12.1 Introduction

This chapter summarises the noise and vibration impact assessment for the proposed Biomass Power Plant. The full assessment is contained in **Appendix G**.

The potential noise impacts of the site were assessed in accordance with the following documents:

- NSW Department of Environment, Climate Change and Water (DECCW) Industrial Noise Policy (INP, EPA 1999) for the assessment of the operational noise of the proposed development with consideration of NSW INP Application Notes (2006).
- NSW DECCW Environmental Criteria for Road Traffic Noise (ECRTN, EPA 1999) for the assessment of the off-site traffic noise on public roads.
- NSW DECCW Interim Construction Noise Guidelines (DECC, 2009) for the assessment of the noise from construction of the proposed development.
- World Health Organisation Guidelines for Community Noise (1999).

Vibration impacts of the proposed construction and operation of the Power Plant have not been assessed. The distance from the proposed Power Plant to the nearest receptor is approximately 800 m and the vibration impacts would be negligible.

12.2 Methodology

12.2.1 Existing and Proposed Operations

The existing SEFE mill includes log receival and storage, debarking, chipping and an associated process plant, and a wharf / ship-loading facility for the export of woodchips.

Normal operating hours are 7.00 am to 11.00 pm Monday to Friday. Very occasionally the mill operates for a single shift on a Saturday. For the hardwood chipping line the operation is continuous other than for short stops to change chipper knives or attend to plant malfunctions as they randomly arise. Softwood chipping line operations start at 7.00 am but the shutdown time varies from 6.00 pm to 11.00 pm depending on production requirements, which do not conform to a regular pattern.

Over the last fours years, between 917,217 and 1,002,968 t of logs have been processed at the Site annually. All timber received by the Site is delivered by truck between 7.00 am and 10.00 pm, Monday to Friday, and occasionally between 7.00 am and 2.30 pm on Saturday.

Ship-loading is undertaken in three-day campaigns around the clock. During loading, two chip dozers are deployed to reclaim chips on the site's chip stacks. This activity occurs up to 22 times per year.

SEFE has advised that the approximately 200 heavy vehicles currently access the Site daily. In addition to log transport, SEFE exports mulch to markets in the metropolitan areas of Sydney and Canberra. Typically 900 truck loads of mulch are sold each year.

Chapter 12 Noise and Vibration

Construction of the Power Plant would include the following facilities:

- weather proof fuel storage bunker;
- fuel reclaim bunker and feed conveyor to supply wood waste to the Power Plant;
- fuel storage bin;
- 18 MW grate furnace;
- superheated steam boiler;
- ash handling system;
- flue gas exhaust stack (35 m high) with an electrostatic precipitator;
- 5 MW multi-stage steam turbine;
- 11 KV generator set connected to the Site's existing high voltage switch room;
- vacuum steam condenser and cooling water system;
- seawater intake structure, delivery and return water pipelines, and diffuser; and
- ancillary plant such as boiler make-up water treatment plant and condensate pumping system.

The construction period will be around 15 months. The main construction activities would involve:

- earthworks including site grading, excavation and piling;
- establishing concrete foundations for the Power Plant;
- construction of buildings and installation of equipment and machinery.

The Power Plant would operate continuously on a four shift roster.

12.2.2 Noise Measurement Methodology

Noise measurements were conducted by long-term unattended monitoring and short-term attended monitoring at the closest noise sensitive receptors. Measurements were undertaken in accordance with AS1055:1997 "*Acoustics – Description and Measurement of Environmental Noise*".

An Acoustic Research Laboratories Environmental Noise Logger, model EL-316 was used for long-term monitoring and a SVANTEK SVAN959 sound level meter for short-term attended monitoring.

To analyse the measured long-term noise levels, meteorological observation provided by SEFE during the monitoring period and data from the nearest Bureau of Meteorology Automatic Weather Station (AWS), Green Cape (AWS ID: 69137), were reviewed. Monitoring periods affected by adverse weather conditions (rain and wind) were excluded. The height difference between the AWS (10 m above ground level) and the sound level meter (1.2 m above ground level) was taken into consideration with a correction factor to modify wind speed used for the data analysis. The weather conditions during the measurement periods would not have adversely affected the results.

12.2.3 Noise Measurement Locations

The closest noise sensitive receptors were identified from aerial photographs and a site inspection conducted in June 2009 (**Table 12-1**). **Figure 12-1** shows the location of these receptors.

Table 12-1 Noise Sensitive Receptors

Receptor	Location	Approx Distance from Power Plant (km)	Indicative Noise Amenity Area[1]	Nearest Site Boundary
A	Edrom Lodge, Edrom	0.8	Rural Residence	SSW
B	Boyd Road, East Boyd	2	Rural Residence	SW
C	Bramble Street, Eden	3.5	Suburban Residence	NNW
D	SEFE Camp[2]	0.5	Industrial-Interface Residence	SSW
Notes:	1. According to the NSW Industrial Noise Policy. 2. Only occupied occasionally by SEFE staff.			

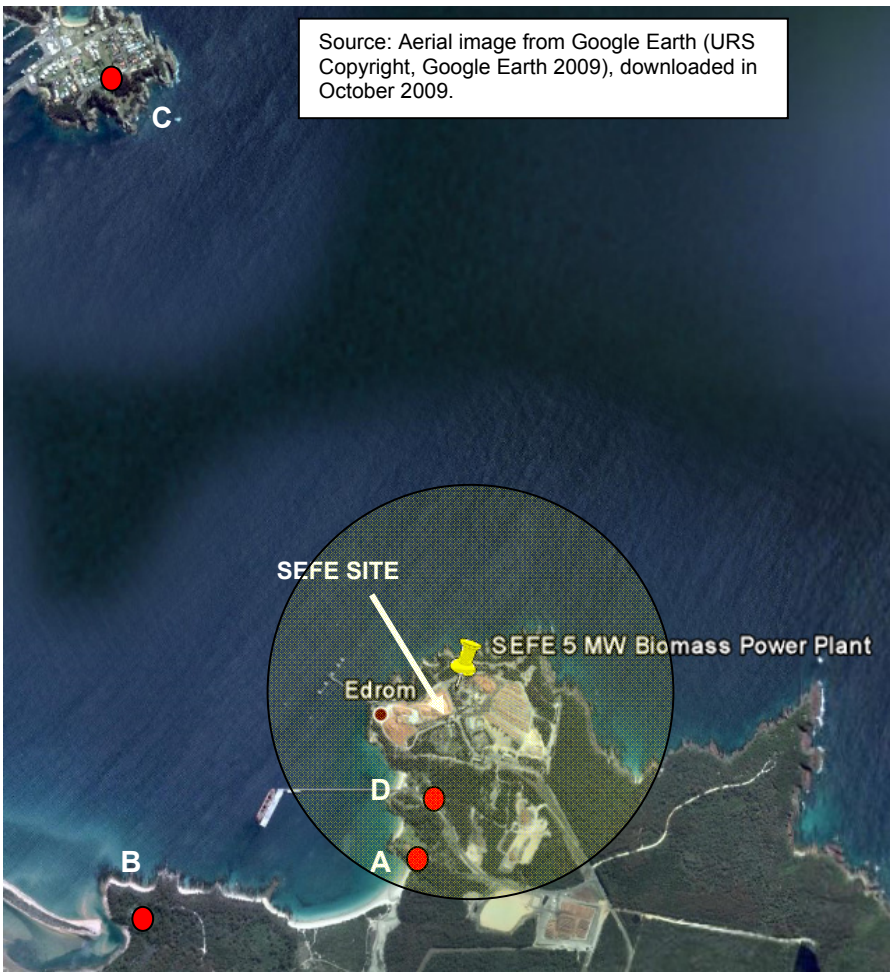

Figure 12-1 Site and Noise Sensitive Receptor Locations

Chapter 12 Noise and Vibration

A brief description of each measurement location is provided below:

- Receptor A: Edrom Lodge – approximately 800 m south-west of the proposed Power Plant. This receptor was used for long-term unattended noise monitoring to obtain background noise levels and short-term attended levels. The main noise sources were waves and local fauna (birds and insects) during the day, evening and night-time periods. Operational noise from the SEFE Site and the neighbouring premises were occasionally noticed during the day and evening periods.
- Receptor C: Bramble Street, Eden, approximately 3.5 km north-west of the proposed Power Plant. This receptor was used for short-term attended noise monitoring to obtain background noise levels. The main noise sources were urban hums, intermittent road traffic and waves.
- Receptor D: SEFE Camp, approximately 500 m south-west of the proposed Power Plant. This receptor was used for long-term unattended noise monitoring to obtain background noise levels and short-term attended noise levels. The main noise sources were the SEFE operation and local fauna (birds and insects) during the day, evening and night-time periods.

Noise monitoring was not conducted at Receptor B. Considering the likely noise environment at this location, background noise levels for this receptor have been conservatively assumed.

12.2.4 Noise Measurement Results

Long-term noise monitoring results are summarised in **Table 12-2** and **Table 12-3**. For the purpose of INP assessment, the following time periods are defined:

- Day: 7.00 am – 6.00 pm Monday to Saturday; 8.00 am – 6.00 pm Sundays and public holidays.
- Evening: 6.00 pm – 10.00 pm all days.
- Night: 10.00 pm – 7.00 am Monday to Saturday; 10.00 pm – 8.00 am Sundays and public holidays.

Table 12-2 Measured Noise Levels – Edrom Lodge, Eden (Receptor A)

Date	Assessment Background Level (ABL), L_{A90} dB(A)			Ambient Noise Level, L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 23 June 2009	46	46	*	50	51	*
Wednesday, 24 June 2009	44	*	*	49	*	*
Thursday, 25 June 2009	44	46	38	50	50	43
Friday, 26 June 2009	43	44	35	50	47	41
Saturday, 27 June 2009	28	32	31	39	37	39
Sunday, 28 June 2009	27	30	31	38	35	35
Monday, 29 June 2009	*	*	*	*	*	*
Tuesday, 30 June 2009	*	*	*	*	*	*
Wednesday, 1 July 2009	*	-	-	*	-	-
Representative Level[1]	**44**	**44**	**33**	**48**	**47**	**41**

Notes: "-" noise logger deployed and collected during the daytime.
"*" period affected by adverse weather conditions or extraneous noise.
1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.

Table 12-3 Measured Noise Levels – SEFE Camp (Receptor D)

Date	Assessment Background Level, (ABL) L_{A90} dB(A)			Ambient Noise Level, L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Tuesday, 23 June 2009	46	48	*	53	54	*
Wednesday, 24 June 2009	41	*	*	52	*	*
Thursday, 25 June 2009	42	45	41	50	50	48
Friday, 26 June 2009	42	42	38	50	46	45
Saturday, 27 June 2009	33	35	36	44	43	42
Sunday, 28 June 2009	30	31	34	43	41	40
Monday, 29 June 2009	*	*	*	*	*	*
Tuesday, 30 June 2009	*	*	*	*	*	*
Wednesday, 1 July 2009	*	-	-	*	-	-
Representative Level[1]	**42**	**42**	**37**	**50**	**49**	**45**

Notes: "-" noise logger deployed and collected during the daytime.
"*"period affected by adverse weather conditions or extraneous noise.
1. Represents median value for L_{A90}, and logarithmic average for L_{Aeq}.

Any 15-minute period affected by adverse weather conditions or extraneous noise was excluded from the above analysis.

Monitoring at receptors A and D was affected by existing industrial noise during weekdays. The SEFE Site did not operate at the weekend. Results generally show consistent daily noise levels throughout each period during the weekdays and weekend at both the monitoring locations. Data are therefore considered representative of the area's acoustic environment and suitable for this assessment.

Table 12-4 presents the short-term attended noise measurement results.

12.2.5 Establishment of Rating Background Levels

While the Power Plant will operate continuously and shiploading occurs around the clock during the three day loading campaign, the rest of the Site would continue to operate between 7.00 am and 11.00 pm on weekdays. Therefore, Rating Background Levels (RBLs) were established for the following operational scenarios:

- 7.00 am – 11.00 pm, Monday to Friday: Site operation including the Power Plant and shiploading activities.
- 11.00 pm – 7.00 am, Monday to Friday and 24 hours on Saturdays, Sundays and public holidays: Operation of the Power Plant only.
- 11.00 pm – 7.00 am, Monday to Friday and 24 hours on Saturdays, Sundays and public holidays: Power Plant operation and ship-loading activity (this scenario occurs 18% of the time per year).

Chapter 12 Noise and Vibration

Table 12-4 Attended Measurement Results

Receptor	Date / Time	Background $L_{A90,10min}$ dB(A)	Ambient $L_{Aeq,10min}$ dB(A)	Comments
A. Edrom Lodge	Tuesday, 23 June 2009 / 9:30 pm	46	50	Noise environment governed by waves, birds and insects. Noise from SEFE and neighbouring premises occasionally noted.
	Tuesday, 23 June 2009 / 9:40 pm	48	52	
	Tuesday, 23 June 2009 / 11:30 pm	47	52	Noise environment governed by waves, birds and insects. No industry operation was noted.
	Wednesday, 24 June 2009 / 11:20 am	44	49	
	Wednesday, 24 June 2009 / 11:30 am	43	46	
D. SEFE Camp	Tuesday, 23 June 2009 / 09:50 pm	43	46	Noise environment governed by waves, birds and insects and operations of SEFE.
	Tuesday, 23 June 2009 / 11:15 pm	40	43	Noise environment governed by waves, birds and insects. No industry operation was noted.
	Wednesday, 24 June 2009 / 11:45 am	45	47	Noise environment governed by waves and birds. No industry operation was noted.
C. Eden	Wednesday, 24 June 2009 / 1:00 pm	42	47	Noise environment governed by waves and urban hums. No industry operation was noted.

Site Operation including Power Plant

As the Site would continue to operate during weekdays from 7.00 am to 11.00 pm, data from **Table 12-2** and **Table 12-3** were used to calculate the RBL and ambient weekday noise levels for each day, evening and night-time period. The night-time RBL was calculated using the L_{A90} levels recorded during the period when the Site was operating, i.e. between 10.00 pm and 11.00 pm, Monday to Friday. Reference was also made to the NSW INP *Application Notes* (2006) to determine the RBL when the evening and / or night-time RBL is higher than the daytime RBL, and when operations only occur for part of the day, evening or night-time period.

Table 12-5 presents a summary of the ambient and RBL at Receptors A and D.

Table 12-5 Rating Background Levels – Operation of Site including Power Plant

Receptor	Rating Background Level L_{A90} dB(A)			Ambient Noise Level L_{Aeq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
A: Edrom Lodge	44	44	41[1]	50	49	47[1]
D: SEFE Camp	42	42[2]	42[1,2]	51	50	49[1]

Notes:
1. Representative level of the period between 10.00 pm – 11.00 pm, when SEFE operates.
2. Evening and night-time noise levels adjusted so as not to be greater than the daytime levels.

The RBLs were used to derive day, evening and night-time noise limits for operation of the Site including the proposed construction and operation of the Power Plant.

As there are no industries or commercial premises in proximity to receptors B and C, long-term noise monitoring at these locations was not conducted. However, considering the location of these receptors and land use, the following RBLs have been assumed for each location:

- Receptor B (Boyd Road, East Boyd): 30 dB(A) for the day, evening and night-time periods which is the lowest background noise level defined in the INP.
- Receptor C (Bramble Street, Eden): 45 dB(A), 40 dB(A) and 35 dB(A) for the day, evening and night-time periods respectively.

Operation of Power Plant Only

As the Power Plant would operate 24 hours a day, the controlling noise criteria will be the night-time criteria, and compliance with this leads to compliance at all other times. To define the applicable RBLs, the RBLs of Receptors A and D during the night-time period were reviewed using the weekend L_{A90} levels from **Table 12-2** and **Table 12-3**. For other receptors (B and C), the RBLs assumed above were used. The RBLs calculated are provided in **Table 12-6**.

Table 12-6 Rating Background Levels – Operation of Power Plant Only

Receptor	Night-Time Rating Background Level L_{A90} dB(A)
A: Edrom Lodge	31
B: Boyd Road, East Boyd	30
C: Bramble Street, Eden	35
D: SEFE Camp	35

12.3 Noise Criteria

12.3.1 Operational Noise Criteria

Operation of Site and Power Plant

The INP sets out two criteria (intrusive and amenity) to assess potential noise impacts of industrial sources. The first criterion is used to control short-term intrusive noise impacts for residences and the second criterion is used to maintain noise level amenity for particular land uses including residential.

Intrusive Noise Impacts

The intrusive criterion is summarised as follows:

- $L_{Aeq,15\ minute} \leq$ rating background level (RBL, L_{A90}) + 5 dB(A)

Where:

  - $L_{Aeq,15minute}$ is the equivalent continuous A-weighted sound pressure level of the source over 15 minutes, unless other descriptors are specified as more appropriate to characterise the source;
  - assessment at the most affected point on or within the residential property boundary, or if that is more than 30 m from the residence, at the most affected point within 30 m of the residence.

Chapter 12 Noise and Vibration

Protecting Noise Amenity

The amenity criterion is established to limit continuing increases in noise levels. The maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in the INP. **Table 12-7** is a summary of the noise levels from the INP showing amenity criteria applicable to the different types of receptors and areas within the study area.

Table 12-7 Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receptor	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable (ANL)	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
	Industrial Interface	Day	65	70
		Evening	55	60
		Night	50	55

Note: Shaded levels represent the Amenity Criteria applicable to this assessment.

A brief description of each amenity area is as follows:

- Rural: An area with an acoustical environment dominated by natural sounds having little or no road traffic.
- Suburban: An area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area typically has decreasing noise levels in the evening period, and the evening / night noise levels are defined by the natural environment and infrequent human activity.
- Industrial Interface: An area in close proximity to industrial premises and that extends to a point from the site boundary where the existing industrial noise from the source has fallen by 5 dB.

The INP specifies that acceptable noise levels (ANLs) should be modified where the existing noise level from industrial sources is close to the ANL or already exceeds the ANL for the area in question.

Adjustments are also to be applied to the source noise level received at the assessment point, before comparison with the amenity criterion, where the noise source contains characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity and dominant low frequency content. The maximum correction is 10 dB(A) where the noise contains two or more modifying factors.

Modification to the ANLs is not required for Receptors B and C as the noise levels of these locations are dominated by the natural environment and not industrial sources.

Modification to ANLs at Receptors A and D have been made taking into consideration the existing industrial noise levels. Based on the results of the long-term and short-term noise monitoring, the existing industrial noise levels during day, evening and night-time period are estimated to be:

- at Receptor A: 46 dB(A), 43 dB(A) and 39 dB(A), respectively; and
- at Receptor D: 49 dB(A), 47 dB(A) and 42 dB(A), respectively.

The modified ANLs at each receptor, adopting the methods provided in Table 2.2 of the INP, are shown in **Table 12-8**. A modification from -2 dB to -6 dB has been made for Receptor A which results in more stringent amenity noise criteria.

Table 12-8 Modified ANL (L_{Aeq}) at each Receptor

Receptor	Existing Industrial Noise Level dB(A)	ANL dB(A)			Modified ANL dB(A)		
		Day	Evening	Night	Day	Evening	Night
A	Day: 46 Evening: 43 Night: 39	50	45	40	50 – 2 = 48	45 – 4 = 41	43 – 6 = 37
D	Day: 49 Evening: 47 Night: 42	65	55	50	65	55	50

Note: ANL: Acceptable Noise Level (Amenity Criteria)

Project-Specific Noise Levels (PSNL)

PSNLs reflect the most stringent noise level derived from both the intrusive and amenity criteria to ensure that intrusive noise is limited and amenity is protected. **Table 12-9** summarises the noise criteria applicable to the operation of the Power Plant.

Table 12-9 Project-Specific Noise Levels – Operation of Site and Power Plant

Receptor	Intrusive Criteria $L_{Aeq,15min}$ dB(A)			Amenity Criteria $L_{Aeq,period}$ dB(A)		
	Day	Evening	Night	Day	Evening	Night
A: Edrom Lodge	49	49	46	**48**	**41**	**37**
B: Boyd Road, East Boyd[1]	**35**	**35**	**35**	50	45	40
C: Bramble Street, Eden[2]	**50**	**45**	**40**	55	45	40
D: SEFE Camp	**47**	**47**	**47**	65	55	50

Notes: Shaded results represent the PSNL applicable to the assessment.

1. Background noise (L_{A90}) levels for day, evening and night were assumed 30 dB(A) resulted in most stringent noise limit.
2. Background noise (L_{A90}) levels for day, evening and night were assumed 45, 40 and 35 dB(A) respectively, considering the land use and location of the receptor.

It can been seen in **Table 12-9** that the controlling noise criteria will be the intrusive criteria for Receptors B, C and D which are based on the representative RBL for each assessment period. It should be noted that 35 dB(A) $L_{Aeq,15min}$ is the most stringent noise limit in accordance with the INP. Amenity criteria are the controlling noise criteria for Receptor A.

Operation of Power Plant Only

From the RBL determined in **Section 12.2.5** and the INP methodology detailed in **Section 12.3.1**, the noise limits applicable to the operation of the Power Plant are presented in **Table 12-10**. As the Power Plant would operate 24 hours a day, the controlling noise criteria will be the night-time criteria, and compliance with this target leads to compliance at all other times.

Table 12-10 Project-Specific Noise Levels – Operation of Power Plant Only

Receptor	Intrusive Criterion $L_{Aeq,15min}$ dB(A)	Amenity Criterion $L_{Aeq,period}$ dB(A)
A: Edrom Lodge[1]	**36**	40
B: Boyd Road, East Boyd	**35**	40
C: Bramble Street, Eden	**40**	40
D: SEFE Camp[1]	**40**	50

Notes: Shaded results represent the PSNL applicable to the assessment.

1. Criteria are based on the weekend RBL which were not affected by industrial noise. Thus modification to the ANL is not required.

12.3.2 Sleep Disturbance Criteria

Where there is the possibility that instantaneous, short-duration, high-level noise events may occur during night-time hours, consideration should be given to the potential for the disturbance of sleep within residences. As the Site would continue to operate during the night-time period, an assessment of sleep disturbance for the worst potentially affected residential receptors has been conducted.

The INP does not specifically address sleep disturbance from high noise level events. Reference can be made to the WHO's *Guidelines for Community Noise (1999)*. The guideline recommends that the noise levels outside bedroom windows and inside bedrooms should be limited to L_{Amax} 60 dB(A) and L_{Amax} 45 dB(A), respectively.

The 60 dB(A) limit is assessed outdoors at the most exposed side of a residential premise. Sleep disturbance thresholds are also determined by factors including noise character and pitch, perceived personal danger, degree of habituation, age, illness or fatigue and the point in time when the noise occurs during the sleep period. For example, noisy events are generally less disturbing to people if confined to the earlier period of the evening when it is still possible to retrieve deep sleep.

12.3.3 Construction Noise Criteria

The noise criteria set out in the *Interim Construction Noise Guideline* (DECC, July 2009) have been used to assess the potential construction noise impact. This guideline is not mandatory although it will be used to assist DECCW in setting statutory conditions in licences or other regulatory instruments for construction noise. **Table 12-11** summarise the construction noise criteria specified in the Guideline.

Table 12-11 Construction Noise Criteria – Noise at Residences

Time of Day	Management Level $L_{Aeq, 15min}$	How to apply
Recommended standard hours: Monday to Friday: 7.00 am to 6.00 pm Saturday: 8.00 am to 1.00 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq, 15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

In accordance with the above guideline, the construction noise management levels applicable for each receptor are provided in **Table 12-12**.

Table 12-12 Project-specific Construction Noise Management Levels

Receptor	Rating Background Level L_{A90} dB(A)	Management Level $L_{Aeq,15min}$ dB(A)
A: Edrom Lodge	44	44 + 10 = **54**
B: Boyd Road, East Boyd	30	30 + 10 = **40**
C: Bramble Street, Eden	45	45 + 10 = **55**
D: SEFE Camp	42	42 + 10 = **52**

12.3.4 Off-site Traffic Noise Criteria

Criteria for off-site road traffic noise are specified in the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN). The applicable criteria for the Power Plant are summarised in **Table 12-13** which falls under the ECRTN category of "Land use developments with potential to create additional traffic on existing freeways / arterials". The worst potentially affected receptor from off-site road traffic would be the Boydtown camping ground.

Regular vehicle movement within the facility is considered as an industrial noise source and is assessed in accordance with the INP.

Table 12-13 Environmental Criteria for Road Traffic Noise

Type of Development	Day $L_{Aeq,15hr}$	Night $L_{Aeq,9hr}$	Where criteria are already exceeded
Land use developments with potential to create additional traffic on existing freeways/arterials	60 dB(A)	55 dB(A)	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.
Note: Day: 7.00 am – 10.00 pm / Night: 10.00 pm – 7.00 am.			

The levels presented above are applicable for all the receptors considered in this assessment.

12.4 Assessment of Potential Impacts

12.4.1 Calculation Methodology

Noise levels due to construction and operation of the Power Plant were predicted using an acoustic computer model created in SoundPLAN Version 6.5. This program is used and recognised internationally. This program is also considered by the INP as a preferred computer noise model.

The noise model was developed to allow the prediction of cumulative noise levels from the plant and construction site by calculating the contribution of each noise source. The model takes into account:

- sound power levels of each source;
- receptor locations;
- digital terrain map with 2m height intervals;
- screening effects due to topography;
- meteorological effects and attenuation due to distance; and
- ground and atmospheric absorption.

12.4.2 Operational Noise

Sound Power Levels (SPLs)

SPLs of existing equipment were calculated from on-site field measurements. Source noise was measured in one-third octave frequency bands (**Table 12-14)**.

Table 12-14 Sound Power Levels – Existing Mill Operations

Operational Noise Source	Source Height Used in Noise Modelling (m)	Estimated Overall Sound Power Level	
		dB(Lin)	dB(A)
Hardwood Chipping (E1 & E2)	6	128	122
Softwood Chipping (Chipper & Debarking Drum (sound-attenuated)	5	130	124
Shakers	5	127	112
Jetslinger (Stacking Conveyor)	50 (E1 & E2 Chip Storage) 30 (Pine Chip Storage) 10 (Fuel Storage)	114	110
Stacker (Wagner)	3	121	113
Truck unloading	2	95	92
Truck manoeuvring (< 30 km/h)	2	74	64
Conveyor	10 – 15	105	103
Ship-loading activity – 22 campaigns per year (Two tracked bulldozers – engine noise, loading & unloading)	2	122	110

Ship-loading is undertaken in three-day campaigns around the clock. During the campaign, two chip dozers are deployed to reclaim chips from the chip stacks. The tracked bulldozer can be occasionally heard at Edrom Lodge, however SEFE has not received any complaints about the noise.

SPLs of the equipment for the Power Plant were provided by SEFE as overall levels for linear and A-weighted values. For noise modelling, the levels were converted to octave frequency band levels. The SPLs presented in **Table 12-15** were used in the noise model.

Table 12-15 Sound Power Levels – Biomass Power Plant

Operational Noise Source	Source Height Used in Noise Modelling (m)	Estimated Overall Sound Power Level[1]	
		dB(Lin)	dB(A)
Gas Turbine Unit & Generator (Acoustically enclosed)	5	117	105
Boiler & Furnace (not enclosed)	10	112	108
Ancillary Sources	3	95	92

Noise emissions from the stack would be minimal and were not considered in the noise modelling.

The acoustic design of the plant will be to the sound power levels specified in **Table 12-15**.

Meteorological Conditions Used in Noise Modelling

Adverse meteorological conditions have the potential to increase noise levels at a receptor. Such phenomena generally occur during temperature inversions and where there is a wind gradient with wind direction from the source to the receptor. It is known that these meteorological effects typically increase noise levels by 3 to 10 dB, and even higher than 10 dB in extreme conditions.

Temperature inversions generally occur during the night-time and early morning periods during the winter season, thus the most significant meteorological effect during the daytime period is wind.

For a conservative approach, the following adverse meteorological conditions (wind and temperature inversions) were assumed as a feature of the assessment area in the noise modelling (**Table 12-16**). Potential noise impacts were predicted for each of the meteorological scenarios in **Table 12-16**.

Table 12-16 Meteorological Conditions used in Noise Modelling

Meteorological Scenario	Meteorological Condition				
	Temperature (°C)	Relative Humidity (%)	Pasquill Stability Class	Wind Speed (m/s)	Wind Direction
Day & Evening Operation – Neutral Met. Conditions	20	70	D	0	n/a
Night-time Operation – Neutral Met Conditions	10	60	D	0	n/a
Day & Evening Operation – Adverse Met. Conditions	20	70	D	4	source-to-receiver
Night-time Operation – Adverse Met. Conditions	10	60	F	2	source-to-receiver

Predicted Operational Noise Levels

Noise modelling was based on likely maximum operating conditions. To assess the cumulative noise impacts it was assumed that all equipment operates continuously and simultaneously. The modelling results using neutral and adverse meteorological conditions compared to the noise limits are presented in **Table 12-17**, **Table 12-18** and **Table 12-19**.

Table 12-17 Predicted Operational Noise Levels (Power Plant Only)

Receptor	Predicted Noise Levels (L_{Aeq}) dB(A)		Noise Limit (L_{Aeq}) dB(A)	Exceedance dB
	Neutral Met Conditions	Adverse Met Conditions	Night-time	
	11.00 pm – 7.00 am	11.00 pm – 7.00 am		
A (Edrom Lodge)	33	36	36	No
B: Boyd Road, East Boyd	< 15	< 15	35	No
C: Bramble Street, Eden	< 15	< 20	40	No
D (SEFE Camp)	< 33	35	40	No

The results presented in **Table 12-17** show that noise emissions from the proposed operation of the Power Plant are within the noise goal under all meteorological conditions.

Table 12-18 Predicted Operational Noise Levels (Power Plant and Shiploading)

Receptor	Predicted Noise Levels (L_{Aeq}) dB(A)		Noise Limit (L_{Aeq}) dB(A)	Exceedance dB
	Neutral Met Conditions	Adverse Met Conditions	Night-time	
	11.00 pm – 7.00 am	11.00 pm – 7.00 am		
A (Edrom Lodge)	37	40	36	1 - 4 (Night-time)
B: Boyd Road, East Boyd	< 20	< 20	35	No
C: Bramble Street, Eden	< 20	< 25	40	No
D (SEFE Camp)	37	39	40	No

The results presented in **Table 12-18** show that exceedances of the night-time noise limit of up to 4 dB is predicted due to the operation of the Power Plant and shiploading under adverse meteorological conditions. It should be noted that ship-loading activity is not considered a typical operation at the site as the activity occurs up to 18 % of the time per year.

Table 12-19 Predicted Cumulative Operational Noise Levels (Site, Power Plant and Shiploading)

Receptor	Predicted Noise Levels (L_{Aeq}) dB(A)						Noise Goal (L_{Aeq}) dB(A)	Exceedance dB
	Neutral Met Conditions			Adverse Met Conditions			D/E/N	
	D	E	N	D	E	N		
A (Edrom Lodge)	47	45	41	50	48	44	48 / 41 / 37	D: 2, E: 4 - 7, N: 4 - 7
B: Boyd Road, East Boyd	< 25	< 25	< 25	< 30	< 30	< 30	35 / 35 / 35	No
C: Bramble Street, Eden	< 25	< 25	< 25	< 30	< 30	< 30	50 / 45 / 40	No
D (SEFE Camp)	50	48	45	51	50	47	47 / 47 / 47	D: 3 - 4, E: 1 - 3
Notes: D: Day / E: Evening / N: Night								

The results presented in **Table 12-19** show that:

- Receptor A: 'worst-case' Operation – Site, Power Plant and Shiploading
  - Noise levels during daytime would exceed the noise goal by up to 2 dB under adverse meteorological conditions.
  - Noise levels during evening and night-time would exceed the noise goal by up to 4 dB under neutral meteorological conditions, and 7 dB under adverse meteorological conditions.
  - Exceedances during typical operations (i.e. no shiploading) are expected to be lower by 1 dB.
- Receptors B & C: No exceedance of the noise goals is expected.

Chapter 12 Noise and Vibration

- Receptor D (only occupied occasionally by SEFE staff): Worst-case' Operation – Site, Power Plant and Shiploading
  - Noise levels during daytime would exceed the noise goal by up to 3 dB under neutral meteorological conditions and 4 dB under adverse meteorological conditions.
  - Noise levels during evening would exceed the noise goal by up to 3 dB under adverse meteorological conditions.
  - Noise levels during night-time would be within the noise goal.
  - Exceedances during typical operations (i.e. no shiploading) are expected to be lower by 1 dB.
- Daytime and evening operation of the Power Plant would increase cumulative noise levels by less than 1 dB which would not be detectable by the human ear.
- Night-time operation of the Power Plant would not exceed the noise limit at all locations.
- Cumulative noise levels taking into consideration Power Plant operation and shiploading activities would increase noise levels by 1 – 2 dB over the levels of existing daytime Site operations.
- During ship-loading, an exceedance of up to 4 dB would occur during night-time at Receptor A.

Given that noise from the Power Plant would be steady rather than fluctuating, it was considered that the difference between L_{Aeq} and L_{Amax} noise levels would be less than 15 dB. Therefore, the predicted noise levels are expected to be within the noise goal for protection from sleep disturbance (L_{Amax} 60 dB(A)) at all residential receptors, and the operation is not predicted to give rise to sleep disturbance. While the Site (except for the Power Plant) would continue to operate until 11.00 pm, the shutdown time would vary from 6.00 pm to 11.00 pm. As the duration of the night-time operation is only an hour (10.00 pm – 11.00 pm), and the time falls in an early night-time period, it was not considered necessary to assess the Site operation against the sleep disturbance criteria. The noise during shiploading would fluctuate during operation of tracked bulldozers. However, the noise would not exceed the sleep disturbance noise goal and is not expected to give rise to sleep disturbance.

Considering the noise levels of the existing operation, degree of exceedance and the ambient noise levels (primarily from wave noise) at the receptors, the potential noise impact due to the operation would be insignificant. Further noise mitigation measures are not considered practical or necessary.

Noise contour maps for the night-time meteorological conditions are presented in **Appendix G**.

Noise intrusion levels at the receptors in the one-third octave frequency bands have been reviewed in detail. It was found that the noise from the SEFE operation would not contain tonality and / or low frequency content in accordance with the assessment guideline provided in the INP. No noise sources are expected to generate instantaneous or short-duration high noise level events, and would therefore not contain impulsive noise.

12.4.3 Construction Noise

Construction Equipment and Associate Noise Levels

Construction equipment expected on the site and corresponding noise levels are summarised in **Table 12-20**. The sound power levels of these items have been taken from Appendix D of AS 2436-1981: "Guide to noise control on construction, maintenance and demolition sites" and library data.

Table 12-20 Sound Power Levels – Construction Equipment

Proposed Activities	Equipment / Plant Item	Sound Power Level L_{Aeq} dB(A)
Site preparation & Earthworks (1 – 2 weeks)	Excavator	110
	Bulldozer	110
	Roller	108
	Loader	108
	Steel/Concrete piling rigs & piling	116
	Dump truck	105
Concrete Foundation Works (2 – 3 weeks)	Concrete truck	108
	Concrete mixer	110
	Compactor	114
Building Construction & Equipment Installation (14 months)	Mobile crane	104
	Delivery trucks	106
	Pneumatic tools	112
	Electric tools	102
	Power generators	102
	Hammers	108

Predicted Construction Noise Levels

Noise levels generated by the construction activities were predicted at each receptor. Noise emissions will vary as construction progresses. Noise modelling was carried out considering adverse meteorological conditions. The results are presented in **Table 12-21**. The predicted noise levels represent the cumulative noise levels of on-going Site operations and the construction activities.

Table 12-21 Predicted Construction Noise Levels

Receptor	Predicted Noise Level $L_{Aeq,15min}$ dB(A)	Daytime Noise Management Level $L_{Aeq,15min}$ dB(A)	Exceedance
A (Edrom Lodge)	50 – 52	54	No
B: Boyd Road, East Boyd	< 30	40	No
C: Bramble Street, Eden	< 30	55	No
D (SEFE Camp)	51 – 53	52	No

The predicted construction noise levels presented in **Table 12-21** show that the cumulative noise levels are expected to be within the noise management level. A very marginal exceedance of the management level is expected at Receptor D which is negligible.

12.4.4 Off-Site Traffic Noise

Off-site traffic noise associated with construction and operation was assessed based on the URS Traffic Study undertaken for the development (**Chapter 14**).

The SEFE site is accessed via the Princes Highway and Edrom Road. From examination of aerial photographs, the worst potentially affected noise sensitive location would be the Boydtown camping ground located on the Princes Highway.

Construction

Construction of the Power Plant is likely to generate up to 40 vehicle movements per day (10 heavy vehicles and 10 contractor vehicles) which represents an increase of 9.1 % on existing traffic volumes. This worst-case scenario assumes that all construction stages occur simultaneously.

The increase in road traffic noise levels from the Princes Highway at the most potentially affected dwelling is expected to be less than 0.5 dB which is negligible. It should be noted that traffic noise impacts due to construction will be short in duration, restricted largely to the first few weeks of the construction phase when plant, equipment and materials are transported to the Site.

Off-site traffic construction noise will be minimised as far as practical through limitations on construction hours and application of Australian Design Rules which apply to road-registered vehicles.

Operation

The operation of the Power Plant would increase the total staff by six from 77. Once the Power Plant is operating, no mulch will be exported from the Site which would result in a reduction of approximately 900 truck dispatches over a year. However, around 920 truck loads of wood waste from other milling operations would be transported to the Site to be consumed as fuel.

The expected increase in traffic is 2.3 % from the existing traffic volumes.

The increase in road traffic noise at the most potentially affected dwelling is expected to be less than 0.3 dB which is negligible.

12.4.5 Conclusion

The noise assessment concludes the following:

- Operation:
  - Noise generated by the Power Plant alone would not exceed the noise goals at any receptor. The Power Plant would increase noise levels by less than 1 dB which is insignificant.
  - Cumulative noise levels during evening and night-time would exceed the noise goal at Receptor A by up to 4 dB under neutral meteorological conditions and 7 dB under adverse conditions. These impacts would be insignificant due to the level of ambient noise currently experienced (primarily wave noise).
  - Some exceedances of the noise goals are expected at the SEFE Camp, but noise impacts will be minimal as the dwelling is generally not occupied.

- Exceedances during typical operations (i.e. no shiploading) are expected to be lower by 1 dB.

- Sleep Disturbance:
  - Predicted noise levels are within the sleep disturbance noise limits.
- Construction Noise:
  - No exceedance of the construction noise limit is expected at any residential location.
- Off-Site Traffic Noise;
  - Construction: The predicted increase in road traffic noise level is less than 0.5 dB at the most potentially affected dwellings which is negligible.
  - Operation: The predicted increase in road traffic noise level is less than 0.3 dB at the most potentially affected dwellings which is negligible.

12.5 Mitigation Measures

A summary of the mitigation measures applicable to the proposed works is provided **Table 12-22**.

Table 12-22 Mitigation Measures

Mitigation Measure	Project Stage		
	Pre construction	Construction	Operations
Predicted noise levels would be verified during commissioning. In the unlikely event of any significant discrepancies from this assessment, additional attenuation measures such as enclosures, silencers and noise barriers would be considered.			✓