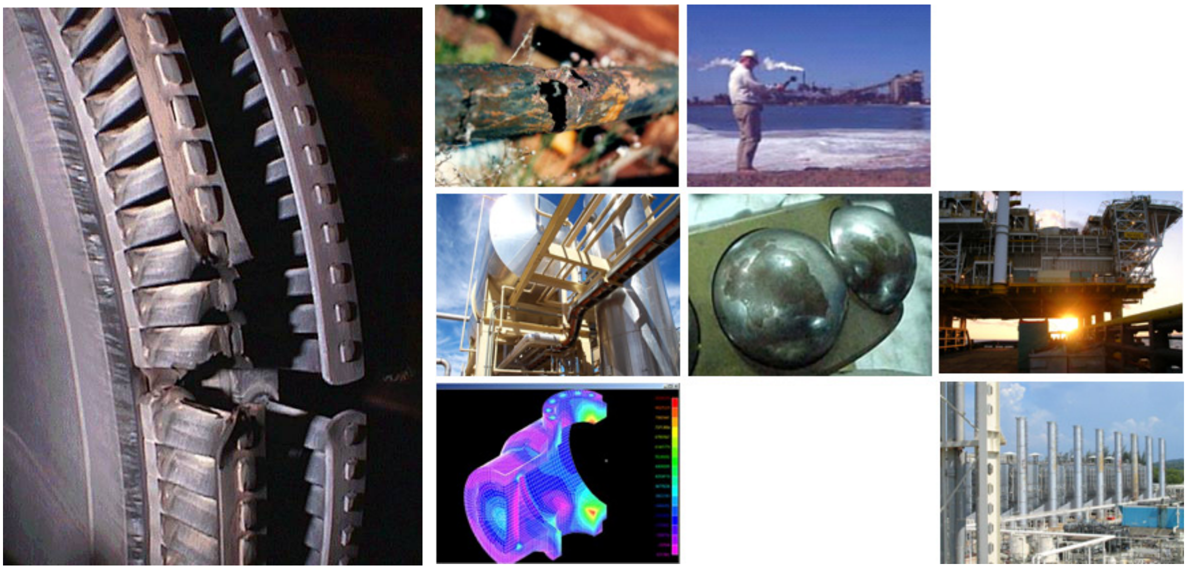
Appendix 20

Onshore airborne noise study

ICHTHYS GAS FIELD DEVELOPMENT PROJECT, ONSHORE AIRBORNE NOISE STUDY



INPEX Browse, Ltd.

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Acoustics • Corrosion

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EXECUTIVE SUMMARY

INPEX Browse, Ltd. proposes to construct liquefied natural gas (LNG) processing facilities at Blaydin Point on Middle Arm Peninsula in Darwin Harbour for the Ichthys Gas Field Development Project (the Project). This study provides an assessment of airborne noise impacts associated with the proposal.

The proposed Project site is some 10 km to the south-east of Darwin's city centre and the nearest residential area is Palmerston, approximately 4 km to the east and north-east at its nearest point.

Noise modelling has been undertaken for normal plant operations and emergency flaring conditions and the model predictions have been compared with noise limit criteria and monitored background noise levels.

Predicted noise levels for both normal operations and emergency flaring are significantly below the relevant noise limit criteria for noise-sensitive receptors and industrial receptors. Predicted noise levels for normal operations are also below monitored background noise levels at the nearest noise-sensitive receptors.

Noise from general construction activities is unlikely to exceed noise associated with normal plant operations. Piling and blasting noise may be somewhat higher than noise associated with normal plant operations. Noise level predictions demonstrate that the outskirts of Palmerston may be affected under worst-case weather conditions for sound propagation. However, due to the large distances between the Project site and the nearest noise-sensitive receptors, the risk of noise impacts is low.

Consideration should be given to the selection of transport routes and/or operating hours for heavy vehicles associated with construction earthworks to ensure that vehicle noise does not adversely affect noise-sensitive receptors.

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1. INTRODUCTION

INPEX Browse, Ltd. (INPEX) proposes to develop the natural gas and associated condensate contained in the Ichthys Field situated about 220 km off Western Australia's Kimberley coast and about 820 km west south west of Darwin. The field encompasses an area of 800 km2 in water depths ranging from 235 to 275 m.

The two reservoirs which make up the field are estimated to contain 12.8 tcf (trillion cubic feet) of sales gas and 527 MMbbl (million barrels) of condensate. INPEX proposes to process the reservoir fluids to produce liquefied natural gas (LNG), liquefied petroleum gases (LPGs) and condensate for export to overseas markets.

For the Ichthys Project, the company plans to install offshore extraction facilities at the field and a subsea gas pipeline from the field to onshore facilities at Blaydin Point in Darwin Harbour. A two train LNG plant, an LPG fractionation plant, a condensate stabilisation plant and a product loading jetty will be constructed at a site on Blaydin Point. Around 85% of the condensate will be extracted and exported directly from the offshore facilities while the remaining 15% will be processed at and exported from Blaydin Point.

In May 2008 INPEX referred its proposal to develop the Ichthys Field to the Commonwealth's Department of the Environment, Water, Heritage and the Arts and the Northern Territory's Department of Natural Resources, Environment and the Arts. The Commonwealth and Northern Territory ministers responsible for environmental matters both determined that the Project should be formally assessed at the environmental impact statement (EIS) level to ensure that potential impacts associated with the Project are identified and appropriately addressed.

Assessment will be undertaken in accordance with the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) and the Environmental Assessment Act (NT). It was agreed that INPEX should submit a single EIS document to the two responsible government departments in the Northern Territory and the Commonwealth for assessment.

SVT Engineering Consultants was commissioned to carry out environmental work associated with INPEX's preparation of the EIS and this technical report, *SVT Engineering Consultants. 2009. Ichthys Gas Field Development Project, Onshore airborne noise study*, was prepared in part fulfilment of that commission.

1.1 Brief Description of Onshore Processing Facilities

The proposed onshore processing facilities comprise a gas reception area (with a pig receiver and slug catcher), two LNG liquefaction trains and a propane and butane fractionation plant. These facilities will include the following noise-emitting plant areas:

- two 4.2 Mt/a LNG trains incorporating acid gas removal, dehydration, hot oil, fuel gas, and fractionation units
- gas turbines for power generation
- a condensate stabilisation plant
- LNG, LPG and condensate storage tanks
- boil-off gas (BOG) compression units

- common utilities (air compression, water treatment, nitrogen generation, firewater systems, etc.)
- a flare system.

A site plan showing the plant layout is provided in Appendix A.

1.2 Scope of study

This study primarily relates to airborne noise emissions from the onshore processing facilities and is based on a gas turbine drive design option for two 4.2 Mt/a trains. A preliminary review of construction noise impacts is also provided.

The principal activity for the study has been the development of an acoustic model of the processing facilities. Noise predictions from the acoustic model are presented and potential impacts discussed. Two operating scenarios have been considered:

1) normal plant operations
2) emergency flaring.

Predicted noise levels have been compared with relevant environmental noise criteria.

The acoustic model has also been used to predict noise levels from pile driving activities during jetty construction.

An assessment of background noise has also been undertaken. The results of the background noise assessment are summarised in this report and have been used as a basis for comparison with predicted noise levels for the processing facilities.

1.2.1 Noise-sensitive receiving premises

The proposed Project site at Blaydin Point is some 10 km to the south-east of Darwin's city centre. The nearest residential area to the site is Palmerston, approximately 4 km to the east and north-east at its nearest point, while a new residential development is proposed for Weddell around 7 km to the south-east of the Project site. Berrimah Farm, approximately 7 km to the north of Blaydin Point, has also been identified as a receiving location of interest.

2. NOISE CRITERIA

The Northern Territory does not currently have noise limits prescribed by legislation. However, the following noise limits have been defined for the project in consultation with the Department of Natural Resources, Environment, the Arts and Sport (NRETAS).

- residential, institutional and educational areas: 55 dB(A) during the day and 45 dB(A) at night
- industrial areas: 70 dB(A) at all times.

Since the proposed LNG plant will operate 24 hours a day, the night-time noise limit of 45 dB(A) is most relevant for noise-sensitive receivers.

3. AMBIENT NOISE ASSESSMENT

Ambient noise levels were measured at two locations (L1 and L2) that are deemed representative of the noise-sensitive receivers nearest to the proposed Project site:

- L1 – O'Ferrals Rd, Bayview. This location is approximately 2.5 km to the north-east of Darwin town centre and 10 km to the north-west of the Project site
- L2 – Constance Court, Palmerston. This location is approximately 5 km to the east-north-east of the Project site.

Both of these locations were selected by NRETAS and are shown in the noise contours presented in Appendix C.

The noise monitoring equipment was set to continuously record $L_{A\,1}$, $L_{A\,10}$ and $L_{A\,90}$ noise levels at 15-minute intervals, where:

- $L_{A\,1}$ is the noise level exceeded for 1% of the time
- $L_{A\,10}$ is the noise level exceeded for 10% of the time
- $L_{A\,90}$ is the noise level exceeded for 90% of the time.

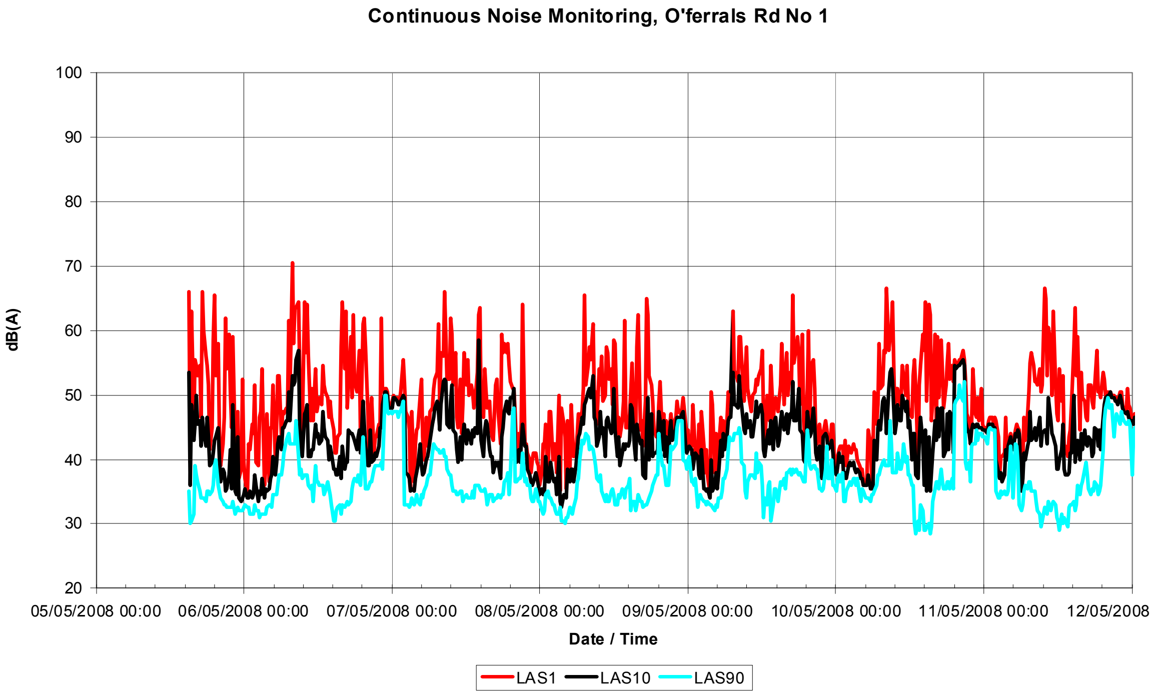
The logging was undertaken from 5 to 23 May 2008.

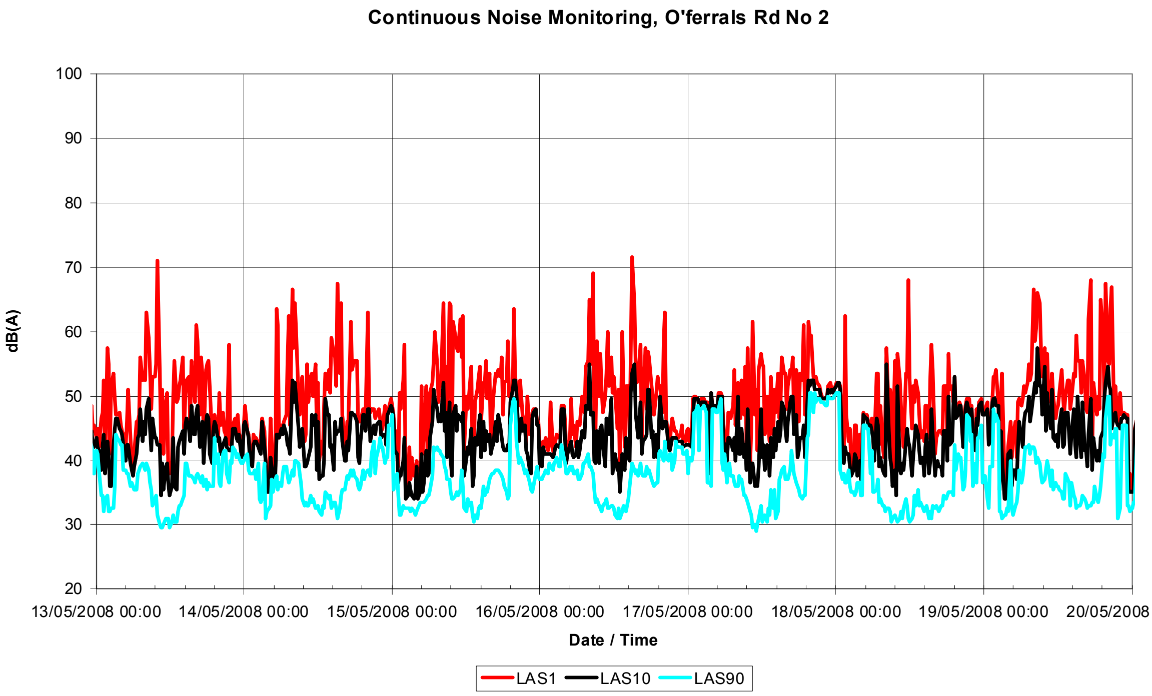
The following sections provide the results of the ambient noise monitoring recorded at each location. Summary tables are provided which include the average $L_{A\,10}$ and $L_{A\,90}$ values collected over the monitoring period during daytime hours, evening hours and night-time hours, and for all periods combined. The standard deviations in the measurement results are also provided. The data have also been analysed to determine the L_{90} (90th percentile) of the $L_{A\,90}$ noise levels for the various time periods. These data provide a good indication of the lowest ambient noise levels. Charts showing the monitored noise data are also presented.

3.1 O'Ferrals Road, Bayview

Table 3-1: Summary of noise logging results for O'Ferrals Road, Bayview

Period	Average $L_{A\,10}$ (dB(A))	Standard deviation in $L_{A\,10}$ (dB)	Average $L_{A\,90}$ (dB(A))	Standard deviation in $L_{A\,90}$ (dB)	L_{90} of $L_{A\,90}$ (dB(A))
Day (0700 to 1900)	44.6	4.2	36.4	3.8	32.0
Evening (1900 to 2200)	44.4	4.3	38.7	5.6	32.0
Night (2200 to 0700)	42.0	4.5	37.9	4.9	32.5
All data	43.5	4.5	37.3	4.7	32.0


Continuous Noise Monitoring, O'ferrals Rd No 1
dB(A)
100
90
80
70
60
50
40
30
20
05/05/2008 00:00
06/05/2008 00:00
07/05/2008 00:00
08/05/2008 00:00
09/05/2008 00:00
10/05/2008 00:00
11/05/2008 00:00
12/05/2008
Date / Time
LAS1
LAS10
LAS90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dB(A)
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90
80
70
60
50
40
30
20
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15/05/2008 00:00
16/05/2008 00:00
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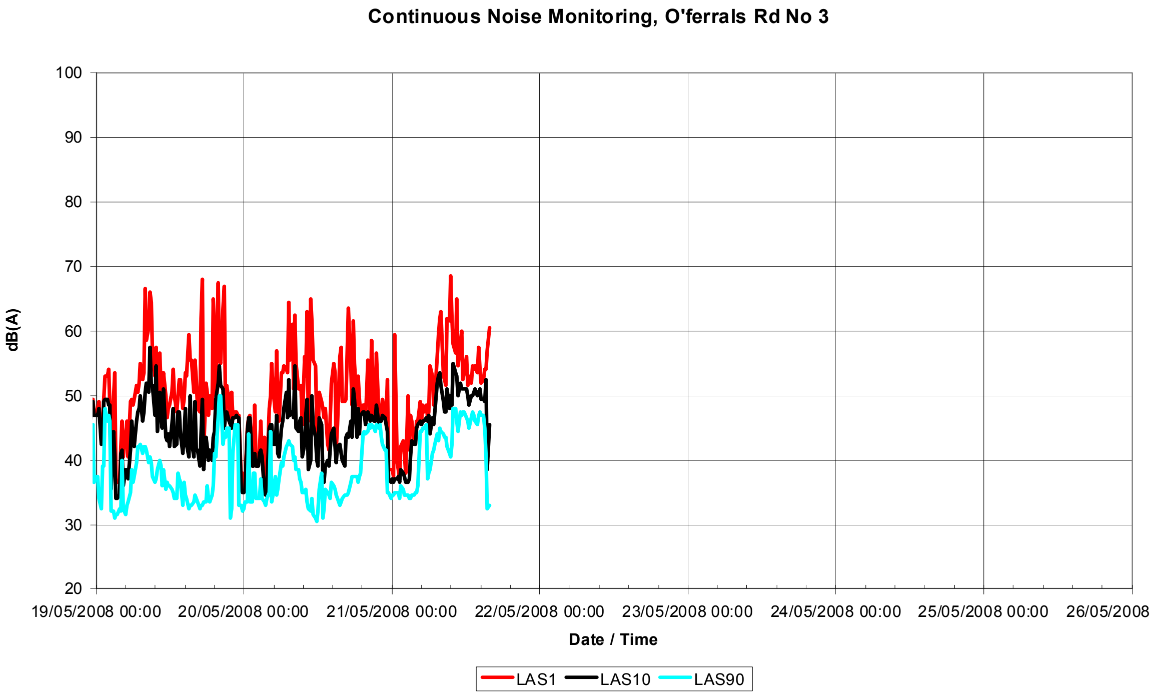
19/05/2008 00:00
20/05/2008
Date / Time
LAS1
LAS10
LAS90

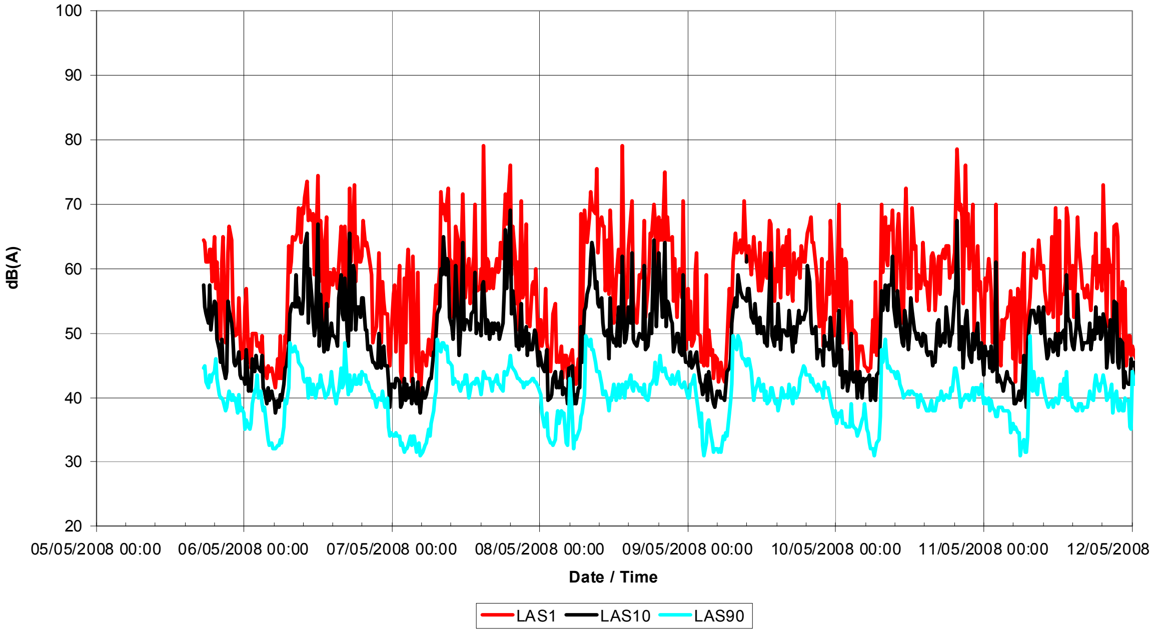


3.2 Constance Court, Palmerston

Table 3-2 : Summary of noise logging results for Constance Court, Palmerston

Period	Average $L_{A\,10}$ (dB(A))	Standard deviation in $L_{A\,10}$ (dB)	Average $L_{A\,90}$ (dB(A))	Standard deviation in $L_{A\,90}$ (dB)	L_{90} of $L_{A\,90}$ (dB(A))
Day (0700 to 1900)	53.3	5.1	42.3	2.9	39.0
Evening (1900 to 22:00)	50.2	4.2	41.6	2.0	39.0
Night (2200 to 0700)	43.6	3.8	36.6	3.4	32.0
All data	48.9	6.3	39.9	4.0	34.0

Continuous Noise Monitoring, Constance No 1



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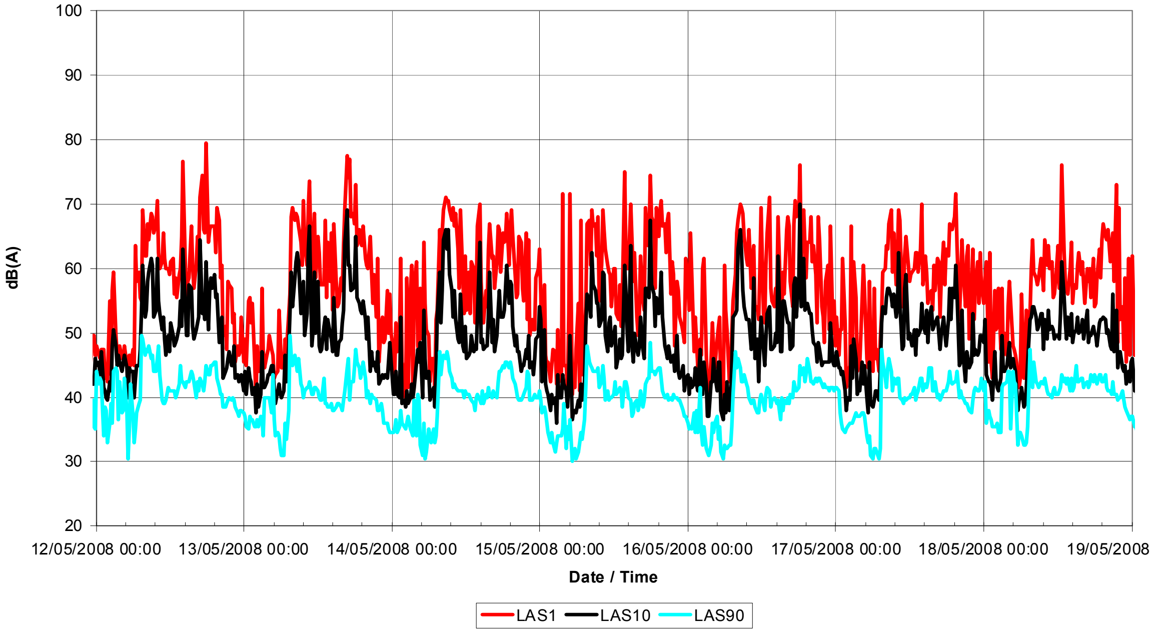

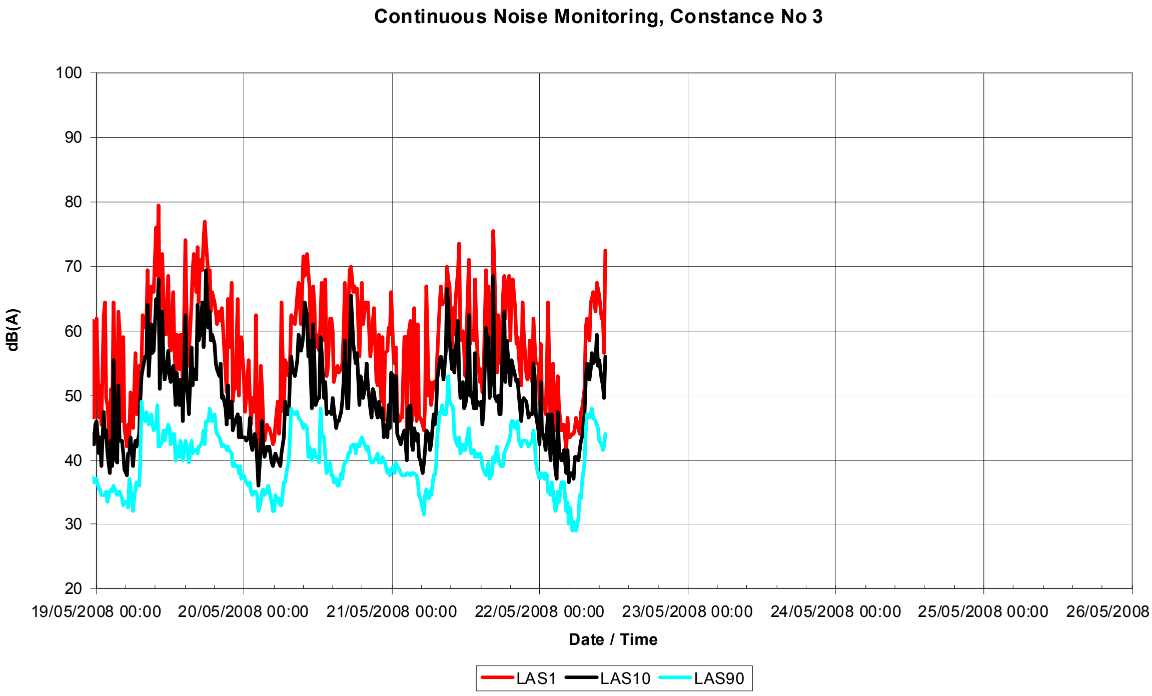

3.3 Summary

The noise logging data at both locations were very consistent throughout the monitoring period indicating that weather conditions were stable. The results also showed a daily cycle in noise levels, particularly at Palmerston, which is consistent with typical human activity in urban environments.

4. NOISE MODELLING

An acoustic model has been developed using the SoundPLAN program developed by SoundPLAN LLC. This program calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. SoundPLAN can be used to model different types of noises, such as industrial noise, traffic noise and aircraft noise, and it has been recognised both internationally and in Australia. It also provides a range of prediction algorithms that can be selected by the user. The CONCAWE[1,2] prediction algorithms have been selected for this study. The inputs required in SoundPLAN are noise source data, ground topographical data, meteorological data and receiver locations.

The model has been used to generate noise contours for the study area and to predict noise levels at key receiving locations.

The acoustic model does not include noise emissions from any source other than the proposed processing facilities.

4.1 Modelling scenarios

Two noise-modelling scenarios have been investigated:

1) normal plant operation

2) emergency flaring.

4.2 Input data

4.2.1 Source sound power levels

Source sound power levels were developed based on equipment identified from the following plot plans provided by INPEX:

D-500-1225-D002 rev EO

D-541-1225-D001 rev EO

D-521-1225-D001 rev EO

D-630-1225-D001 rev EO

D-630-1225-D002 rev EO

D-630-1225-D003 rev EO

D-630-1225-D004 rev EO

D-640-1225-D001 rev EO

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[1] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry.

[2] *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities,* CONCAWE Report 4/81, 1981

D-640-1225-D002 rev EO

D-700-1225-D001 rev EO

D-700-1225-D002 rev EO

D-780-1225-D001 rev EO

A detailed listing of the sources included in the model and their estimated sound power levels is provided in Appendix B. Estimates of sound power levels are based on SVT's experience of similar facilities. The cumulative sound power level for all equipment during normal plant operations is estimated to be approximately 127 dB(A).

For the emergency flaring case, a single noise source has been included in the model with a source sound power level of 140 dB(A). This source is located 4 m above ground level and is enclosed by a 12-m-high barrier specifically designed to reduce noise emissions.

4.2.2 Topography, barriers and ground type

Topographical information for the noise model was provided by INPEX in AutoCAD format and was imported into the noise model.

An absorptive ground type has been assumed for sound propagation over land. For propagation over water, a reflective ground type has been assumed.

The noise modelling includes the barrier effects of local topography only. Because the design is still at an early stage, the barrier effects of buildings and structures have not been included in the noise modelling.

4.2.3 Meteorology

SoundPLAN calculates noise levels for defined meteorological conditions. In particular, temperature, relative humidity, wind speed and direction data are required as input to the model.

For the noise modelling, SVT has used the worst-case night-time meteorological conditions suggested by the Western Australian Environmental Protection Authority's guidance statement for assessing noise impact from new developments[3]. However, the temperature and relative humidity values have been modified to better represent Northern Territory conditions. Table 4-1 below presents the worst-case meteorological conditions for noise propagation.

Table 4-1: Worst-case meteorological conditions for noise emission

Temperature	Relative humidity	Wind speed	Pasquill stability category
20 °C	70%	3 m/s	F

[3] Environmental Protection Authority. 2007. *Guidance for the assessment of environmental factors (in accordance with the* Environmental Protection Act 1986*)—environmental noise*. Guidance Statement No. 8 (Draft). Environmental Protection Authority, Perth, Western Australia.

4.2.4 Receiving locations

The model has been used to predict noise levels at the following receiving locations:

Table 4-2 : Receiving locations

Receiver	Approximate distance from Project site	Coordinates		Comment
		E	N	
Berrimah Farm	7 km to the north	710606	8622547	Noise-sensitive receiver
Palmerston	4 km to the north-east	712598	8617104	Western limit of closest residential area to Project site
Weddell	7 km to the south-east	714220	8608944	Northern limit of proposed residential area
O'Ferrals Road, Bayview	10 km to the north-west	702187	8623745	Ambient noise logging location
Constance Court, Palmerston	5 km to the north-east	714073	8617104	Ambient noise logging location

4.3 Noise modelling results

Noise contours for normal plant operation and for emergency flaring are presented in Appendix C. Table 4-3 provides a summary of the predicted noise levels due to the plant at each of the key receiving locations.

Table 4-3 : Summary of predicted noise levels

Location	Noise level dB(A)	
	Normal plant operation	Emergency flaring
Berrimah Farm	24	35
Palmerston	33	39
Weddell	17	31
O'Ferrals Road, Bayview	20	36
Constance Court, Palmerston	26	35

The noise modelling results demonstrate that noise emissions from the proposed LNG plant are likely to be significantly below the noise limits defined for the Project (see Section 2) at all existing and potential noise-sensitive receiving locations, both for normal operating conditions and for emergency flaring. Furthermore, predicted noise levels are below typical background noise levels monitored at the nearest residential area (see Section 3).

Predicted noise levels do not exceed 70 dB(A) beyond the Project site and hence noise emissions are compliant with the noise limit for industrial emitters.

5. CONSTRUCTION NOISE

The following potential noise sources have been identified for the construction phase:

Work category	Construction equipment
Geotechnical investigation	
Boring	Boring machine
	Excavator
Oceanographic survey	Work vessel
Site development	
Clearing and grubbing	Dozer, grader, payloader
	Backhoe
	Dump truck
	Crusher, vibro-screen
Blasting	Drilling machine
	Explosive device
Piling	Diesel hammer / hydraulic hammer
	Crawler crane
	Vibro-piling machine
	Auger
Earth structure and trenching	Dozer, grader, payloader
	Backhoe
	Giant breaker
	Tandem roller, compactor
	Dump truck
	Dewatering pump
Armour Stone Work	Backhoe
	Crawler crane
	Dump truck
Road and paving	Asphalt spreader
	Roller
Concrete structure	Batching plant
	Concrete pump car
	Concrete vibrator
Marine construction	
Jetty construction	Piling gantry frame

Work category	Construction equipment
	Diesel hammer / hydraulic hammer
	Drilling machine for rock anchor
	Mortar grouting pump
	Crawler crane
	Gantry crane
	Working barge
	Jack-up barge
	Floating crane
	Tugs
	Work boats
Dredging	Trailing suction hopper dredger
	Cutter suction dredger
	Backhoe dredger
	Grub dredger
	Stone-dumping vessel
	Drain vessel
Reclamation	Stone column installation rig
	Vertical drain installation rig
Blasting for dredging and jetty construction	Drilling machine
	Explosive device
Equipment erection	
Lifting	Heavy-duty cranes
	SPMT, trailer
Assembling work	Compressor
	Generator
	Engine welder
	Chipping machine
Piping work	
Flushing and blowing	Compressor
Surface protection and painting	Compressor
	Blasting machine
Temporary works	
Transportation	Prime mover and trailer

	Work category	Construction equipment
		Dump truck, cargo truck
		Tandem trailer
		Tank lorry, tandem lorry
		Bus, pickup, 4WD vehicle
		Towing barge and tug
		Ferry, passenger boat, speed boat
	Maintenance shop	Maintenance shop equipment
		Diesel-driven generator
		Diesel-driven compressor

With the possible exception of blasting and piling, it is unlikely that noise emissions from these sources will exceed those associated with normal plant operations and consequently no adverse noise impacts are anticipated.

Noise and vibration levels associated with blasting are very difficult to predict prior to the actual blasting. However, due to the large distances between the Project site and the nearest noise-sensitive receptors, no adverse impacts are anticipated, particularly if blasting is restricted to daytime hours.

Impact noise from piling during jetty construction has been investigated using the noise model (refer section 5.1.

The movement of light vehicles to and from a construction site, which normally peaks at shift changeovers, is unlikely to result in a significant noise impact. However, noise from heavy vehicles associated with earthworks can be a source of annoyance if routes are through residential streets or quiet country roads, particularly if movements occur outside daytime hours. If this is the case then noise management measures may have to be introduced to minimise noise. These may include, for example, appropriate route selection and/or restriction of heavy-vehicle movements through noise-sensitive areas to daytime hours.

The Australian Standard *AS 2436:1981, Guide to noise control on construction, maintenance and demolition sites* provides further guidance on managing noise from construction activities.

5.1 Noise Impacts from Piling During Jetty Construction

The noise model has also been used to predict noise impacts from piling during jetty construction. A noise source representing an impact pile driver was included in the model at the furthest extent of the jetty, i.e. at a location where worst-case impacts would be anticipated.

Noise source data was obtained from SVT's in-house data base and originated from measurements recorded for a 1200mm impact pile driver used for jetty construction at a mining port. The data represents the L_{A10} noise level recorded over multiple impacts, i.e. the noise level exceeded for 10% of the measurement period.

Noise contours for piling operations are presented in Appendix C. Table 5-1 provides a summary of the predicted noise levels at each of the key receiving locations.

Table 5-1 : Summary of predicted noise levels from piling

Location	Noise Level dB(A)
Berrimah Farm	39
Palmerston	49
Weddell	27
O'Ferrals Road, Bayview	37
Constance Court, Palmerston	42

The noise modelling results demonstrate that noise emissions from piling are below the day time noise limits defined for the project (see Section 2) but have the potential to exceed the night time limit of 45 dB(A) at the outskirts of Palmerston under worst-case weather conditions for sound propagation.

6. DISCUSSION AND CONCLUSION

Noise level predictions for the proposed LNG plant have been shown to be significantly below applicable noise limits for both normal operating conditions and emergency flaring. Predicted noise levels for normal plant operations are also shown to be below monitored ambient noise levels. The predicted levels are low enough to provide a high level of confidence that the proposed LNG plant will have no significant noise impact on the identified noise-sensitive receptors.

Noise levels above 70 dB(A) do not extend beyond the proposed site boundary and are, therefore, compliant with the noise limit for industrial emitters.

6.1 Intrusive Noise Characteristics

The annoyance associated with a particular noise emission is dependent on the characteristics of the noise as well as the noise level. The following characteristics are known to particularly intrusive:

- Tonality (eg whining or droning)
- Modulation (regular and cyclic variation in noise level or frequency content)
- Impulsiveness (eg banging and thumping)
- Low frequency noise (LFN)

Many noise sources exhibit one or more of these characteristics when assessed in the near-field (i.e. close to the noise source). However, frequency dependent sound attenuation during propagation as well as masking effects from ambient sounds such as traffic and wind noise can render these characteristics inaudible at more distant receiving locations.

6.1.1 Tonality

Any tonality in noise emissions from plant and equipment at the proposed LNG plant is highly unlikely to be evident at the nearest noise-sensitive receptors for the following reasons:

- Because of the high number of individual noise emitters associated with the proposed LNG plant, it is unlikely that any individual noise source will emit tonal noise which protrudes above the cumulative noise from all other sources. Consequently, any tonality in noise emissions will have a localized impact in the near field of individual sources.
- Noise from piping and valves can produce a high frequency whistling noise which is tonal in nature and with sufficient intensity to protrude above the cumulative noise from other sources in the near field. However, because of the high frequency nature of this noise it is strongly attenuated by atmospheric absorption during propagation and is quickly rendered inaudible as distance increases.

6.1.2 Modulation

Noise from the proposed LNG operations is continuous in nature and is, therefore, highly unlikely to exhibit any regular and cyclic variation in noise level or frequency content.

6.1.3 Impulsiveness

Noise from the proposed LNG operations is continuous in nature and is, therefore, highly unlikely to exhibit any impulsive characteristics.

6.1.4 Low Frequency Noise

Low frequency noise (LFN) is a problem which is known to affect only a small number of people with heightened sensitivity. However, in most cases, no environmental sound that can account for the sufferer's reaction can be found. Measurement of low frequency sound is technically very difficult and there is no method for prediction of disturbance. However, the risk of LFN noise is likely to be low due to the distances between the project site and the nearest noise-sensitive receivers.

6.2 Construction Noise

It is unlikely that noise from general construction activities will exceed those associated with normal plant operations and consequently no adverse noise impacts are anticipated.

Piling and blasting noise may be somewhat higher than noise associated with normal plant operations, and may also be impulsive in character. However, due to the large distances between the Project site and the nearest noise-sensitive receptors, the risk of noise impacts is low. Noise level predictions presented in Section 5.1 demonstrate that noise from piling has the potential to exceed the night-time noise limit on the outskirts of Palmerston under worst-case weather conditions for sound propagation. At other noise-sensitive locations, noise level predictions are below the night-time noise limit.

Consideration should be given to transport routes and/or operating hours for heavy vehicles associated with earthworks to ensure that noise from these vehicles does not adversely affect noise-sensitive receptors.

APPENDIX A : SITE PLAN

APPENDIX B : NOISE SOURCE LIST

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
LNG Trains 1 and 2 (Train 2 offset by 200 m and 107 m in X and Y directions respectively)							
K551E001	Regen overhead condenser	103.6	708655	8615295	7	20	9 fans at 94 dB(A) per fan
K551E002	Lean solvent cooler	109.2	708664	8615320	7	20	36 fans at 94 dB(A) per fan
K551E031	Incinerator flue gas/acid gas heater	92.6	708717	8615337	7	1	Assuming 80 dB(A) at 1 m
K551E032	Incinerator flue gas/air heater						Incorporated in E031
K561E003	Regen gas cooler	98.4	708569	8615448	7	20	3 fans at 94 dB(A) per fan
K591E003	MCHE inlet gas comp aftercooler	103.6	708590	8615410	7	20	9 fans at 94 dB(A) per fan
K591E008	End flash comp 1st stage intercooler	98.4	708584	8615421	7	20	3 fans at 94 dB(A) per fan
K591E009	End flash comp 2nd stage intercooler						Incorporated in E008
K591E010	End flash comp 3rd stage cooler						Incorporated in E008
K591E011	End flash comp aftercooler						Incorporated in E008
K601E001	Propane desuperheater	103.6	708645	8615314	7	20	9 fans at 94 dB(A) per fan

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K601E002	Propane condenser	113.4	708592	8615446	7	20	96 fans at 94 dB(A) per fan
K601E003	Propane subcooler	107.4	708617	8615362	7	20	24 fans at 94 dB(A) per fan
K601E005	Low-pressure MR compressor intercooler	104.4	708561	8615461	7	20	12 fans at 94 dB(A) / fan
K601E006	Medium-pressure MR compressor intercooler	103.6	708600	8615393	7	20	9 fans at 94 dB(A) / fan
K601E007	High-pressure MR compressor aftercooler	103.6	708634	8615332	7	20	9 fans at 94 dB(A) per fan
K611E003	Depropaniser condenser	105.3	708534	8615509	7	20	15 fans at 94 dB(A) per fan
K611E006	Debutaniser condenser	103.6	708548	8615485	7	20	9 fans at 94 dB(A) per fan
K643E103	Hot oil trim cooler	103.6	708575	8615437	7	20	9 fans at 94 dB(A) per fan
K551F031	Thermal incinerator	92.6	708705	8615358	7	1	Assuming 80 dB(A) at 1 m
K551K031	Incinerator air blower	92.6	708713	8615343	7	1	Assuming 80 dB(A) at 1 m
K581K001	De-ethaniser recompressor	102.1	708567	8615397	7	2.5	Approx. 85 dB(A) at 1 m from compressor
K581K002	De-ethaniser inlet expander	102.1	708565	8615396	7	2.5	Approx. 85 dB(A) at 1 m from compressor
K591K001	MCHE inlet gas compressor	105.1	708552	8615400	7	2.5	Approx. 85 dB(A) at 1 m from compressor
K591K002	End flash compressor	105.1	708544	8615414	7	2.5	Approx. 85 dB(A) at 1 m from compressor

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K601K001	Propane refrigerant compressor	115.1	708622	8615301	7	3	Approx. 85–90 dB(A) at 1 m from package
K601K002	Low-pressure MR compressor	115.1	708520	8615482	7	3	Approx. 85–90 dB(A) at 1 m from package
K601K003	Medium-pressure MR compressor				7		Incorporated in K002
K601K004	High-pressure MR compressor				7		Incorporated in K002
K591KM001	MCHE inlet gas compressor motor	100.4	708557	8615391	7	2.5	Assuming sound pressure level (SPL) approx. 85 dB(A) at 1 m
K591KM002	End flash compressor motor	100.4	708541	8615418	7	2.5	Assuming SPL approx. 85 dB(A) at 1 m
K601KT001	Propane refrigerant compressor gas turbine	112.4	708607	8615293	7	3	Approx. 80–85 dB(A) at 1 m from package
K601KT002	MR compressor gas turbine	112.4	708505	8615473	7	3	Approx. 80–85 dB(A) at 1 m from package
K551P001 A	Lean solvent booster pump	94.6	708637	8615418	7	1.5	Approx. 82 dB(A) at 1 m
K551P001 B	Lean solvent booster pump	94.6	708640	8615420	7	1.5	Approx. 82 dB(A) at 1 m
K551P001 C	Lean solvent booster pump						Standby
K551P002 A	Lean solvent charge pump	94.6	708665	8615369	7	1.5	Approx. 82 dB(A) at 1 m
K551P002 B	Lean solvent charge pump	94.6	708670	8615372	7	1.5	Approx. 82 dB(A) at 1 m
K551P002 C	Lean solvent charge pump						Standby

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K551P003 A	Rich solvent pump	94.6	708644	8615389	7	1.5	Approx. 82 dB(A) at 1 m
K551P003 B	Rich solvent pump	94.6	708646	8615385	7	1.5	Approx. 82 dB(A) at 1 m
K551P003 C	Rich solvent pump						Standby
K551P004 A	Regen reflux pump	90.7	708671	8615352	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K551P004 B	Regen reflux pump						Standby
K551P005 A	Reboiler hot oil pump	94.6	708648	8615401	7	1.5	Approx. 82 dB(A) at 1 m
K551P005 B	Reboiler hot oil pump	94.6	708652	8615404	7	1.5	Approx. 82 dB(A) at 1 m
K551P005 C	Reboiler hot oil pump						Standby
K551P006 A	Demin water pump	90.7	708681	8615370	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K551P006 B	Demin water pump						Standby
K551P031	Acid gas KO pump	90.7	708684	8615359	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K581P001 A	De-ethaniser feed pump	94.6	708580	8615392	7	1.5	Approx. 82 dB(A) at 1 m
K581P001 B	De-ethaniser feed pump						Standby
K591P001 A	LNG run-down pump	94.6	708549	8615440	7	1.5	Approx. 82 dB(A) at 1 m

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K591P001 B	LNG run-down pump						Standby
K601P001	Propane return pump	94.6	708601	8615314	7	1.5	Approx. 82 dB(A) at 1 m
K611P001 A	De-ethaniser reflux pump	94.6	708592	8615544	7	1.5	Approx. 82 dB(A) at 1 m
K611P001 B	De-ethaniser reflux pump						Standby
K611P002 A	Depropaniser reflux pump	94.6	708572	8615534	7	1.5	Approx. 82 dB(A) at 1 m
K611P002 B	Depropaniser reflux pump						Standby
K611P003 A	Debutaniser reflux pump	94.6	708580	8615522	7	1.5	Approx. 82 dB(A) at 1 m
K611P003 B	Debutaniser reflux pump						Standby
K611P004 A	LPG reinjection pump	94.6	708582	8615524	7	1.5	Approx. 82 dB(A) at 1 m
K611P004 B	LPG reinjection pump						Standby
K611P005 A	De-isopentaniser reflux pump	94.6	708589	8615528	7	1.5	Approx. 82 dB(A) at 1 m
K611P005 B	De-isopentaniser reflux pump						Standby
K611P006 A	Stabilised condensate pump	94.6	708598	8615532	7	1.5	Approx. 82 dB(A) at 1 m
K611P006 B	Stabilised condensate pump						Standby

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X (m)	Y (m)	Ground level (m)	Height above ground (m)	
K643P101 A	Hot oil circulation pump	94.6	708615	8615430	7	1.5	Approx. 82 dB(A) at 1 m
K643P101 B	Hot oil circulation pump	94.6	708620	8615432	7	1.5	Approx. 82 dB(A) at 1 m
K643P101 C	Hot oil circulation pump						Standby
K643P102	Hot oil start-up pump	94.6	708629	8615437	7	1.5	Approx. 82 dB(A) at 1 m
K643P103	Hot oil drain pump	90.7	708633	8615445	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
Condensate stabilisation							
K521K001	Stabiliser overhead compressor	105.1	708395	8615316	7	2.5	Approx. 85 B(A) at 1 m from compressor
K522K001	Stabiliser overhead compressor	105.1	708411	8615324	7	2.5	Approx. 85 B(A) at 1 m from compressor
K521P001	Stabiliser recycle pump	94.6	708399	8615297	7	1	Approx. 82 dB(A) at 1 m
K522P001	Stabiliser recycle pump	94.6	708413	8615304	7	1	Approx. 82 dB(A) at 1 m
LNG and LPG tank areas							
K633P001	Ethane transfer pump	90.7	707925	8615368	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K633P002	Propane transfer pump	90.7	707952	8615382	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K635P001	Solvent make-up pump	90.7	707973	8615395	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K632P003 A	Propane loading pump	94.6	708172	8615429	7	1.5	Approx. 82 dB(A) at 1 m
K632P003 B	Propane loading pump	94.6	708188	8615439	7	1.5	Approx. 82 dB(A) at 1 m
K632P003 C	Propane loading pump						Standby
K632P004 A	Butane loading pump	94.6	708255	8615476	7	1.5	Approx. 82 dB(A) at 1 m
K632P004 B	Butane loading pump	94.6	708273	8615486	7	1.5	Approx. 82 dB(A) at 1 m
K632P004 C	Butane loading pump						Standby
BOG compression							
K631K001 A	BOG compressor	105.1	708206	8615621	7	2.5	Approx. 85 B(A) at 1 m from compressor
K631K001 B	BOG compressor	105.1	708211	8615612	7	2.5	Approx. 85 B(A) at 1 m from compressor
K631K001 C	BOG compressor						Standby
K632K001	Propane BOG compressor	103.1	708221	8615593	7	2.5	Approx. 85 B(A) at 1 m from compressor
K631E001	BOG compressor aftercooler	96.6	708175	8615600	7	10	4 fans (of 6) assuming sound power level of 91 dB(A) per fan
K632K001	Propane BOG condenser	93.6	708181	8615588	7	10	2 small fans assuming sound power level of 91 dB(A) per fan
K631P004 A	BOG KO drum drain pump	94.6	708198	8615603	7	1.5	Approx. 82 dB(A) at 1 m

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X (m)	Y (m)	Ground level (m)	Height above ground (m)	
K631P004 B	BOG KO drum drain pump						Standby
K632P001 A	Propane condensate return pump	94.6	708203	8615595	7	1.5	Approx. 82 dB(A) at 1 m
K632P001 B	Propane condensate return pump						Standby
K632P002 A	Butane condensate return pump	94.6	708207	8615588	7	1.5	Approx. 82 dB(A) at 1 m
K632P002 B	Butane condensate return pump						Standby
Condensate tank area							
K634P003 A	Off-spec condensate return pump	90.7	708271	8615840	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K634P003 B	Off-spec condensate return pump						Standby
K634P004 A	Condensate loading pump	94.6	708271	8615840	7	1	Approx. 82 dB(A) at 1 m
K634P004 B	Condensate loading pump	94.6	708271	8615840	7	1	Approx. 82 dB(A) at 1 m
K634P004 C	Condensate loading pump						Standby
Common utilities							
K683A001 A	Instrument air drier package	104.6	708685	8615068	7	2	Approx. 80–85 dB(A) at 1 m from package
K683A001 B	Instrument air drier package				7		Standby

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K692A001 A	Nitrogen generation package	104.6	708717	8615099	7	2	Approx. 80–85 dB(A) at 1 m from package
K692A001 B	Nitrogen generation package						Standby
K652E001	Cooling-water cooler	98.4	708764	8615117	7	5	3 fans at 94 dB(A) per fan
K681K001 A	Air compressor	104.6	708672	8615092	7	2	Approx. 80–85 dB(A) at 1 m from package
K681K001 B	Air compressor	104.6	708677	8615084	7	2	Approx. 80–85 dB(A) at 1 m from package
K681K001 C	Air compressor						Standby
K652P001 A	Cooling-water circulation pump	94.6	708775	8615125	7	1.5	Approx. 82 dB(A) at 1 m
K652P001 B	Cooling-water circulation pump	94.6	708778	8615120	7	1.5	Approx. 82 dB(A) at 1 m
K652P001 C	Cooling-water circulation pump						Standby
K674P001 A	Drinking-water pump	94.6	708750	8615120	7	1.5	Approx. 82 dB(A) at 1 m
K674P001 B	Drinking-water pump				7		Standby
K675P001 A	Demineralised-water pump	94.6	708769	8615136	7	1.5	Approx. 82 dB(A) at 1 m
K675P001 B	Demineralised-water pump				7		Standby
K643P001	Hot oil make-up pump	90.7	708831	8615143	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m

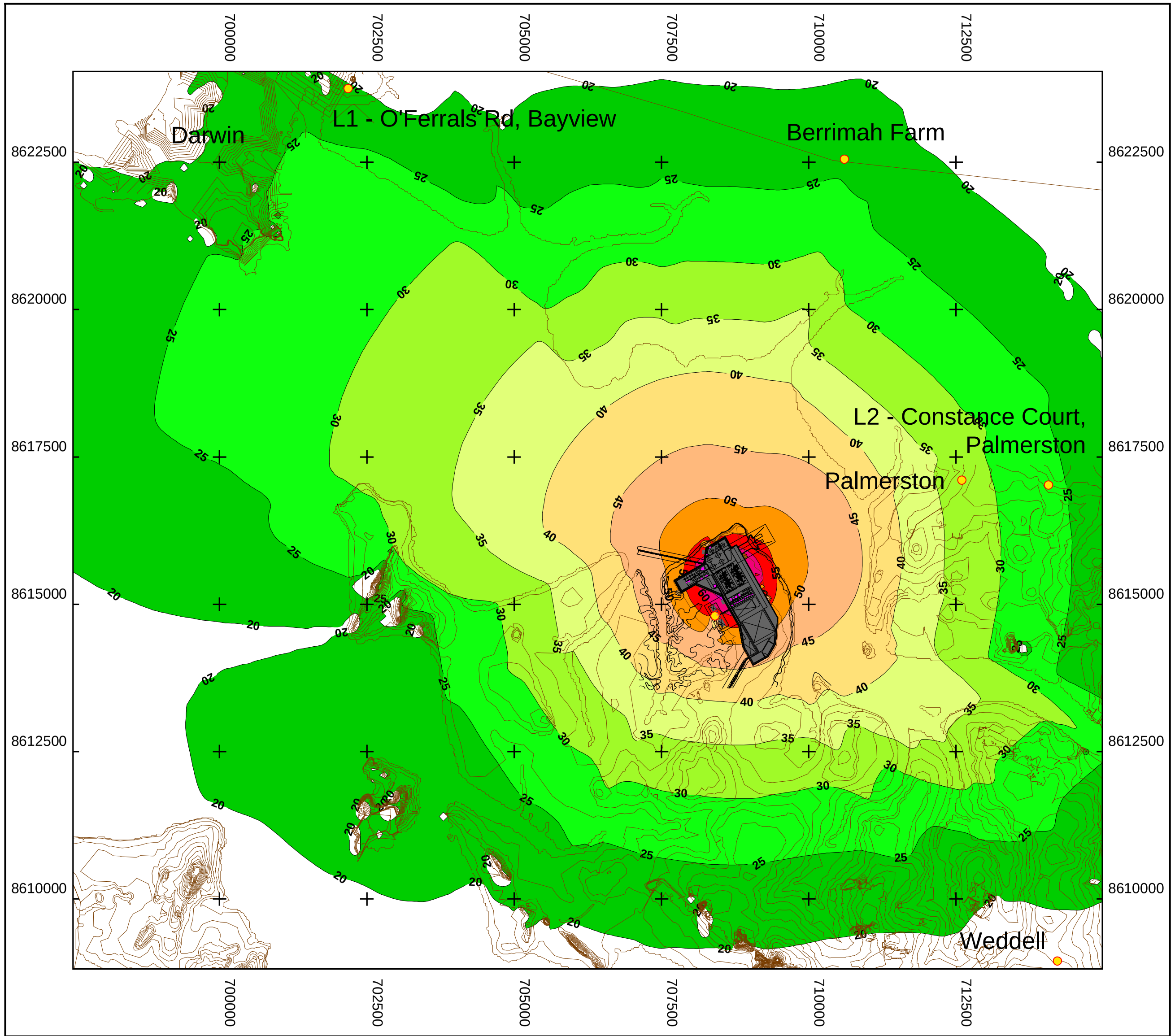
Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K672P001 A	Service water pump	90.7	708826	8615148	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K672P001 B	Service water pump						Standby
K672P002 A	Backwash pump	90.7	708824	8615156	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K672P002 B	Backwash pump						Standby
K791P001 A	Fresh firewater jockey pump	90.7	708820	8615160	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
K791P001 B	Fresh firewater jockey pump						Standby
K791P002	Fresh firewater pump	94.6	708819	8615164	7	1.5	Approx. 82 dB(A) at 1 m
K791P003	Fresh firewater diesel pump	100.4	708816	8615168	7	1.5	Assuming SPL approx. 85 dB(A) at 1 m
Power generation							
K782A001	GT power generation package	107.4	708747	8615007	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A002	GT power generation package	107.4	708784	8615027	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A003	GT power generation package	107.4	708820	8615048	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A004	GT power generation package	107.4	708855	8615068	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A005	GT power generation package	107.4	708892	8615089	7	3	Approx. 80–85 dB(A) at 1 m from package

Tag number	Name	Sound power level (dB(A))	Coordinates				Comment
			X	Y	Ground level	Height above ground	
			(m)	(m)	(m)	(m)	
K782A006	GT power generation package	107.4	708927	8615110	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A007	GT power generation package	107.4	708963	8615130	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A008	GT power generation package	107.4	709000	8615150	7	3	Approx. 80–85 dB(A) at 1 m from package
K782A009	GT power generation package	107.4	709037	8615167	7	3	Approx. 80–85 dB(A) at 1 m from package
Flare							
K702P001	Warm flare KO drum pump	90.7	708697	8614979	7	1	In service—assuming SPL approx. 78 dB(A) at 1 m
	Emergency flaring	140.4	708445	8614817	7	4	Multi-point enclosed ground flare
Piling							
	1200mm impact pile driver	139.8	707910	8616315	0	20	Data from SVT database

APPENDIX C : NOISE CONTOURS

Figure 1

INPEX DARWIN
NORMAL PLANT OPERATION
Noise Contours for Worst-Case Wind Conditions



Noise levels dB(A)

	< 20
20 <=	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	< 65
65 <=	< 70
70 <=	

Length Scale 1:115000

0 0.5 1 2 3 km

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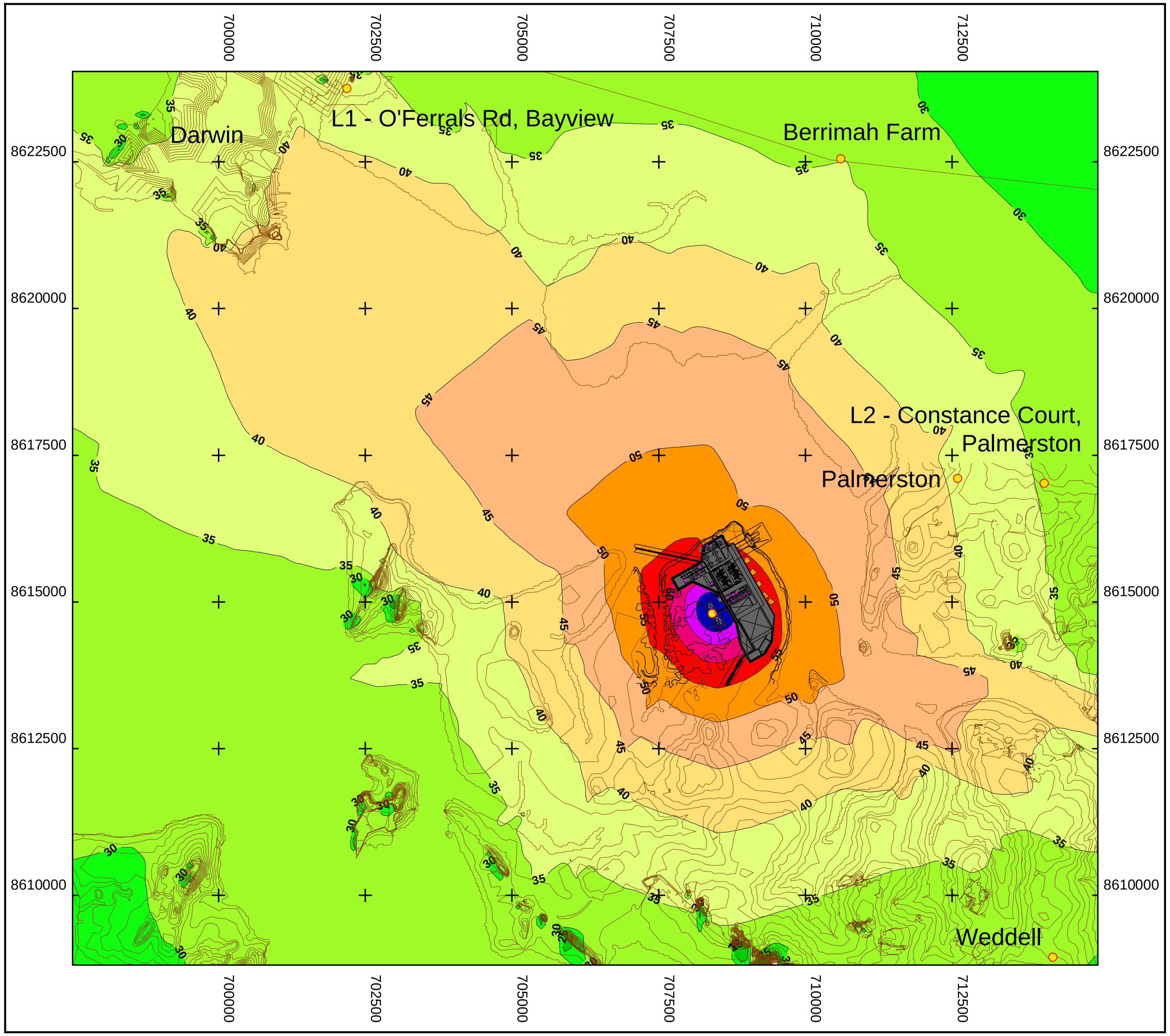
INPEX DARWIN

EMERGENCY FLARING

Noise Contours for Worst-Case Wind Conditions

Figure 2



Noise levels dB(A)

	< 20
20 <=	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	< 65
65 <=	< 70
70 <=	

Length Scale 1:115000

0 0.5 1 2 3 km

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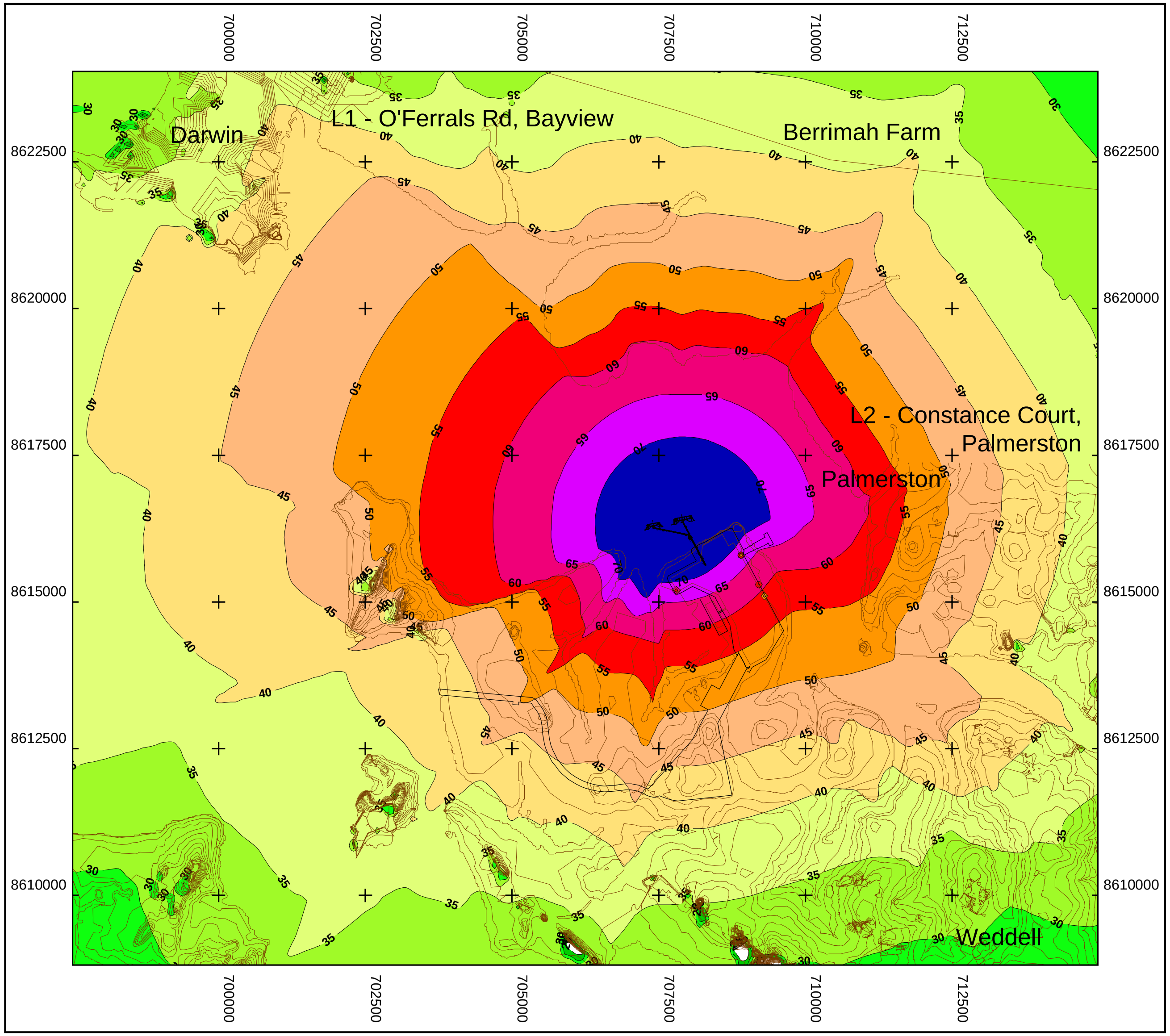
INPEX DARWIN
PILE DRIVING DURING JETTY CONSTRUCTION
Noise Contours for Worst-Case Wind Conditions

Figure 3



Noise levels dB(A)

	< 20
20 <=	< 25
25 <=	< 30
30 <=	< 35
35 <=	< 40
40 <=	< 45
45 <=	< 50
50 <=	< 55
55 <=	< 60
60 <=	< 65
65 <=	< 70
70 <=	

Length Scale 1:115000

0 0.5 1 2 3 km

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