8.1 Introduction

The noise and vibration impacts associated with the construction, operation and traffic noise of the proposed Facilities at Marulan have been assessed primarily in accordance with the following policy guidelines published by the Department of Environment and Climate Change (DECC):

- *NSW Industrial Noise Policy* (INP);
- *Environmental Criteria for Road Traffic Noise* (ECRTN); and
- *Environmental Noise Control Manual* (ENCM).

A noise and vibration assessment was conducted by Wilkinson Murray Acoustical Consultants. This chapter presents a summary of the assessment of construction noise from the Common Shared Works, specifically bulk earthworks. The full assessment is presented in **Appendix D**. This chapter also presents a summary noise and vibration impacts associated with the construction and operation of the proposed Facilities. A more detailed noise and vibration assessment for the proposed Facilities is presented in the respective *Project Applications*.

8.2 Methodology

8.2.1 Construction and Operational Noise

Assessment Process

The INP outlines processes to help strike a feasible and reasonable balance between the establishment and operation of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

In summary, noise management involves the following main steps:

1) Determining the project specific noise levels for intrusiveness and amenity that are relevant to the Project.
2) Measuring and determining existing background and ambient noise levels, using the method relevant to the expected level of impact.
3) Where the proposed development is expected to produce annoying noise characteristics, adjustments are to be applied to the noise levels produced by the development in question.
4) Predicting or measuring the noise levels produced by the development in question, having regard to meteorological effects (such as wind, temperature inversions).
5) Comparing the predicted or measured noise level with the project-specific noise levels and assessing impacts.
6) Considering feasible and reasonable noise mitigation strategies where the project-specific noise levels are exceeded.
7) Negotiation between the regulatory/consent authority and the proponent and between the community and the proponent to evaluate the economic, social and environmental costs and benefits from the proposed development against the noise impacts.

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8) The regulatory/consent authority sets statutory compliance levels that reflect the achievable and agreed noise limits for the development.

9) Monitoring of environmental noise levels from the development to determine compliance with the consent/licence conditions.

Steps 1 to 6 are included in this noise assessment. Steps 7 to 9 will follow as part of the approvals process.

Noise Predictions

The EnergyAustralia Facility and Stage 1 of the Delta Electricity Facility are most likely to operate at the time of peak electricity demand periods. In NSW these are generally 2:00 pm to 8:00 pm during the summer and 5:00 pm to 7:00 pm during the winter but may operate at any time in a 24-hour period. Stage 2 of the Facility would have continuous operation up to approximately 90 % of the year.

For this assessment, noise predictions were made using the Environmental Noise Model (ENM) modelling software algorithm. This is a point-to-point model that takes into account attenuation factors, including distance, ground absorption, air absorption and the effects of adverse meteorological conditions.

Intervening topography attenuates noise before it reaches receivers. Additionally, noise propagation over distances of at least several hundred metres is influenced by meteorological factors such as wind speed, wind direction and the presence of temperature inversions. In addition to increasing noise levels, these meteorological conditions significantly reduce the attenuating effect of intervening topography (and bunds) since the sound waves follow a curved path that can go over such barriers.

Measured hourly data from nearby automatic weather stations for an entire year (2006) was processed for the Site by URS using CALMET (a diagnostic 3-dimensional meteorological model) and the CSIRO's The Air Pollution Model (TAPM) using three automatic weather stations in the area. This data included the stability class ratings for inversions (Class A to G), which is relevant in determining the inversion class of the area.

The INP generally directs the use of a single set of adverse meteorological data to use in the assessment of noise impacts; however, Wilkinson Murray has adopted a more rigorous approach in past assessments. This approach is generally more conservative than one using a single set of meteorological data as it accounts for the directional distribution of prevailing winds for each residence surrounding the proposal. This alternative assessment procedure has been accepted by DECC for previous similar assessments and is considered appropriate for this Project.

Where there exists the possibility of peak noise level events to occur during night time, DECC requires that consideration be given to the potential for sleep arousal within residences.

Operational Noise

The INP is designed to assess industrial noise using the more stringent of the following two approaches:

- intrusive noise impacts in the short term for residences; and
- amenity for particular land uses such as residences.

Intrusive

The INP's intrusive goal is set 5 dBA above the Rating Background Level (RBL) for each time period (daytime (7am to 6pm), evening (6pm to 10pm) or night time (10pm to 7am)) of interest as defined by DECC. The Rating Background Levels are derived from the measured L_{A90} noise levels as per the DECC guidelines.

Amenity

The amenity goal sets an upper limit to the total noise level (L_{Aeq}) in an area from all industrial noise (existing and future). The criterion depends on the time of day, area classifications and the relationship of the total measured L_{Aeq} (and contribution from existing industrial noise) to determine the Acceptable Noise Level for the development.

The potentially affected area is classified as Rural by the INP. Given this, the acceptable amenity levels (L_{Aeq}) which apply over the whole day, evening or night period are as follows and are applicable as there are no other industrial noise sources:

1. Daytime 50 dBA
2. Evening 45 dBA
3. Night time 40 dBA

The INP also requires consideration of low frequency noise. Further discussion on the criteria relevant to the Project is provided in **Section 8.4.1**.

Exceedance of Criteria

In cases where the criteria are exceeded, the INP sets out a range of responses, including:

- application of "feasible and reasonable" mitigation measures to reduce noise levels, for example, controlling noise at the source, controlling the transmission of noise and controlling noise at the receiver;
- negotiation with relevant government bodies and/or the affected community to determine reasonable levels based on the extent of any residual impacts and other factors such as social and economic benefits derived from the noise source; and
- in extreme cases, acquisition of affected properties. Recent Department of Planning (DoP) approach for major projects would suggest acquisition of properties where the operational noise level, under adverse under meteorological conditions, exceeds the RBL by more than 10 dBA (40 dBA for this Project).

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In particular, the INP indicates:

> *"The industrial noise source criteria … are best regarded as planning tools. They are not mandatory, and an application for a noise-producing development is not determined purely on the basis of compliance or otherwise with the noise criteria. Numerous other factors need to be taken into account in the determination. These factors include economic consequences, other environmental effects and the social worth of the development. The criteria help to determine consent/licence conditions because they provide information on the likely effect of any environmental noise associated with the development."*

Construction Noise

With respect to construction noise, the requirements outlined in Chapter 171 of the ENCM are usually applied and this approach is reproduced below.

Level Restrictions

(i) Construction period of 4 weeks and under.

The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).

(ii) Construction period greater than 4 weeks and not exceeding 26 weeks.

The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).

Time Restrictions

Monday to Friday	*7 am to 6 pm*
Saturday	*7 am to 1 pm (if inaudible at residential premises)* *8 am to 1 pm (if audible at residential premises)*

No construction work to take place on Sundays or Public Holidays

Silencing

All possible steps should be taken to silence construction site equipment. It is particularly important that silenced equipment should be used on road or rail works where 24 hour operation is necessary.

There is no suggested criterion for projects that occur for greater than 26 weeks. However, the following criterion is typically used and appropriate:

> *The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 5 dB(A).*

8.2.2 Traffic Noise

With respect to access to the Marulan Site, road traffic movements (construction and operation) will occur along Canyonleigh Road. The functional category of this road is considered to be "sub-arterial" (RTA Road Design Guide, 1996) and using the DECC document, the ECRTN, the applicable noise criterion for day time (7.00 am to 10.00 pm) is $L_{Aeq,15hr}$ 60 dBA and for night time (10.00 pm to 7.00 am) $L_{Aeq,9hr}$ 55 dBA. Traffic generating developments are allowed an increase above these limits of 2 dB, once all reasonable and feasible mitigation is implemented. For analysis of the traffic data and the estimated vehicle movements during the construction phase, given that this is the only access, a limit of an increase of 2 dB applies.

There would be minor increases in road noise during the peak construction activities; however, the noise assessment determined that there was minimal risk of exceeding the 2dB limit. During the operational stage there would be minor light vehicle activity and as such negligible noise impacts expected. Given the low risk of exceeding the 2dB limit, a further detailed assessment was not deemed necessary.

8.2.3 Vibration

In terms of vibration sources identified during the construction stage, likely plant would include rollers, dozers and other earth moving equipment. Given that the nearest existing residential receivers will be at least 1,000 m away from the closest area of works, the vibration levels would not be perceptible and therefore would not impact on the residences.

Given the low risk associated with vibration impacts (both annoyance and structural damage) a detailed vibration assessment is not deemed necessary.

8.3 Existing Environment

8.3.1 Residential Receivers

Adjoining the Site are rural lands that include residences. There are ten residential receivers within a 3 km radius of the Site, which are listed in **Table 8-1** and illustrated in **Figure 8-1**.

A number of structures near the Marulan Site were assessed to confirm potential receivers. Council has advised that a property to the south of the Marulan Site had a development application approved for a dwelling on 29 March 1994, however no evidence of physical commencement of work has been presented to Council, and as such, the Development Consent may have lapsed. There is currently a shed on the property to the south of the Marulan Site that does not appear to be a habitable dwelling and accordingly, is not considered a receiver.

Another structure to the north of the Marulan Site is not considered a receiver as it is a shearers quarters (also known as "The Barracks" understood to be used by students of the University of Sydney for approximately one week every two months). These quarters are not permanently occupied.

Table 8-1 Summary of Residential Receiver Locations Identified

Receiver Location	Building Type
R15	Rural Residence
R16	Rural Residence
R17	Rural Residence
R18	Rural Residence
R19	Rural Residence
R20	Rural Residence
R21	Rural Residence
R22	Rural Residence
R23	Rural Residence
R24	Rural Residence
R25	Rural Residence
R26	Rural Residence

8.3.2 Background Monitoring

Monitoring was conducted at four locations considered to be representative of residential receivers around the Site. As required by the INP, extraneous noise and any effects due to adverse meteorological conditions (rain and wind speed greater than 5 m/s at a height of 1.5 m) have been excluded. **Figure 8-1** shows the locations of the noise loggers with respect to the proposed Facilities.

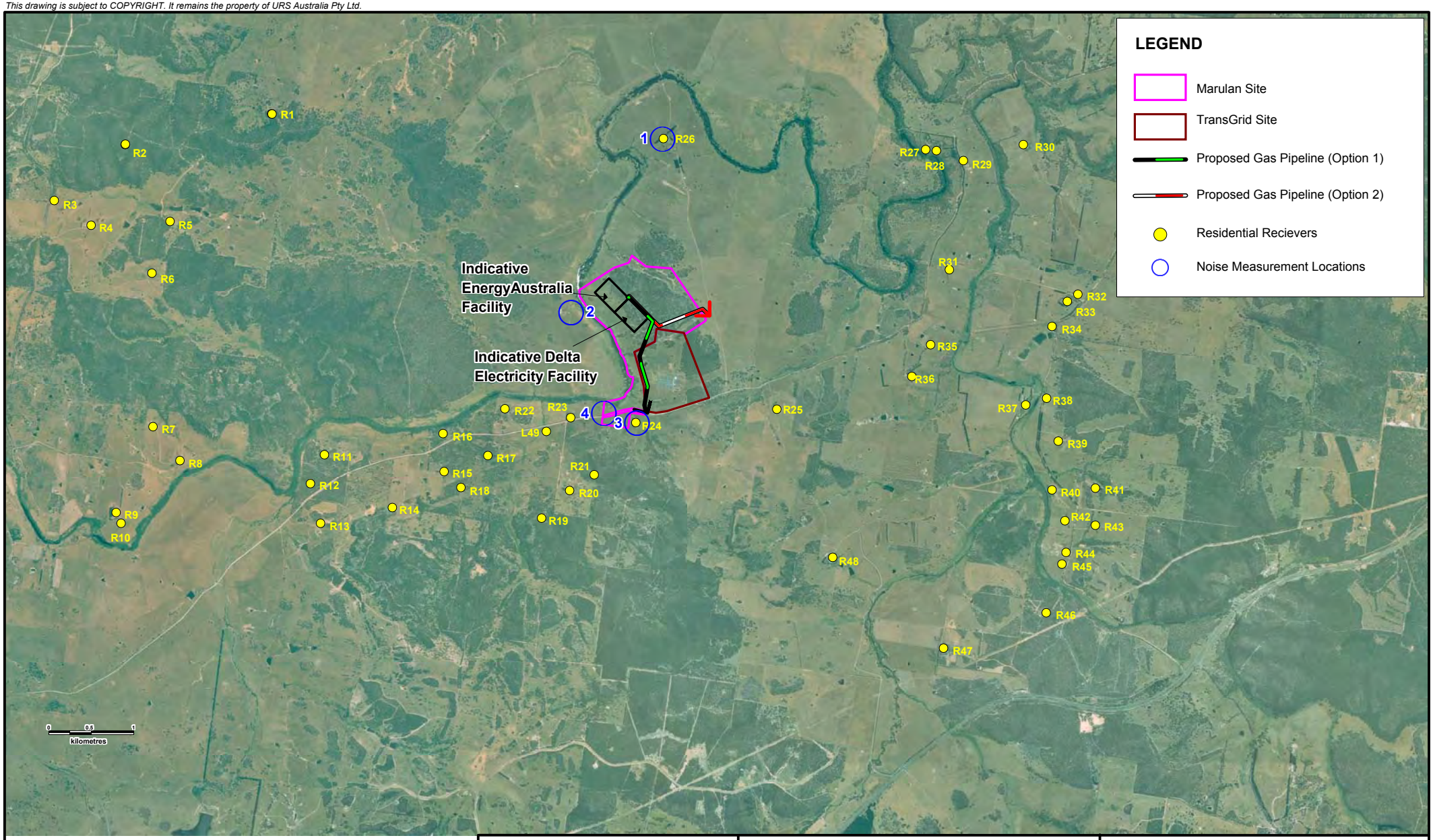
Table 8-2 summarises the results of the noise monitoring.

Table 8-2 Summary of RBL Levels from Unattended Noise Measurements

Measurement Location	Relevant Proposed Receivers	Rating Background Level RBL (dBA)[3]		
		Day	Evening	Night
1	R26	28[2]	30	31[1]
2	Marulan Site	27[2]	29[2]	29[2]
3	R24, R25	29	42[1]	31[1]
4	R15, R16, R17, R18, R19, R20, R21, R22, R23	27[2]	29[2]	29[2]

Notes:

1 - Extraneous noise influence and will not be used as part of this assessment. Lowest permissible RBL, as listed in *INP*, of 30dBA will be used instead.
2 -Where the measured RBL is less than 30 dBA, the lowest permissible RBL, as listed in INP, of 30dBA will be used instead.
3 - RTA Noise Logger Version 1 - 25



	Client: DELTA ELECTRICITY AND ENERGYAUSTRALIA	Project: MARULAN GAS TURBINE FACILITIES	Title: **LOCATION OF RESIDENTIAL RECEIVERS AND NOISE MONITORING LOCATIONS**
	URS	Drawn: AJW · Approved: NB · Date: 07/05/2008 · Job No: **43177371** · File No: 43177371-144.wor	Figure: **8-1**

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8.4 Noise Criteria

8.4.1 Operational Noise

The intrusive noise criteria described **Section 8.2.1** is applicable to this Project therefore the Project specific noise goal of 35 dBA $L_{Aeq,15minutes}$, which is 5 dBA above the lowest permissible RBL of 30 dBA as recommended within the INP, is adopted for all residential receivers. This criterion is the most stringent criterion that can be developed by the procedures in the INP. As the residential receivers are rural, the criterion applies within 30 m of the existing residence.

Low Frequency Noise Assessment

Where noise sources contain certain characteristics, such as tonality, impulsiveness, intermittency or dominate low frequency content the INP requires that a modifying factor of +5 dBA is added to the noise levels because this type of noise typically causes greater annoyance to the community. However, as discussed below, using a more detailed assessment it was found that it would be unlikely that low frequency noise impacts would result from the operation of the Facilities. Accordingly, a 5 dBA adjustment to the operational noise criteria is not required.

From current information it would appear to be possible for a gas turbine plant to exceed the (dBC-dBA) difference. At the most affected receiver (R24) a difference between C and A weighting levels of 17 dB was calculated. It should be noted that the noise modelling data used for the predictions was in octaves and that the calculation of the difference between C and A weighting levels was dominated by two octave bands being 63 and 125 Hz. Data below 63 Hz is generally not available. The uncertainty of the calculation of the difference between C and A weighting levels would appear to be quite large.

Recent international research has shown that the use of this difference approach is not suitable when the noise levels are low, since the low frequencies may then be below threshold of hearing levels (A review of Published Research on Low Frequency Noise and its Effects, Report for Department for Environment, Food and Rural Affairs (UK) by Dr Geoff Leventhall, 2003). Current research suggests that (dBC-dBA) difference should not be used as an annoyance predictor, but as a simple indicator of whether further investigation may be necessary (Low Frequency Noise and Annoyance, Noise & Health 2004, 6:23, 59-72).

Recently the UK Department for Environment, Food and Rural Affairs (DEFRA) has developed a new procedure to assess low frequency noise.

A measurement of L_{Aeq}, L_{10} and L_{90} is taken in third octave bands between 10 Hz and 160 Hz. If the L_{Aeq} taken over a time when the noise is said to be present exceeds the reference curve in **Table 6-2**, it may indicate a source of low frequency noise that could cause disturbance. The character of the sound should be checked if possible by playing back an audio recording at an amplified level. **Table 8-3** shows the proposed reference curve.

Table 8-3 Proposed Reference Curve

Hz	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB, Leq	92	87	83	74	64	56	49	43	42	40	38	36	34

If the noise occurs only during the day, or if the noise is steady, then a 5 dB relaxation may be applied to all third octave bands. A noise is considered steady if either of the conditions below is met:

- $L_{10} – L_{90}$ <5 dB.
- The rate of change of sound pressure level (fast time weighting) is less than 10 dB per second.

Once the above parameters are evaluated, the assessment process involves a comparison with the reference curve shown in **Table 8-3**. The assessment has indicated that the Facilities would be likely to meet the required criterion.

The INP is a guideline and, as discussed above, further investigations using the most recent research in lieu of the INP, suggest that low frequency noise would not be at a level to cause annoyance to the closest residential receivers. Accordingly, a 5 dBA adjustment to the operational noise criteria is not required.

8.4.2 Sleep Arousal Criteria

Peak noise level events during night time hours (10:00 pm to 7:00 am) such as reversing beepers, noise from heavy items being dropped or other high noise level events, have the potential to cause sleep disturbance. Where there exists the possibility of peak noise level events, DECC requires that consideration be given to the potential for sleep arousal within residences.

The detailed analysis of the potential for sleep arousal should cover the maximum noise level or $L_{A1, (1\ minute)}$, that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Although there is no criterion for sleep disturbance, DECC use the current sleep disturbance criterion of an $L_{A1,1\ minute}$ not exceeding the $L_{A90,15\ minutes}$ by more than 15 dB(A) as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.

Some guidance on possible impacts is contained in the review of research results in the appendices to the ECRTN. Other factors that may be important in assessing the extent of impacts on sleep include:

- how often high noise events will occur;
- time of day (normally between 10:00 pm and 7:00 am); and
- whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).

Therefore, the primary sleep arousal criterion adopted for this Project is 45 dBA $L_{A1,1\ minute}$ (based on the lowest permissible RBL of 30 dBA+15 dBA) during the hours 10:00pm to 7:00am assessed external to a bedroom window.

8.4.3 Construction Noise Criteria

Considering the construction duration, the following criterion is appropriate:

> *The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 5 dB(A).*

The construction criterion for this project is therefore 35 dBA L_{A10}. It is anticipated that construction will most likely take place from 7.00 am to possibly up to 6.00 pm during weekdays and 8.00 am to 1.00 pm on Saturdays. Should the contractor wish to work outside these "standard" hours, they will need to apply to the relevant authorities for approval.

8.4.4 Summary of Applicable Criteria

As described above the following is a summary of the noise criteria applicable to this Project:

- Operation –
  - Daytime 35 dBA $L_{Aeq,15minutes}$
  - Evening 35 dBA $L_{Aeq,15minutes}$
  - Night time 35 dBA $L_{Aeq,15minutes}$
- Sleep Arousal 45 dBA $L_{A1,1\ minute}$
- Construction 35 dBA L_{A10}

8.5 Assessment of Impacts – Common Shared Works

The likely plant to be used has been assumed for the bulk earthworks phase to include a grader, a water cart, an excavator, a dozer, a scraper and a roller. The sound power level of these plant items was sourced from Wilkinson Murray's extensive database of actual measured plant items under different usage.

All equipment would not be working at the maximum power levels simultaneously. Experience indicates that these maximum noise levels occur only rarely, and the L_{A10} noise levels will be at least 7 dBA below the maximum levels. For this reason, 7 dBA was subtracted from the calculated "worst case" maximum noise levels to give an estimate of the typical L_{A10} noise level from the Site. Using the assumed plant items and their associated maximum sound power levels (with consideration given to the operational changes, intermittent processes and changes in distance of mobile plant), the combined L_{A10} sound power levels (i.e., at the source) for clearing and excavation works is 114 dBA

Bulk earthworks for the Site would be undertaken for the two Facilities, either in a staged manner or at the same time. For the purposes of this assessment it has been assumed that the earthworks are conducted in a single stage as this would provide a worst case scenario for all construction activities.

Table 8-4 summarises the calculated $L_{A10,15min}$ noise levels under daytime adverse meteorological conditions.

Table 8-4 Calculated Construction Noise Levels at Existing Receivers

Residence No.	Calculated Noise Level $L_{A10,15min}$ (dBA)	Noise Criteria $L_{A10,15min}$ (dBA)	Compliance (Yes/No)
R15	32	35	Yes – compliance achieved
R16	32	35	Yes – compliance achieved
R17	34	35	Yes – compliance achieved
R18	32	35	Yes – compliance achieved
R19	32	35	Yes – compliance achieved
R20	33	35	Yes – compliance achieved
R21	33	35	Yes – compliance achieved
R22	31	35	Yes – compliance achieved
R23	40	35	No – exceedance of up to 5dBA
R24	38	35	No – exceedance up to 3dBA
R25	29	35	Yes – compliance achieved
R26	35	35	Yes – compliance achieved

The assessment of noise during the bulk earthworks (clearing / excavation phase) of the Project shows general compliance with the construction noise criteria. However, some marginal exceedances of the construction noise criterion are identified at locations R23 and R24.

The range of mitigation measures available would depend on the final plant and construction methodology selected. Once the contractor is selected and the plant, construction methodology and duration is better known, a Construction Noise Management Plan is to be developed as part of the CEMP, confirming noise management and additional reasonable and feasible noise mitigation measures can be investigated if necessary. These additional noise mitigation options may include, for example:

- positioning of plant / processes; and
- limiting the “clustering” of plant / processes.

8.6 Assessment of Impacts – Facilities

8.6.1 Construction

This section relates to noise generated during the construction of the Facilities (beyond earthworks to create the pad).

To predict the typical worst case noise levels at typical construction stages over the duration of the Project, the following typical scenarios have been considered:

Scenario 1: A worst case month where activities including construction of the slab are anticipated to occur simultaneously.

Scenario 2: A worst case month where activities including construction of the building, fitout and landscaping are anticipated to occur simultaneously.

Scenario 3: This represents the activities occurring towards the end and is associated with commissioning. This essentially is the noise that will be experienced during operation and as such is not assessed.

Table 8-5 summarises the calculated daytime noise levels under adverse meteorological conditions (10^{th} percentile exceedance noise levels) without noise mitigation at the existing residences.

Table 8-5 Calculated Construction Noise Levels at Existing Receivers

Locations	Scenario 1 Calculated Noise Level $L_{Aeq,15min}$ (dBA)	Scenario 2 Calculated Noise Level $L_{Aeq,15min}$ (dBA)	Noise Criteria $L_{A1,1min}$ (dBA)
R15	27	25	35
R16	27	25	35
R17	30	28	35
R18	27	25	35
R19	27	25	35
R20	29	27	35
R21	29	27	35
R22	27	25	35
R23	36	34	35
R24	34	32	35
R25	25	23	35
R26	31	29	35

Table 8-5 shows marginal exceedances of the construction noise criteria of 1 dBA at R23.

As noted in **Section 8.5**, once the contractor is selected, the plant, processes and duration will be better known and a Construction Noise Management Plan will be developed and feasible noise mitigation measures implemented as necessary.

8.6.2 Operation

The cumulative impact of the EnergyAustralia Facility and each of Stages 1 and 2 of the Delta Electricity Facility have been considered.

Reasonable and Feasible Noise Mitigation for the Facilities

Essentially there are three main physical noise mitigation strategies for noise control, namely:

1) Controlling noise at the source. There are two approaches that need to be considered: Best Management Practices (BMP) where particular operational procedures are adopted that minimise noise while retaining productive efficiency and Best Available Technology Economically Achievable (BATEA) where equipment, plant and machinery is used that incorporates the most advantaged and affordable technology to minimise noise output.

2) Controlling the transmission of noise. Barriers are one of the most effective methods to reduce noise levels by controlling the transmission path. Barriers are more effective if they are near the source or the receiver.

3) Controlling noise at the receiver. This typically includes the provision of good glazing systems (i.e. laminated glass or double glazing) and the provision of ventilation to allow fresh air into rooms where glazing has required windows be permanently shut.

The proposed Facilities are assumed to consist of 'E Class' turbines, which have inherent noise mitigation measures incorporated into the design. The inherent noise mitigation design features include measures such as:

- air intake silencers;
- generator transformer walls on three sides; and
- exhaust air silencers.

During the tendering and detailed design processes, the Delta Electricity Stage 2 Facility would be designed to meet the specified noise limits and mitigation measures would be finalised For the purposes of the noise assessment of the Delta Electricity Stage 2 Facility, modelling assumed the following noise control treatments:

- heat recovery steam generator to be reduced to a sound power level of 100 dBA; and
- use of low noise condenser fans with barriers (4 m screen around the condensing fans) and silencers. A total sound power level of 105 dB(A) has been assumed for the condensing fans.

These mitigation measures have been provided as examples to confirm that it is possible to achieve the necessary noise limits.

Every effort was made to place the Facilities in a topographically shielded position on the Site; however, with the height of the stacks and supporting structures, barrier noise reduction measures at adjacent residences were found to be limited.

Low Frequency Noise

The INP recommendations for low frequency noise involve an assessment to be conducted on the difference between C and A weighting levels. If a 15 dB difference exists, a correction of 5 dB is to be applied. Using this approach the assessment identified that the Facilities has the potential for low frequency noise.

However, recent international research has shown that the use of this difference approach is not suitable when the noise levels are low, since the low frequencies may then be below threshold of hearing levels (A review of Published Research on Low Frequency Noise and its Effects, Report for Department for Environment, Food and Rural Affairs (UK) by Dr Geoff Leventhall, 2003). Current research suggests that (dBC-dBA) difference should not be used as an annoyance predictor, but as a simple indicator of whether further investigation may be necessary (Low Frequency Noise and Annoyance, Noise & Health 2004, 6:23, 59-72).

Chapter 8 Noise and Vibration

Recently the UK Department for Environment, Food and Rural Affairs (DEFRA) has developed a new procedure to assess low frequency noise. Using this approach the assessment found that it would be unlikely that low frequency noise impacts would result from the operation of the Facilities.

EnergyAustralia and Delta Electricity are committed to ameliorating any low frequency noise issues if they arise for the Project consistent with the most recent low frequency noise assessment process that have been developed overseas in lieu of the INP, namely:

- Proposed Criteria for the Assessment of Low Frequency Noise Disturbance, 2005, Prepared for Defra by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams; and
- Procedure for the Assessment of Low Frequency Noise Complaints 2005, Prepared for Defra by Dr. Andy Moorhouse, Dr. David Waddington, Dr. Mags Adams.

Further investigations using the most recent research in lieu of the INP suggest that low frequency noise would not be at a level to cause annoyance to the closest residential receivers. Accordingly, a 5 dBA adjustment to the operational noise criteria is not required.

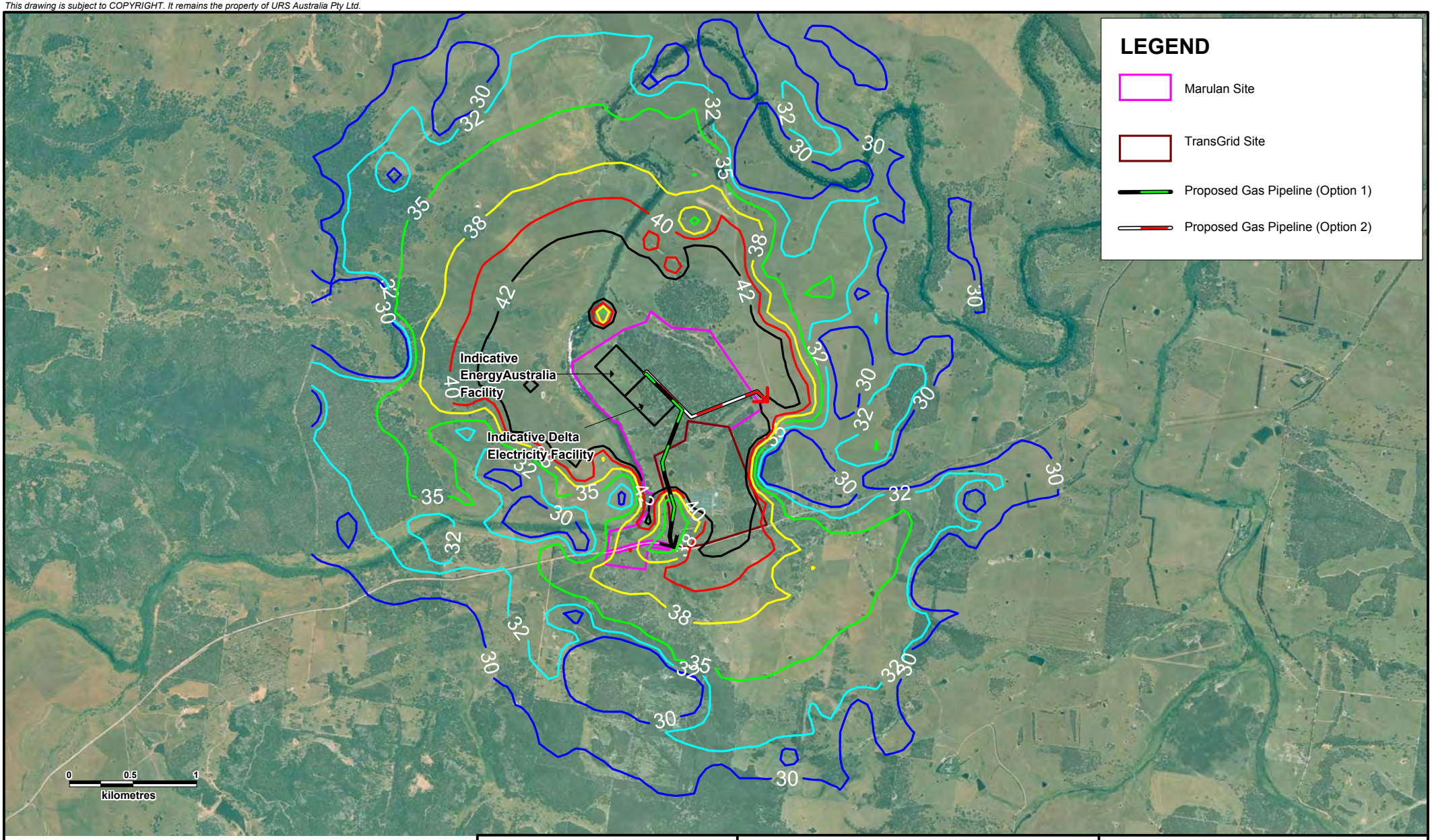
EnergyAustralia and Stage 1 Delta Electricity

As there is potential for residences to be impacted by both the Delta Electricity Facility and the EnergyAustralia Facility it is considered important to investigate the potential cumulative noise impacts of both Facilities.

Table 8-6 presents the calculated cumulative $L_{Aeq,15min}$ 10^{th} percentile exceedance noise levels for the EnergyAustralia Facility and Delta Electricity Stage 1 for daytime, evening and night time operations. **Figure 8-2** presents the worst case noise contour for EnergyAustralia and Delta Electricity Facility Stage 1. It should be noted that noise contours are indicative only, the point to point calculations should be considered more accurate than the noise contours.

Table 8-6 Summary of Calculated Cumulative Noise Levels to Existing Residences – EnergyAustralia Facility and Delta Electricity Facility Stage 1.

Residence No.	Time Period	Calculated 10% $L_{Aeq,15min}$ Noise Level (dBA)			Noise Criteria $L_{Aeq,15min}$(dBA)
		EnergyAustralia Facility	Delta Electricity Facility Stage 1	Total	
R15	Day	21	26	27	35
	Evening	23	28	29	
	Night	22	27	28	
R16	Day	24	28	29	35
	Evening	25	30	31	
	Night	25	29	30	
R17	Day	23	28	29	35
	Evening	26	30	31	
	Night	25	30	31	
R18	Day	21	26	27	35
	Evening	23	28	29	
	Night	22	27	28	
R19	Day	26	27	30	35
	Evening	26	28	30	
	Night	26	28	30	
R20	Day	29	29	32	35
	Evening	31	31	34	
	Night	31	31	34	
R21	Day	29	29	32	35
	Evening	31	31	34	
	Night	31	31	34	
R22	Day	22	27	28	35
	Evening	25	31	32	
	Night	24	29	30	
R23	Day	34	33	37	35
	Evening	36	35	39	
	Night	35	35	38	
R24	Day	36	36	39	35
	Evening	38	38	41	
	Night	38	38	41	
R25	Day	23	23	26	35
	Evening	31	32	35	
	Night	30	30	33	
R26	Day	33	32	36	35
	Evening	34	33	37	
	Night	34	33	37	



NOTE: Please note these contours are indicative only, the point to point calculations should be considered more accurate than these noise contours

Client
DELTA ELECTRICITY AND ENERGYAUSTRALIA

URS

Project
MARULAN GAS TURBINE FACILITIES

Drawn: AJW | Approved: NB | Date: 07/05/2008
Job No: **43177371** | File No: 43177371-133.wor

Title
INDICATIVE NOISE CONTOURS FOR ENERGYAUSTRALIA FACILITY AND DELTA ELECTRICITY FACILITY STAGE 1

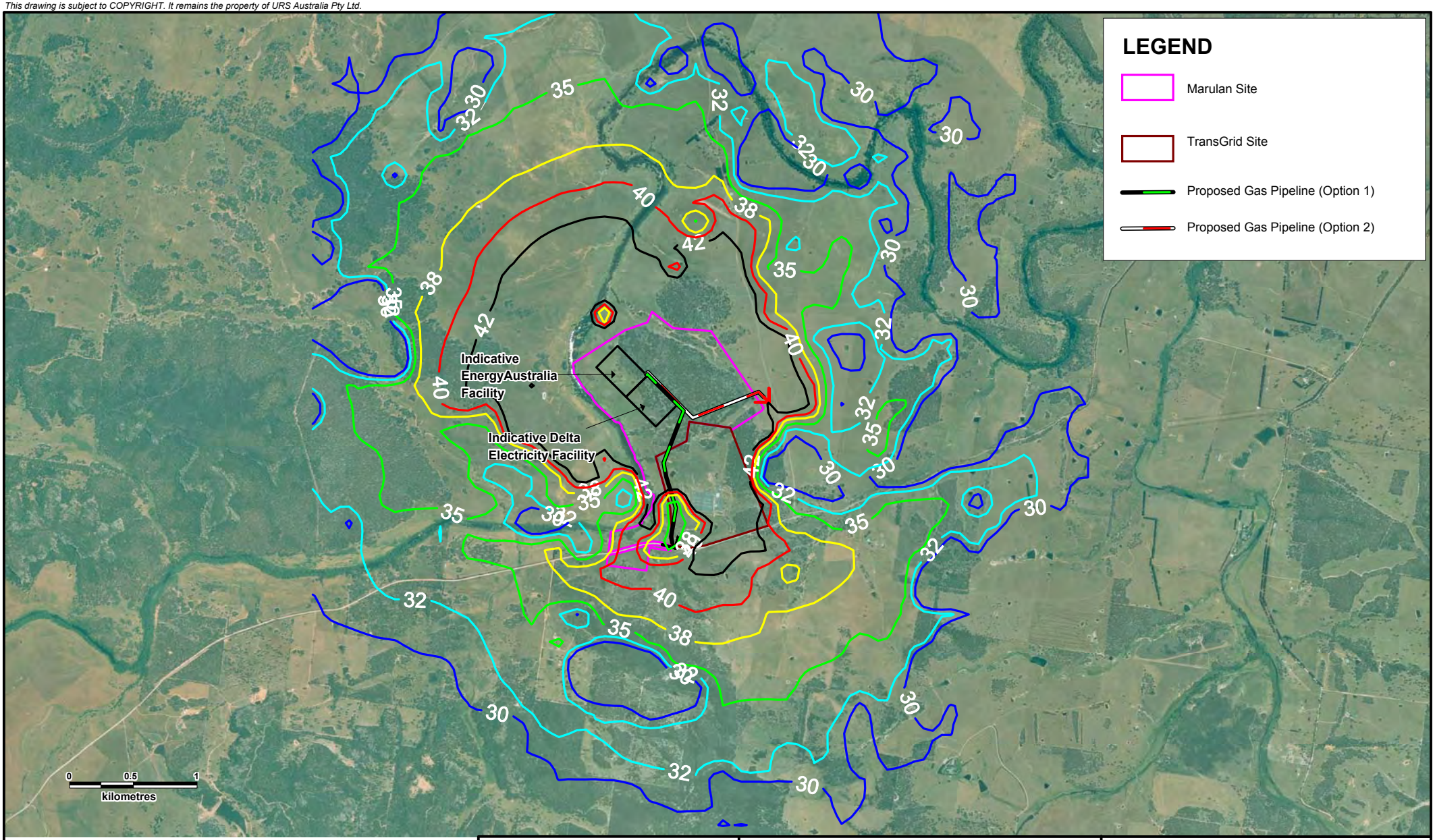
Figure: **8-2**

EnergyAustralia and Stage 2 Delta Electricity

Table 8-7 presents the calculated cumulative $L_{Aeq,15min}$ 10^{th} percentile exceedance noise levels for the EnergyAustralia Facility and Delta Electricity Stage 2 Facility for daytime, evening and night time operations. The calculated noise levels for Delta Electricity Stage 2 assumes that the mitigation measures outlined in **Section 8.6.2** have been adopted. **Figure 8-3** presents the worst case noise contour for EnergyAustralia and Delta Electricity Facility Stage 2 (with mitigation). It should be noted that noise contours are indicative only, the point to point calculations should be considered more accurate than the noise contours.

Table 8-7 Summary of Calculated Noise Levels to Existing Residences – EnergyAustralia Facility and Delta Electricity Facility Stage 2 (with mitigation).

Residence No.	Time Period	Calculated 10% $L_{Aeq,15min}$ Noise Level (dBA)			Noise Criteria $L_{Aeq,15min}$(dBA)
		EnergyAustralia Facility	Delta Electricity Facility - Stage 2 (with mitigation)	Total	
R15	Day	21	29	30	35
	Evening	23	31	32	
	Night	22	30	31	
R16	Day	24	30	31	35
	Evening	25	32	33	
	Night	25	31	32	
R17	Day	23	30	31	35
	Evening	26	33	34	
	Night	25	31	32	
R18	Day	21	29	30	35
	Evening	23	31	32	
	Night	22	30	31	
R19	Day	26	29	31	35
	Evening	26	31	32	
	Night	26	31	32	
R20	Day	29	31	33	35
	Evening	31	33	35	
	Night	31	33	35	
R21	Day	29	31	33	35
	Evening	31	33	35	
	Night	31	33	35	
R22	Day	22	29	30	35
	Evening	25	33	34	
	Night	24	31	32	
R23	Day	34	37	39	35
	Evening	36	39	41	
	Night	35	39	40	
R24	Day	36	38	40	35
	Evening	38	41	43	
	Night	38	40	42	
R25	Day	23	25	27	35
	Evening	31	34	36	
	Night	30	31	34	
R26	Day	33	34	37	35
	Evening	34	35	38	
	Night	34	35	38	



NOTE: Please note these contours are indicative only, the point to point calculations should be considered more accurate than these noise contours

Client
DELTA ELECTRICITY AND ENERGYAUSTRALIA

URS

Project
MARULAN GAS TURBINE FACILITIES

Drawn: AJW | Approved: NB | Date: 07/05/2008

Job No: **43177371** | File No: 43177371-136.wor

Title
INDICATIVE NOISE CONTOURS FOR ENERGYAUSTRALIA FACILITY AND DELTA ELECTRICITY FACILITY STAGE 2 (WITH MITIGATION TO STAGE 2)

Figure: **8-3**

Chapter 8 Noise and Vibration

The following observations as a result of the cumulative noise predictions are presented:

- for the EnergyAustralia Facility and Delta Electricity Stage 1 operations the cumulative noise predictions indicate that there is a marginal 1-4 dB exceedance of the criteria at R23 and R26 under adverse weather conditions;
- for the EnergyAustralia Facility and Delta Electricity Stage 1 operations the cumulative noise predictions indicate that there is a significant exceedance of 6 dB above the criteria at R24 under adverse weather conditions. The noise level at R24 also exceeds the INP recommended night time amenity criteria of 40 dBA;
- for the EnergyAustralia Facility and Delta Electricity Stage 2 operations the cumulative noise predictions indicate that there is a marginal 2-3 dB exceedance of the criteria at R26 under adverse weather conditions;
- for the EnergyAustralia Facility and Delta Electricity Stage 2 operations the cumulative noise predictions indicate that there is a minor 1 dB exceedance of the criteria at R25 under adverse weather conditions; and
- for the EnergyAustralia Facility and Delta Electricity Stage 2 operations the cumulative noise predictions indicate that there is a significant exceedance of greater than 5 dB above the criteria at R23 and R24 under adverse weather conditions. The noise levels at R23 and R24 also exceed the INP recommended night time amenity criteria of 40 dBA.

The INP states that any unacceptable impacts from a development proposal that are likely to persist after noise-mitigation action has been taken can be dealt with through negotiation, either by improved mitigation or by trade-offs with benefits. The exceedances of the criteria indicate that noise mitigation in addition to the BATEA plant and equipment is required for the Project. The noise exceedance categories trigger the implementation of appropriate noise management and/or mitigation strategies. That is, ‘minor’ and ‘marginal’ exceedances would generally trigger implementation of an appropriate noise management action like architectural treatments, while ‘significant’ noise exceedances could trigger a negotiated agreement or in an extreme case property acquisition.

For existing buildings architectural treatments are generally limited to acoustic treatment of the building elements and the installation of acoustic screens close to dwellings. Building element treatments are more effective when they are applied to masonry structures than light timber frame structures. The acoustic treatments provided are typically limited to:

- fresh air ventilation systems (possibly air conditioning) that meet Building Code of Australia requirements with the windows and doors shut;
- upgraded windows and glazing and solid core doors on the exposed facades of masonry structures only (these techniques would be unlikely to produce any noticeable benefit for light frame structures with no acoustic insulation in the walls);
- upgrading window and door seals;
- sealing of wall vents, eaves, roofs; and
- installation of external screen walls.

EnergyAustralia and Delta Electricity have entered into negotiations with the affected residences to:

- negotiate agreements or in the most extreme cases acquisition for the two residential dwellings that are predicted to have a 10^{th} percentile noise level that exceeds 40 dBA (residences 23 and 24); and
- negotiate agreement or possibly provide architectural treatments to the dwelling with a marginal noise exceedance (residence 26).

8.6.3 Assessment of Potential for Sleep Arousal

The potential for sleep disturbance within the residences will likely be greatest during the early morning hours (notionally 2:00 am to 4:00 am) when background noise levels are at their lowest.

The maximum anticipated noise level during abnormal (emergency) operating condition is $L_{A1, 1min}$ 41 dBA. With a criterion of 45 dBA it can be concluded that the potential for sleep disturbance from the operation of the Facilities would be negligible.

8.7 Assessment of Impacts – Gas Pipeline

A detailed noise and vibration assessment for the construction and operation of the gas pipeline will be carried out in the separate Project Application.

8.8 Mitigation Measures

Table 8-8 presents the mitigation measures to address noise and vibration issues for the proposed Facilities. The phase of implementation is indicated in the table by *Cons* – Construction, *Ops* – Operation, *Planning* and *Design.*

Chapter 8 Noise and Vibration

Table 8-8 Summary of Noise and Vibration Mitigation Measures

Mitigation Measures	Implementation of mitigation measures		
	Common Shared Works	Facilities	Gas Pipeline
Prepare and implement a Construction Noise Management Plan (CNMP) within the CEMP to consider, if appropriate: • positioning of plant / processes; and • limiting the "clustering" of plant / processes.	✓ (Design & Cons)	✓ (Design &Cons)	
EnergyAustralia Facility and Delta Electricity Facility Stage 1 would incorporate the following inherent noise treatments into the design: • air intake silencers; • generator transformer walls on three sides; • exhaust air silencers.		✓ (Design)	
Delta Electricity Facility Stage 2 detailed design would incorporate mitigation measures as necessary to achieve the specified noise limits.		✓ (Design & Ops)	
Where operational noise is predicted to exceed the noise criteria for residential dwellings (established in accordance with the Industrial Noise Policy (INP) guideline and most recent assessment process) property acquisition or negotiated agreements would be put in place.		✓ (Planning)	
Low frequency noise to be addressed during detailed design consistent with the most recent assessment process that has been developed overseas, in lieu of the INP.		✓ (Design)	
Further assessment would be undertaken of the noise and vibration impacts associated with the construction and operation of the gas pipeline.			✓ (Planning)
A single complaints line would be established for the two Facilities. A Consultation Plan would be developed to outline a coordinated, jointly managed response process for both Facilities.	✓ (Cons & Ops)	✓ (Cons & Ops)	✓ (Cons)