	63	62	60	59	58
12 000	75	75	74	74	74	73	73	72	72	71	70	68	67	65	63	62	61	59	58
12 500	74	74	74	74	73	73	73	72	72	71	70	68	67	65	64	62	61	59	58
13 000	74	74	74	74	74	73	73	72	71	71	70	68	67	65	64	62	61	59	58
13 500	74	74	74	74	73	73	73	72	71	71	70	68	67	65	64	62	61	59	58
14 000	74	74	74	73	73	73	72	72	71	70	70	68	67	65	64	62	61	59	58
14 500	73	73	73	73	73	72	72	71	71	70	69	68	66	65	64	62	61	59	58
15 000	73	73	73	72	72	72	71	71	70	70	69	68	66	65	63	62	61	60	58
15 500	72	72	72	72	72	71	71	70	70	69	69	68	66	65	63	62	61	60	58
16 000	72	72	72	71	71	71	70	70	70	69	69	67	66	65	63	62	61	60	58
16 500	71	71	71	71	71	70	70	70	69	69	68	67	66	65	63	62	61	60	58
17 000	71	71	70	70	70	70	70	69	69	68	68	67	66	64	63	62	61	60	58

Future Runway

Existing Runway

Figure 3-10 AS2021 Look-up Table for Airbus 330

Table 3-3 Typical Worst-Case Noise Levels: Existing Runway

Aircraft	Noise Level, dB L_{Amax}	
	Departures	Arrivals
Airbus 319-131	60	53
Airbus 320-232	59	53
Airbus 321-232	61	54
Airbus 330-301	67	58
Airbus 380-841	65-66	58
Boeing 717-200	60	48
Boeing 737-800	67	57
Boeing 777-300	66	58
Boeing 787-8	62	55

Table 3-4 Typical Worst-Case Noise Levels: Future Runway

Aircraft	Noise Level, dB L_{Amax}	
	Departures	Arrivals
Airbus 319-131	68	70
Airbus 320-232	67	69
Airbus 321-232	69	71
Airbus 330-301	75	73
Airbus 380-841	70-76	74
Boeing 737-700	73	72
Boeing 737-800	73	73
Boeing 787-8	65-73	71

The look-up tables indicate that a number of different aircraft types result in noise levels above 65 dB L_{Amax}. This outcome aligns with the N65 contours in that despite being mostly outside ANEF 20, there may be some impacts from aircraft noise.

4 RESULTS

4.1 Background Noise Monitoring

The results of the noise monitoring are summarised in *Table 4-1* and plotted in *Figure 4-1* and *Figure 4-2* with the wind speed and direction from Perth Airport Bureau of Meteorology site also provided. The parameters presented are:

- L_{A90} – considered to represent the constant background noise level, being the noise level that is exceeded for 90% of the time or the lowest 10% of the noise;
- L_{Aeq} – is the equivalent constant noise level over the same time period and often described as the average noise level. This is important as it is used in the assessment of tonality.
- L_{A10} – is the noise level exceeded for 10% of the time and as such, noise levels are at or below this for 90% of the time.

As discussed further in *Section 4.2*, noise from the early morning truck movements is the dominant noise source and therefore the period of interest is from 6.00am to 7.00am Mondays to Fridays, since this is considered night-time in the Noise Regulations and has lower assigned noise levels. Noise levels for Saturday are also provided, however less truck activity is expected at the Midland Brickworks site.

There were two days (2 & 7-Oct-20) where winds were generally westerly and whilst the L_{A90} values are similar, the L_{Aeq} and L_{A10} values are significantly different. From the audio recordings, the noise levels were elevated on 7-Oct-20 due to a high number of aircraft flyover (approximately 19) as well as some local traffic.

Table 4-1 Background Noise Monitoring Results

Day/Date	Time	Location 1, dB			Location 2, dB			Wind Speed (m/s)	Wind Dir
		L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}		
Friday 2-Oct-20	6.00-6.20am	43	39	44	49	44	52	6.2	WSW
	6.20-6.40am	44	41	45	48	43	50	5.8	WSW
	6.40-7.00am	49	41	51	48	42	50	8.1	WSW
Saturday 3-Oct-20	6.00-6.20am	43	40	43	45	41	47	2.5	NE
	6.20-6.40am	44	41	44	44	42	46	2.5	NNE
	6.40-7.00am	43	40	44	53	41	54	2.1	NE

Table 4-1 continued on following page

Day/Date	Time	Location 1, dB			Location 2, dB			Wind Speed (m/s)	Wind Dir
		L_{Aeq}	L_{A90}	L_{A10}	L_{Aeq}	L_{A90}	L_{A10}		
Monday 5-Oct-20	6.00-6.20am	50	41	53	50	43	54	3.2	N
	6.20-6.40am	50	41	51	51	42	55	3.1	N
	6.40-7.00am	53	42	57	52	42	56	2.9	NNE
Tuesday 6-Oct-20	6.00-6.20am	53	40	58	53	44	57	5.3	NNE
	6.20-6.40am	53	41	58	53	44	58	5.5	NNE
	6.40-7.00am	53	41	58	53	43	57	4.9	NNE
Wednesday 7-Oct-20	6.00-6.20am	55	39	60	55	41	60	6.7	WSW
	6.20-6.40am	56	43	60	54	42	60	5.0	WSW
	6.40-7.00am	57	44	61	55	43	60	5.0	W
Thursday 8-Oct-20	6.00-6.20am	49	45	51	50	46	51	2.3	NE
	6.20-6.40am	46	42	47	48	44	50	2.5	NNE
	6.40-7.00am	45	41	46	49	43	50	2.0	NNE

Figure 4-1 Background Noise Monitoring - Location 1

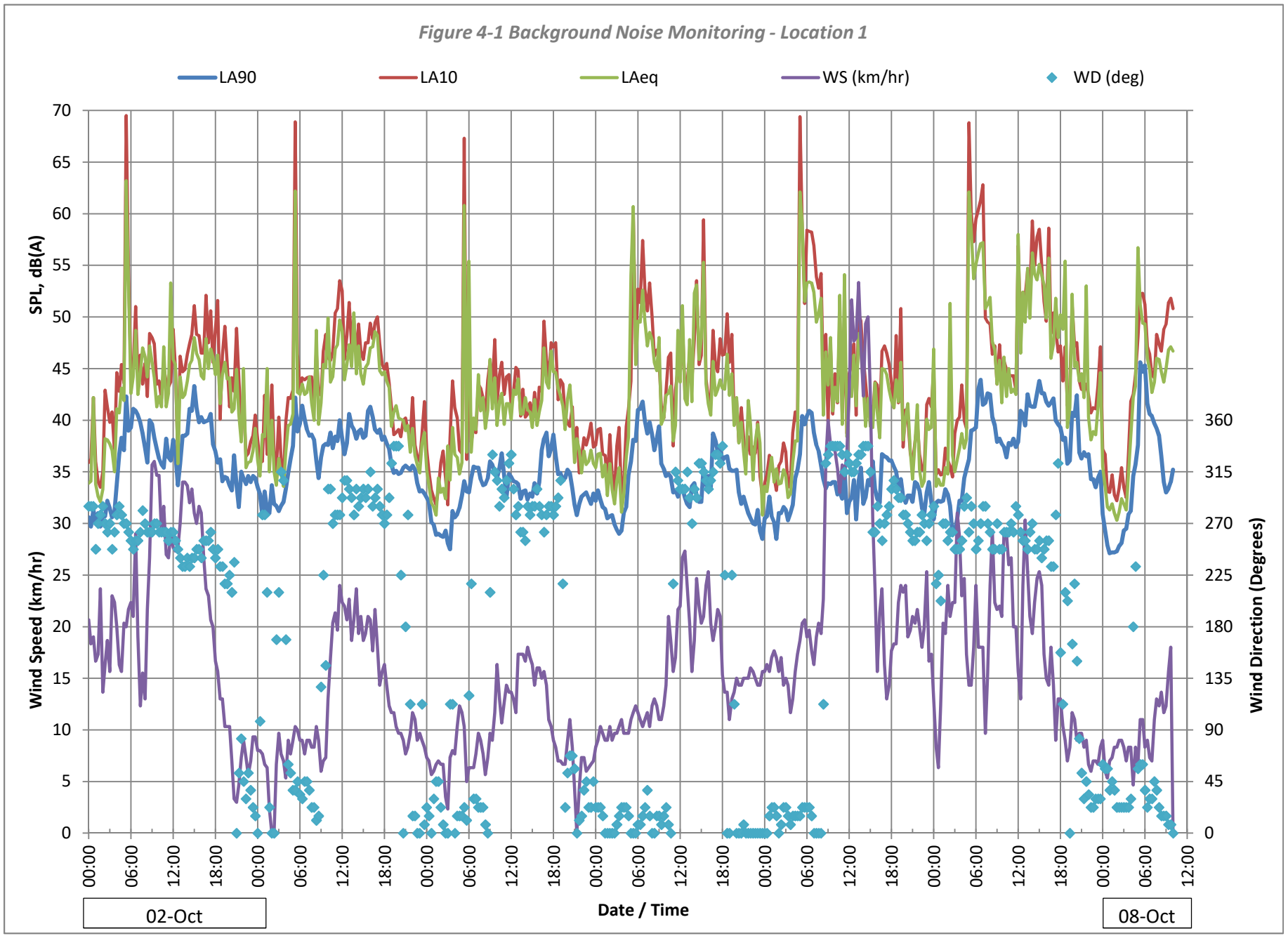
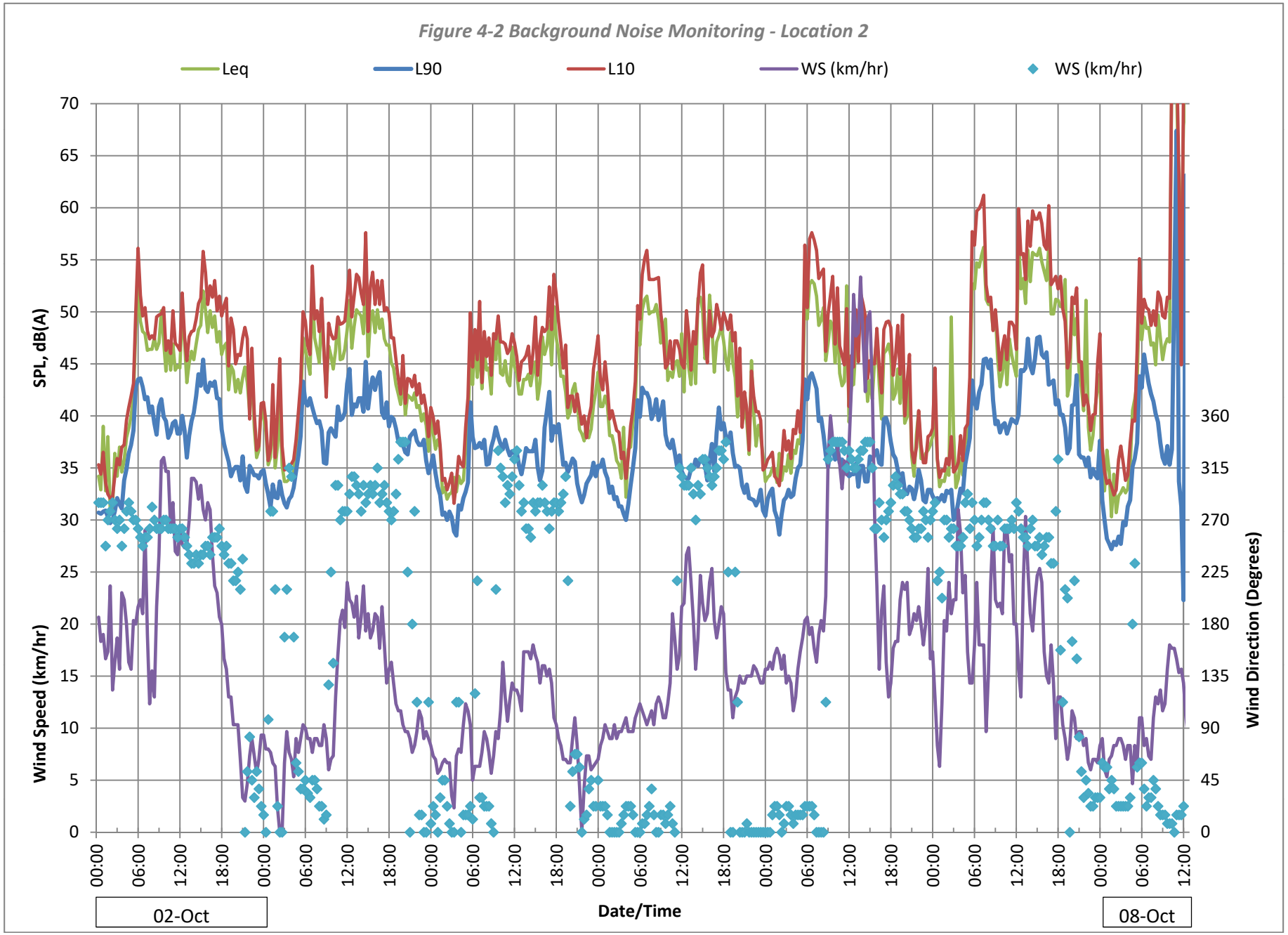


Figure 4-2 Background Noise Monitoring - Location 2



The most important days are considered to be 6 & 8-Oct-20 as the wind direction coincides with the time when noise from Midland Brick truck movements would be downwind. The background noise levels can be summarised as:

- Location 1 L_{A90} varies from 40-45 dB, L_{Aeq} from 45-53 dB and L_{A10} from 46-58 dB;
- Location 2 L_{A90} varies from 43-46 dB, L_{Aeq} from 48-53 dB and L_{A10} from 50-58 dB;

With reference to *Table 2-3*, the existing assigned noise levels range 37-43 dB L_{A10} prior to 7.00am and in the future, as more land becomes zoned residential, will reduce to 35 dB L_{A10}. The measurement results indicate that with operational noise from Midland Brick at or below the assigned levels, the background noise levels will be higher and mask intrusive characteristics, such that the *Table 2-1* adjustments are not considered applicable to the predicted noise levels.

4.2 Industrial Noise Modelling

With reference to *Section 3.1*, each of the modelling scenarios are discussed in *Section 4.2.1* to *Section 4.2.4*. Also provided are the most critical night-time assigned noise levels, applicable during the period of 10.00pm to 7.00am.

4.2.1 Existing (Scenario 1)

Table 4-2 presents the existing predicted noise levels at the existing receivers and compares the results to the night-time assigned noise level. This scenario includes truck movements in the western area, Kilns 9, 10 and 11 operating and the existing bund in place. Only the L_{A10} parameter is presented as this is the most critical in terms of compliance. As discussed in *Section 4.1*, due to relatively high background noise levels, no adjustments are made for intrusive characteristics.

Table 4-2 Predicted Noise Levels [dB L_{A10}] and Assessment Existing Conditions

Location	Predicted Noise Level	Assigned Night Level	Complies / Exceeds
71 Bernley Drive (Ground)	31	37	*Complies*
71 Bernley Drive (Upper)	39	37	+ 2 dB
42 Winston Crescent (Ground)	31	37	*Complies*
42 Winston crescent (Upper)	41	37	+ 4 dB
36 Harford Avenue	33	38	*Complies*
52 Cranwood Crescent	33	40	*Complies*

The noise modelling indicates that compliance is predicted to the ground floor of existing residences, however there may be exceedences to the upper floor (where one is present) as a result of the early morning trucks being the dominant noise source.

There have been no complaints from residents in this area, despite the predicted exceedences. The reasons for this may be:

- The model does not allow the L_{A10} noise from trucks to be readily calculated such that the technique uses the multiple point source method and then spreadsheet calculations. It is possible that the model is over-predicting the actual noise levels.
- From *Section 4.1*, the background noise levels (L_{A90}) are generally at or above the predicted noise levels with the average noise levels (L_{Aeq}) above the predicted noise levels. As such, calibration of the truck noise could only occur within the near-field of the trucks since the elevated background noise prevented the direct measurement of Midland Brick truck noise at existing residences.
- Due to the elevated background noise levels, primarily from Reid Highway, noise from Midland Brick is masked at the residences, such that the residents do not notice the noise.

The assumptions adopted in the noise modelling, e.g. that the wind is blowing from the source to the receiver, are inherently conservative and focused on replicating worst-case noise propagation conditions. As such, whilst exceedences are calculated, the model may be overly conservative and/or with background noise masking Midland Brickworks site noise, there is no actual perceived impact.

4.2.2 Stage 1B and Stage 2 (Transition Period - Scenario 2)

The scenario assumes residences are occupying Stages 1, 1B and 2 with early morning trucks no longer occurring south of Bassett Road. The noise wall is in position with the southern containers removed (as per *Appendix B*). All of the existing bund is removed and Area 3 of the overall development is assumed to be zoned residential (lowering the assigned noise levels). The results are presented in *Table 4-3*.

Table 4-3 Predicted Noise Levels [dB L_{A10}] and Assessment for Scenario 2

Receiver	Predicted Noise Level	Assigned Night Level	Complies / Exceeds
71 Bernley Dr (Ground)	33	37	*Complies*
71 Bernley Dr (Upper)	34	37	*Complies*
42 Winston Cr (Ground)	33	37	*Complies*
42 Winston Cr (Upper)	35	37	*Complies*
36 Harford Av	35	37	*Complies*
52 Cranwood Cr	35	37	*Complies*
Stage 1B Lot 10 (Ground)	34	39	*Complies*
Stage 1B Lot 10 (Upper)	37	39	*Complies*
Stage 1B Lot 22 (Ground)	34	41	*Complies*
Stage 1B Lot 22 (Upper)	36	41	*Complies*
Stage 1B Lot 38 (Ground)	35	39	*Complies*

Receiver	Predicted Noise Level	Assigned Night Level	Complies / Exceeds
Stage 1B Lot 38 (Upper)	37	39	*Complies*
Stage 2 Lot 46 (Ground)	36	38	*Complies*
Stage 2 Lot 46 (Upper)	37	38	*Complies*
Stage 2 Lot 53 (Ground)	34	40	*Complies*
Stage 2 Lot 53 (Upper)	37	40	*Complies*

The above shows that compliance is achieved at existing and future residences at all times, noting that background noise levels are expected to be higher than the predicted noise levels and will therefore mask the operation noise from the brickworks.

4.2.3 Stage 1B and Stage 2 (Scenario 3)

This scenario now assumes Kiln 11 has been decommissioned. The noise wall is still in position and the results are presented in *Table 4-4*.

Table 4-4 Predicted Noise Levels [dB L_{A10}] and Assessment for Scenario 3

Location	Predicted Noise Level	Assigned Night Level	Complies / Exceeds
71 Bernley Drive (Ground)	28	37	*Complies*
71 Bernley Drive (Upper)	33	37	*Complies*
42 Winston Crescent (Ground)	32	37	*Complies*
42 Winston crescent (Upper)	35	37	*Complies*
36 Harford Avenue	33	37	*Complies*
52 Cranwood Crescent	33	37	*Complies*
Stage 1B Lot 10 (Ground)	33	39	*Complies*
Stage 1B Lot 10 (Upper)	34	39	*Complies*
Stage 1B Lot 22 (Ground)	30	41	*Complies*
Stage 1B Lot 22 (Upper)	34	41	*Complies*
Stage 1B Lot 38 (Ground)	31	39	*Complies*
Stage 1B Lot 38 (Upper)	34	39	*Complies*
Stage 2 Lot 46 (Ground)	34	38	*Complies*
Stage 2 Lot 46 (Upper)	34	38	*Complies*
Stage 2 Lot 53 (Ground)	31	40	*Complies*
Stage 2 Lot 53 (Upper)	34	40	*Complies*

As expected, noise levels are less in this scenario, with the removal of Kiln 11, and therefore still compliant.

4.2.4 Stage 1B and Stage 2 (No Noise Wall - Scenario 4)

With the noise sources moved substantially further away from both the houses and noise wall, the effectiveness of the noise wall is likely to be small. As such, consideration was given to the noise levels if the noise wall was removed with the results presented in *Table 4-5*.

Table 4-5 Predicted Noise Levels [dB L_{A10}] and Assessment for Scenario 4

Location	Predicted Noise Level	Assigned Night Level	Complies / Exceeds
71 Bernley Drive (Ground)	28	37	*Complies*
71 Bernley Drive (Upper)	33	37	*Complies*
42 Winston Crescent (Ground)	32	37	*Complies*
42 Winston crescent (Upper)	35	37	*Complies*
36 Harford Avenue	33	37	*Complies*
52 Cranwood Crescent	34	37	*Complies*
Stage 1B Lot 10 (Ground)	34	39	*Complies*
Stage 1B Lot 10 (Upper)	34	39	*Complies*
Stage 1B Lot 22 (Ground)	35	41	*Complies*
Stage 1B Lot 22 (Upper)	34	41	*Complies*
Stage 1B Lot 38 (Ground)	35	39	*Complies*
Stage 1B Lot 38 (Upper)	34	39	*Complies*
Stage 2 Lot 46 (Ground)	34	38	*Complies*
Stage 2 Lot 46 (Upper)	34	38	*Complies*
Stage 2 Lot 53 (Ground)	35	40	*Complies*
Stage 2 Lot 53 (Upper)	34	40	*Complies*

The above shows that there is negligible noise level increase to a potential upper floor if the noise wall is removed. It also shows that whilst there are noise level increases to some ground floors, noise levels remain below the assigned noise levels and are therefore compliant.

In the longer term the brickworks site, or part thereof, is planned to be rezoned as urban. This will mean there will be additional houses between Stages 1B and 2 and the consolidated brickworks that will provide barrier attenuation to these Stages. However, with reduced industrial land, the night-time assigned noise level will also reduce to a minimum of 35 dB L_{A10}. When this is the case, *Table 4-5* shows that noise levels will comply at all existing and future residences.

4.3 Aircraft Expected Noise Levels

As discussed in *Section 3.2*, whilst all of Stage 1B and the majority of Stage 2 lots are outside of ANEF 20, a number of aircraft events above 65 dB L_{Amax} may occur in the future, ranging from 100-200 per day depending on a lot's locality. The most impact will be from aircraft using the future parallel runway. *Table 4-6* shows the noise levels along with the average day and night movements (rounded to nearest whole number), obtained from the ANEF plot for 2080 forecast movements.

Table 4-6 Typical Worst-Case Noise Levels: 2080 Runway and Movement Times

Aircraft	Noise Level, dB L_{Amax} Arrival	Number of Movements	
		Day	Night
Airbus 319-131	70	10	5
Airbus 320-232	69	10	3
Airbus 321-232	71	9	8
Airbus 330-301	73	5	2
Airbus 380-841	74	6	3
Boeing 737-700	72	1	1
Boeing 737-800	73	31	21
Boeing 787-8	71	29	18
Total		101	61

Given the majority of Stage 1B and Stage 2 lots are either outside ANEF 20 or marginally within, mandatory detailed house assessments are considered unnecessary. However, noting the number of future movements and whilst not required in the WAPC Approval Conditions, it will be recommended to future lot owners that some facade upgrades be considered such as:

- All external glazing to be minimum 6mm thick;
- External windows to habitable rooms be fixed or awning style;
- External sliding doors, bi-fold doors or similar to be fitted with acoustic seals;
- Timber entry door or timber door to habitable rooms to be minimum 35mm thick, solid timber core with full perimeter acoustic seals.

Standard glazing in a sliding window frame is expected to achieve $R_w + C_{tr}$ 20 performance. An awning style window with 6mm thick glass is expected to achieve around $R_w + C_{tr}$ 28 performance representing an 8 dB increase in noise reduction.

Such facade upgrades would also attenuate other external noises such as from the Midland Brick site and road traffic.

5 CONCLUSION

To manage noise impacts to the proposed Stage 1B and Stage 2 subdivision, the following is proposed to be implemented:

- All lots are to incorporate the following notifications:

  "This lot is in close proximity to an existing bricks works and may be adversely affected by virtue of gaseous, odour, noise and/or dust emissions from that facility."

  "This lot is situated in the vicinity of Perth Airport, and is currently affected, or may in the future, be affected by aircraft noise. Noise exposure levels are likely to increase in the future as a result of increases in numbers of aircraft using the airport, changes in aircraft type or other operational changes. Further information about aircraft noise, including development restrictions and noise insulation requirements for noise affected properties, are available on request from the relevant local government offices."

  The above will address Condition 3 and 6 of the subdivision approval.

- It is suggested (not mandatory) that the following be considered in the construction of dwellings:

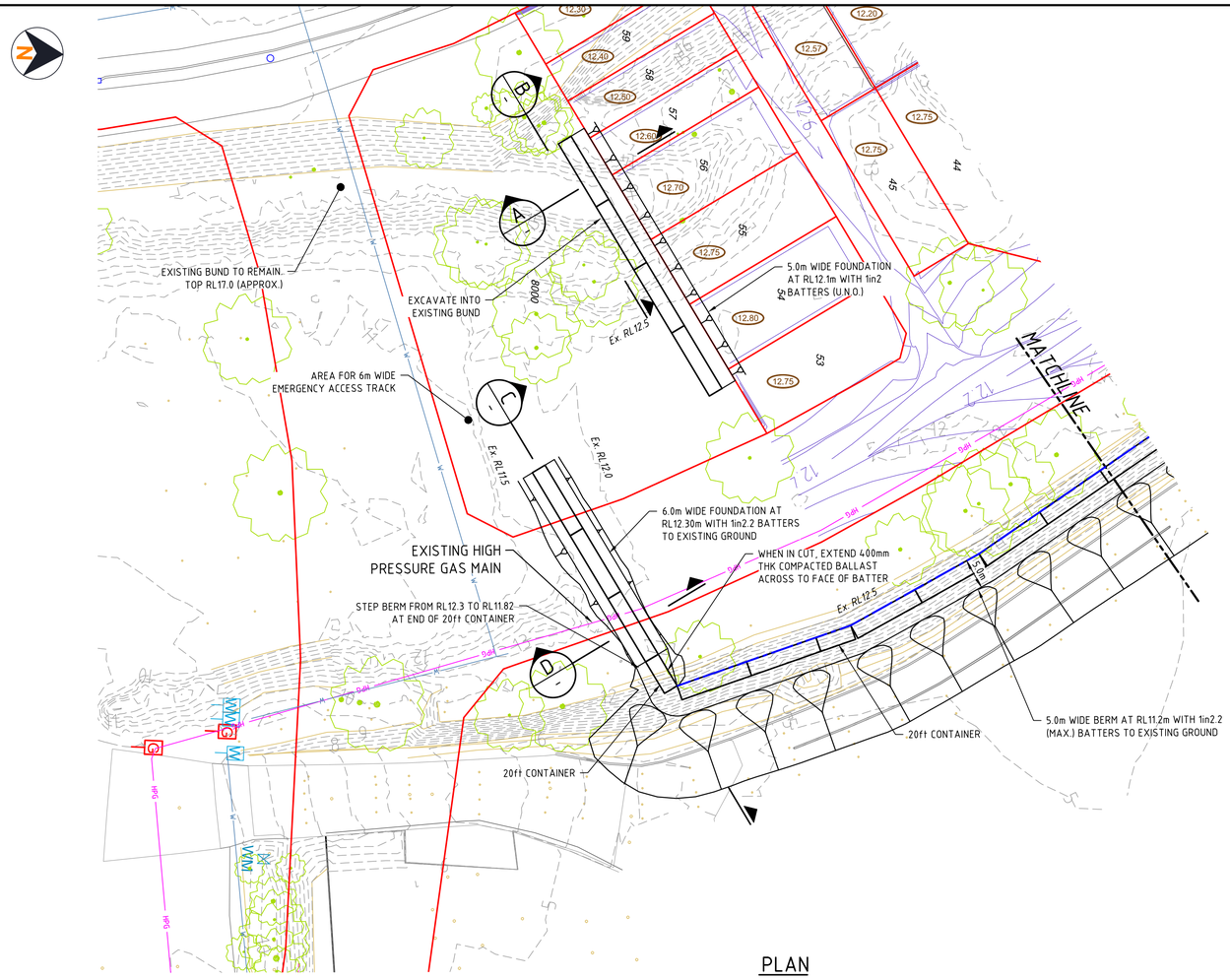
  - All external glazing to be minimum 6mm thick;
  - External windows to habitable rooms be fixed or awning style;
  - External sliding doors, bi-fold doors or similar to be fitted with acoustic seals;
  - Timber entry door or timber door to habitable rooms to be minimum 35mm thick, solid timber core with full perimeter acoustic seals.

  The above will be included on the Local Development Plan (LDP) to satisfy Condition 2 and Condition 16 of the subdivision approval.

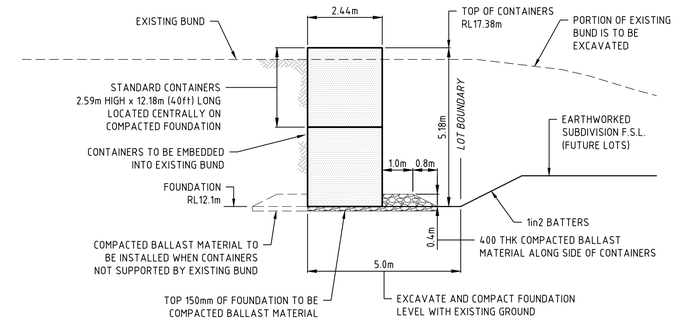
The analysis has shown that with Kiln 11 still operating and with the noise wall in place, compliance is achieved at Stage 1B and Stage 2. Once Kiln 11 is decommissioned, compliance is achieved with or without the noise wall in place, since the majority of the Midland Brick operations have been consolidated north of Bassett Road. As such, where the subdivision conditions refer to a noise wall, this is only required whilst Kiln 11 remains operational.

Appendix A

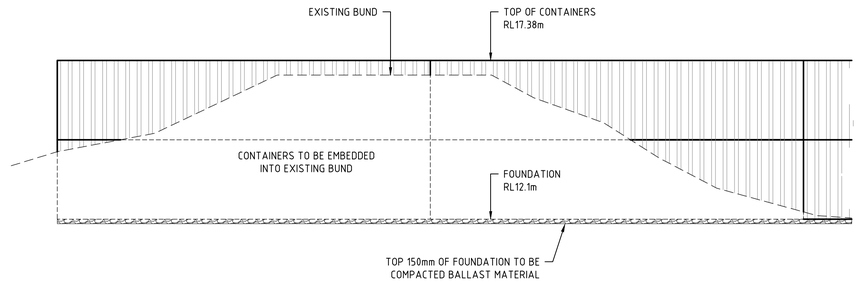
Stage 1Noise Wall Drawings



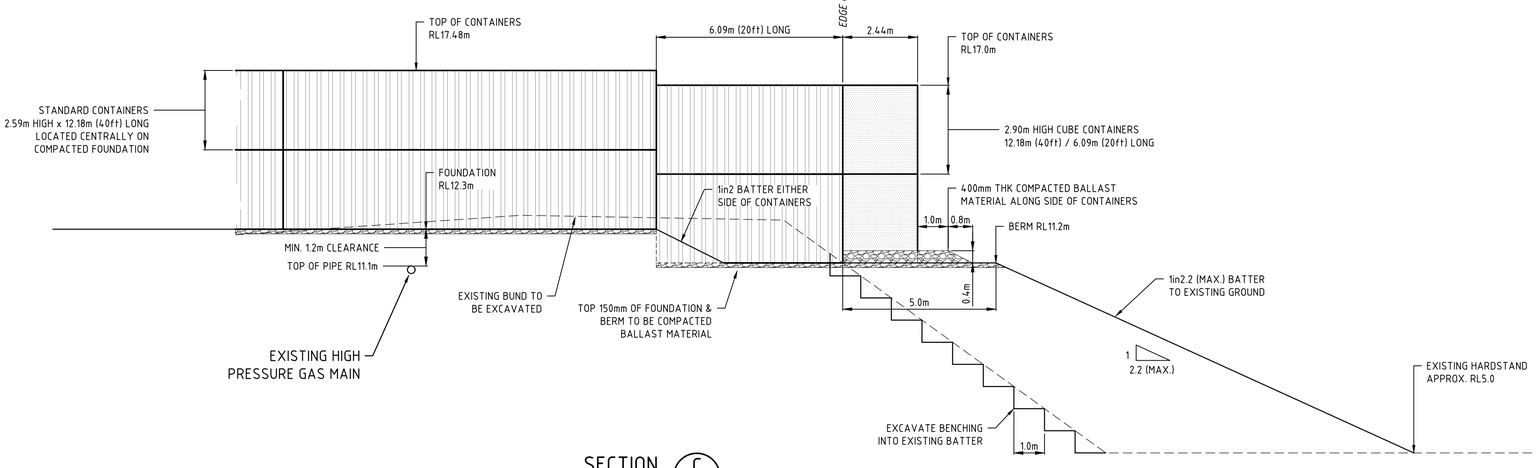
PLAN
1:500



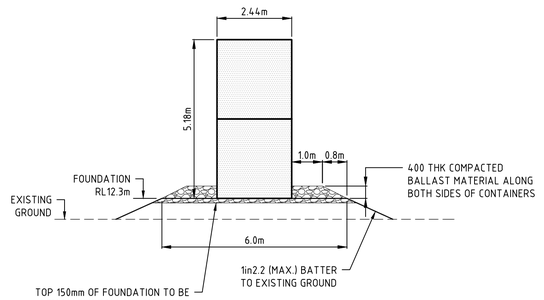
SECTION A
1:100



ELEVATION B
1:100



SECTION C
1:100



SECTION D
1:100

NOTES

1. NOISEWALL TO BE CONSTRUCTED USING STANDARD (2.59m) OR HIGH CUBE (2.90m)SEA CONTAINERS.
2. CONTAINERS TO TYPICALLY BE 12.18m (40ft) LONG UNLESS INDICATED ON THE PLAN AS BEING 6.08m (20ft) LONG.

SEA CONTAINER NOISEWALL

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS IT HAS BEEN CERTIFIED BY A PRACTISING STRUCTURAL ENGINEER.

Terpkos Engineering Pty Ltd

STRUCTURAL ENGINEER | COMPANY | DATE

WAPC No. 158848

SCALE 1:500 1:100

A1

No.	DATE	DRAWN	APPROVED	AMENDMENT
B	11.11.20	RDE	CCB	ISSUED FOR PRICING.
A	15.10.20	RDE	CCB	ISSUED FOR COMMENTS.

This plan shall not to be used for construction unless issued as rev 0 and signed as approved.

CLIENT HESPERIA LINC + FINI

DESIGNED	CHECKED	APPROVED
RDE	CCB	C.BITMEAD
DRAWN	CHECKED	DATE
RDE	CCB	11.11.20

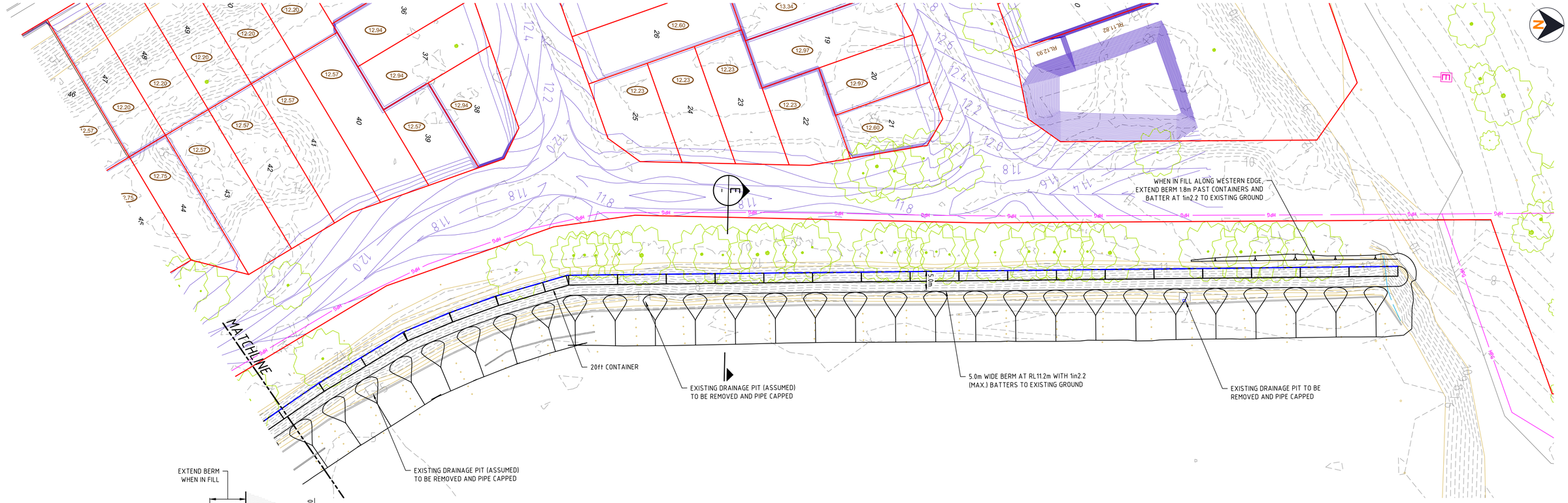
TABEC Civil Engineering Consultants
TABEC PTY LTD ACN 090 796 204
14 Wickham Street, East Perth WA 6004
t 08 9425 5900 e info@tabec.com.au
www.tabec.com.au

PROJECT MIDLAND BRICK - STAGE 1A

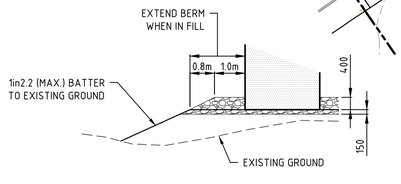
TITLE NOISEWALL PLAN SHEET 1

DRAWING NUMBER 2419-1A-160 ISSUE B

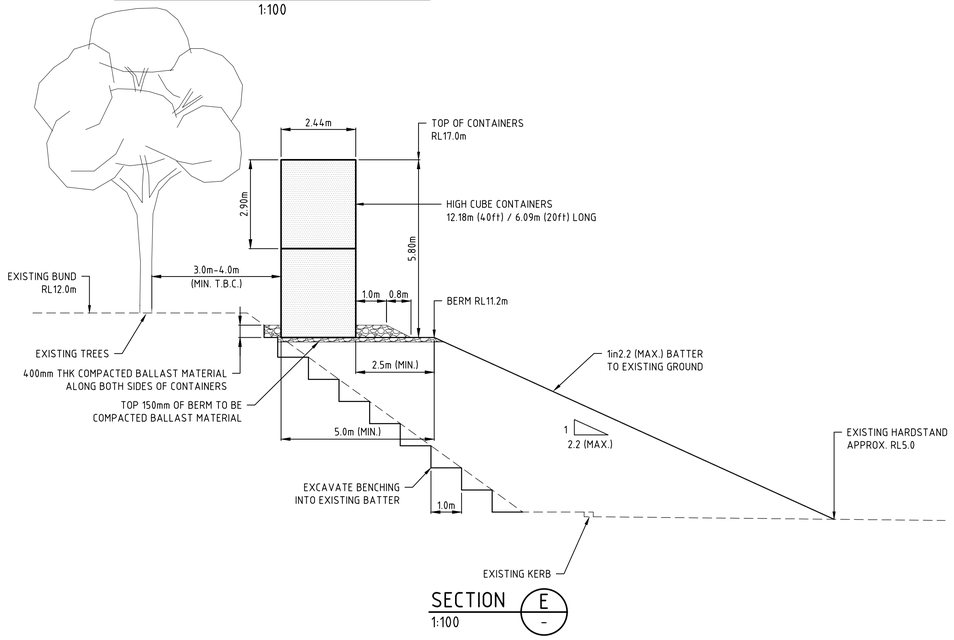
T:\Projects\2419\Design\CAD\Drawings\Stage 1A\2419-1A-160.dwg 10/11/20 2:53:49 revans



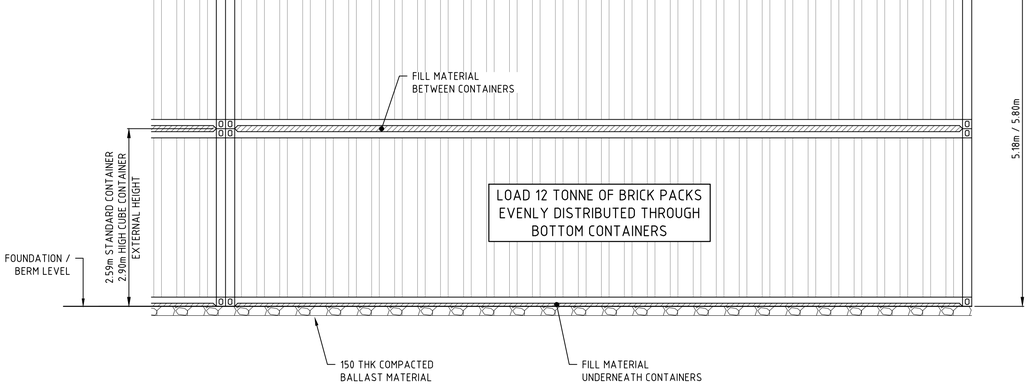
PLAN
1:500



WESTERN INTERFACE WHEN IN FILL
1:100



SECTION E
1:100



TYPICAL CONTAINER ELEVATION
1:50

NOTES

1. NOISEWALL TO BE CONSTRUCTED USING STANDARD (2.59m) OR HIGH CUBE (2.90m)SEA CONTAINERS.
2. CONTAINERS TO TYPICALLY BE 12.18m (40ft) LONG UNLESS INDICATED ON THE PLAN AS BEING 6.08m (20ft) LONG.

SEA CONTAINER NOISEWALL

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS IT HAS BEEN CERTIFIED BY A PRACTISING STRUCTURAL ENGINEER.

Terpkos Engineering Pty Ltd

STRUCTURAL ENGINEER | COMPANY | DATE

WAPC No. 158848

SCALE 1:500 | A1

No.	DATE	DRAWN	APPROVED	AMENDMENT
B	11.11.20	RDE	CCB	ISSUED FOR PRICING.
A	15.10.20	RDE	CCB	ISSUED FOR COMMENTS.

CLIENT: HESPERIA LINC + FINI

DESIGNED	CHECKED	APPROVED
RDE	CCB	C.BITMEAD
DRAWN	CHECKED	DATE
RDE	CCB	11.11.20

TABEC Civil Engineering Consultants
TABEC PTY LTD ACN 090 796 204
14 Wickham Street, East Perth WA 6004
t 08 9425 5900 e info@tabec.com.au www.tabec.com.au

PROJECT: MIDLAND BRICK - STAGE 1A
TITLE: NOISEWALL PLAN SHEET 2
DRAWING NUMBER: 2419-1A-161
ISSUE: B

T:\Projects\2419\Design\CAD\Drawings\Stage 1A\2419-1A-160-161.dwg 10/11/20 2:53:49 revons

Appendix B

Stage 1B and 2 Noise Wall Drawing

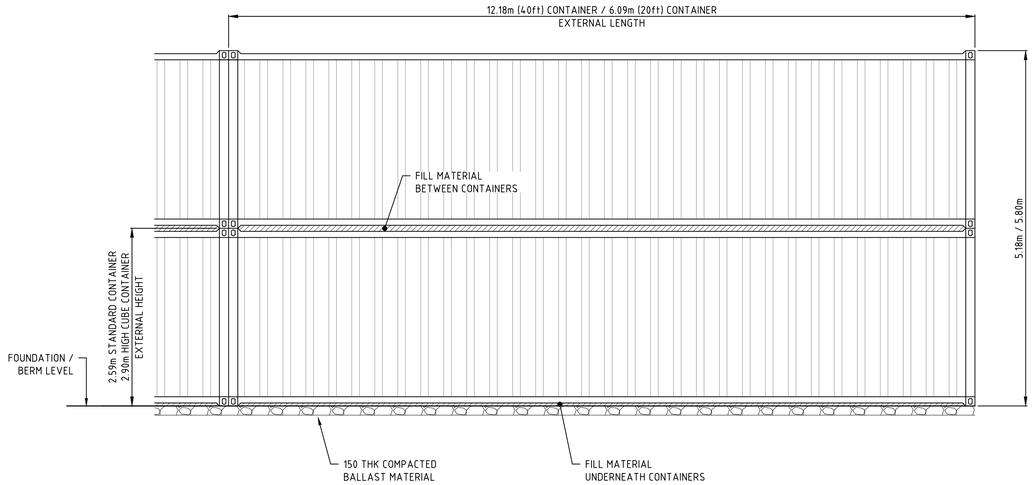
SEA CONTAINERS TO BE REMOVED AS PART OF STAGE 2 WORKS

SEA CONTAINERS TO BE REMOVED AS PART OF STAGE 2 WORKS

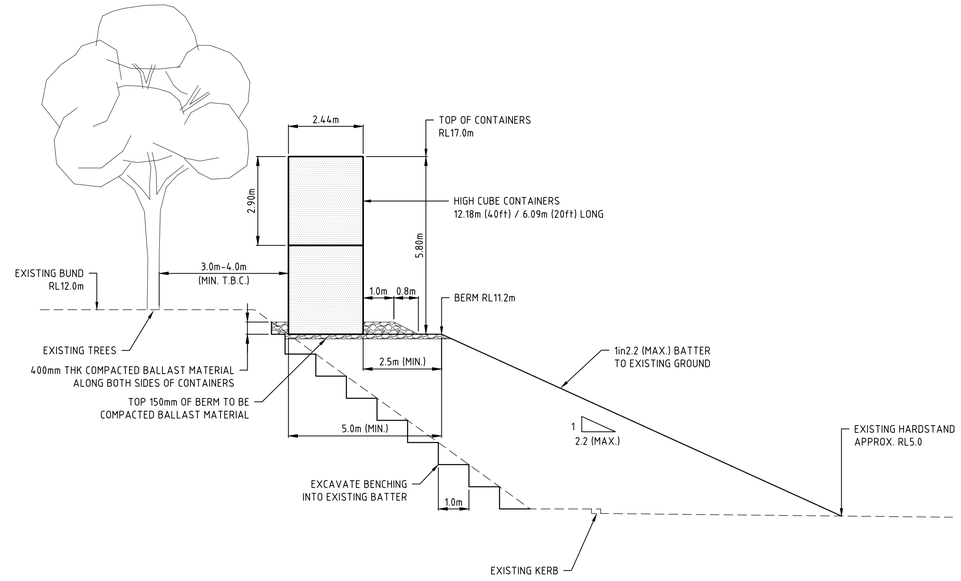
EXISTING HIGH PRESSURE GAS MAIN

EXISTING SEA CONTAINER NOISEWALL

PLAN
1:500



TYPICAL SEA CONTAINER NOISEWALL ELEVATION
(FOR INFORMATION ONLY)
1:50



TYPICAL SEA CONTAINER NOISEWALL CROSS SECTION
(FOR INFORMATION ONLY)
SECTION A
1:100

WAPC No. 158848

SCALE 1:500

A1

No.	DATE	DRAWN	APPROVED	AMENDMENT
A	01.12.20	RDE	CCB	ISSUED FOR COMMENTS.

CLIENT: HESPERIA LINC + FINI

DESIGNED	CHECKED	APPROVED
RDE	CCB	C.BITMEAD
DRAWN	CHECKED	DATE
RDE	CCB	01.12.20

TABEC Civil Engineering Consultants
TABEC PTY LTD
ACN 090 796 204
14 Wickham Street, East Perth WA 6004
t 08 9425 5900 e info@tabec.com.au
www.tabec.com.au

PROJECT: MIDLAND BRICK - STAGE 2

TITLE: NOISEWALL PLAN

DRAWING NUMBER: 2419-02-160

ISSUE: A

T:\Projects\2419\Design\CAD\Drawings\Stage 02\2419-02-160.dwg 01/12/20 11:23:57 revans

Appendix C

Terminology

The following is an explanation of the terminology used throughout this report.

Decibel (dB)
The decibel is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting
An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound level is described as L_A dB.

Sound Power Level (L_w)
Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be directly measured using a sound level meter but is calculated based on measured sound pressure levels at known distances. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level (L_p)
The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

L_{ASlow}
This is the noise level in decibels, obtained using the A frequency weighting and the S (Slow) time weighting as specified in IEC 61672-1:2002. Unless assessing modulation, all measurements use the slow time weighting characteristic.

L_{AFast}
This is the noise level in decibels, obtained using the A frequency weighting and the F (Fast) time weighting as specified in IEC 61672-1:2002. This is used when assessing the presence of modulation only.

L_{APeak}
This is the greatest absolute instantaneous sound pressure in decibels using the A frequency weighting as specified in IEC 61672-1:2002.

L_{Amax}
An L_{Amax} level is the maximum A-weighted noise level during a particular measurement.

L_{A1}
An L_{A1} level is the A-weighted noise level which is exceeded for one percent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}
An L_{A10} level is the A-weighted noise level which is exceeded for 10 percent of the measurement period and is considered to represent the "*intrusive*" noise level.

L_{Aeq}
The equivalent steady state A-weighted sound level ("equal energy") in decibels which, in a specified time period, contains the same acoustic energy as the time-varying level during the same period. It is considered to represent the "average" noise level.

L_{A90}
An L_{A90} level is the A-weighted noise level which is exceeded for 90 percent of the measurement period and is considered to represent the "*background*" noise level.

One-Third-Octave Band
Means a band of frequencies spanning one-third of an octave and having a centre frequency between 25 Hz and 20 000 Hz inclusive.

L_{Amax} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded at any time.

L_{A1} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 1% of the representative assessment period.

L_{A10} assigned level
Means an assigned level which, measured as a $L_{A\ Slow}$ value, is not to be exceeded for more than 10% of the representative assessment period.

Tonal Noise
A tonal noise source can be described as a source that has a distinctive noise emission in one or more frequencies. An example would be whining or droning. The quantitative definition of tonality is:

the presence in the noise emission of tonal characteristics where the difference between -

(a) the A-weighted sound pressure level in any one-third octave band; and

(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

This is relatively common in most noise sources.

Modulating Noise
A modulating source is regular, cyclic and audible and is present for at least 10% of the measurement period. The quantitative definition of modulation is:

a variation in the emission of noise that —

(a) is more than 3 dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;

(b) is present for at least 10% of the representative.

Impulsive Noise
An impulsive noise source has a short-term banging, clunking or explosive sound. The quantitative definition of impulsiveness is:

a variation in the emission of a noise where the difference between $L_{A\ peak}$ and $L_{A\ Max\ slow}$ is more than 15 dB when determined for a single representative event;

Major Road
Is a road with an estimated average daily traffic count of more than 15,000 vehicles.

Secondary / Minor Road
Is a road with an estimated average daily traffic count of between 6,000 and 15,000 vehicles.

Influencing Factor (IF)

$$= \frac{1}{10}(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}) + \frac{1}{20}(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450})$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a 100m radius of the premises receiving the noise

$\%\text{Type A}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a 100m radius of the premises receiving the noise

$\%\text{Type B}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

Representative Assessment Period
Means a period of time not less than 15 minutes, and not exceeding four hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

Background Noise
Background noise or residual noise is the noise level from sources other than the source of concern. When measuring environmental noise, residual sound is often a problem. One reason is that regulations often require that the noise from different types of sources be dealt with separately. This separation, e.g. of traffic noise from industrial noise, is often difficult to accomplish in practice. Another reason is that the measurements are normally carried out outdoors. Wind-induced noise, directly on the microphone and indirectly on trees, buildings, etc., may also affect the result. The character of these noise sources can make it difficult or even impossible to carry out any corrections.

Ambient Noise
Means the level of noise from all sources, including background noise from near and far and the source of interest.

Specific Noise
Relates to the component of the ambient noise that is of interest. This can be referred to as the noise of concern or the noise of interest.

Australian Noise Exposure Forecast (ANEF)
A single number index for predicting the cumulative exposure to aircraft noise in communities near aerodromes during a specified time period (normally one year).

NOTE: The computation of this index includes—

(a) measurements of aircraft noise (expressed in Effective Perceived Noise Decibels, EPNdB), which take account of the spectral, temporal and spatial aspects of the noise;

(b) estimates and generalizations of aircraft type groups and mix, number of operations, runway utilization, flight paths and operational procedures; and

(c) time of day, i.e. whether daytime (0700 hours to 1900 hours) or evening/night-time (1900 hours to 0700 hours).

This single number index is useful for rating the compatibility of various land uses with respect to aircraft noise. For this purpose, equivalent ANEF values at individual positions around an aerodrome are combined on a map to form ANEF contours.

Acceptable
If from Table 2.1, the building site is classified as 'acceptable', there is usually no need for the building construction to provide protection specifically against aircraft noise. However, it should not be inferred that aircraft noise will be unnoticeable in areas outside the ANEF 20 contour. (See Notes 1, 2 and 3 of Table 2.1.)

Conditionally Acceptable
If from Table 2.1, the building site is classified as 'conditionally acceptable', the maximum aircraft noise levels for the relevant aircraft and the required noise reduction should be determined from the procedure of Clauses 3.1 and 3.2, and the aircraft noise attenuation to be expected from the proposed construction should be determined in accordance with Clause 3.3 (see Notes 1 and 3 of Table 2.1).

Unacceptable
If, from Table 2.1 the building site is classified as 'unacceptable', construction of the proposed building should not normally be considered. Where in the community interest redevelopment is to occur in such areas, e.g. a hotel in the immediate vicinity of an aerodrome, refer to the notes to Table 2.1.

DS
The distance in metres from the building site to the extended runway centerline along the line drawn in Figure 3.1 of AS2021.

DL
The distance in metres from the closer end of the runway to the intersection of the extended runway centre-line and the line drawn Figure 3.1 of AS2021.

DT
The distance in metres from the further end of the runway to the intersection of the runway centre-line and the line drawn Figure 3.1 of AS2021.

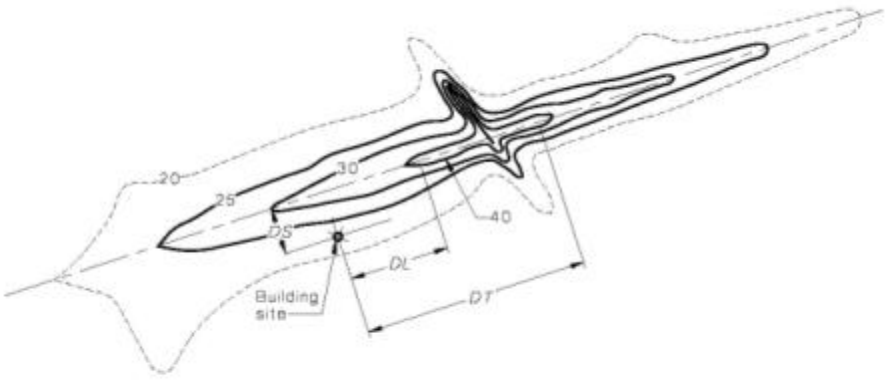
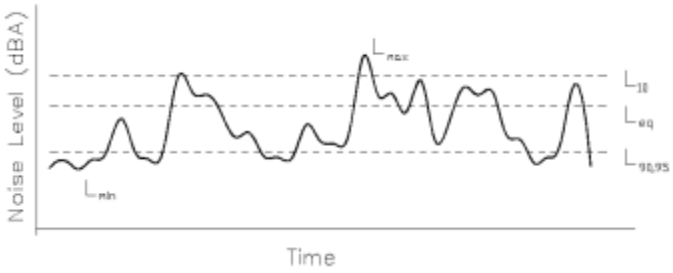


FIGURE 3.1 DETERMINATION OF *DS*, *DL* AND *DT* FOR STRAIGHT FLIGHT PATHS

Chart of Noise Level Descriptors



Typical Noise Levels