10.0 Noise

10.1 Introduction

This noise assessment has been undertaken by subconsultants Vipac Engineers & Scientists. A copy of their report is given in Appendix C.

The objectives of the noise assessment are to:

- Conduct a noise survey for the refinery, the conveyor and the surrounding noise sensitive receivers;
- Estimate the noise emissions of the proposed new equipment;
- Develop a noise model to predict noise levels at the nearest sensitive receivers before and after the expansion;
- Assess operational noise impact, by comparison of existing noise levels against predicted future noise levels, as a result of the proposed extension;
- Assess noise impacts during construction;
- Assess noise impacts from the changes to traffic flows for both future operations and construction;
- Develop noise management strategies and practices to reduce noise emissions for both proposed and existing sources; and
- Prepare a noise environmental management plan.

10.2 Noise Standards

A number of different noise standards have been used to assess the noise impact of various components of the expansion project such as operations, construction and traffic. The standards that have been used are discussed below.

10.2.1 Operational Noise

The Northern Territory government's Draft Waste Management and Pollution Control (Environmental Noise) Regulation ('the Regulation') has specific maximum noise levels for various aspects of noise including community activities, construction sites, residential premises, agricultural equipment on rural premises, special sporting, cultural and entertainment events, and vehicles, trains etc. While the Regulation does not apply on a mining lease it can be used as a guide to what might be acceptable noise levels.

The specific maximum noise levels specified in the draft Regulation for residential areas are tabulated in Table 10.2.1

Table 10.2.1
Maximum Noise Levels from Draft Regulation

Area Number	Area Description	Time of Day	L_{A10}[1] dB(A)	L_{A1}[2] dB(A)	L_{Amax}[3] dB(A)
4	An area of noise sensitive premises that is within 15 m of a building used for noise sensitive purposes on the premises, where the building is more than 100 m from: • a road carrying more than 10,000 vehicles per day; or • a significant business	7am to 7pm Mon-Sat	45	55	65
		9am to 7pm Sunday & Public holiday	40	50	65
		7pm to 10pm all days	40	50	55
		10pm on any day to 7am Mon – Sat and 9am Sunday & public holiday	35	45	55
5	An area of noise sensitive premises that is within 15 m of a building used for noise sensitive purposes on the premises, where the building is within 100 m from: • a road carrying more than 10,000 vehicles per day; or • a significant business	7am to 7pm Mon-Sat	50	60	70
		9am to 7pm Sunday & Public holiday	45	55	70
		7pm to 10pm all days	45	55	60
		10pm on any day to 7am Mon – Sat and 9am Sunday & public holiday	40	50	60

1. L_{A10} is the noise level exceeded for 10% of the time.
2. L_{A1} is the noise level exceeded for 1% of the time and is a common expression of the maximum noise level.
3. L_{Amax} is the maximum instantaneous sound pressure level.

10.2.2 Construction Noise

The draft NT Regulation also addresses construction noise. In Part 4 - Specific Maximum Noise Pollution Level, the draft Regulation states*:*

*"**13. Noise from construction sites between 7 am and 7 pm weekdays or Saturday***

Noise emitted from a construction site as a result of construction work carried out between 7 am and 7 pm on a day that is not a Sunday or public holiday is to be taken to comply with regulation 3[1] if the occupier of the construction site establishes that-

a) The construction work was carried out in accordance with the control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Site;.

b) The equipment used on the construction site was the quietest reasonably available; and

c) Where the occupier was required to prepare a construction noise management plan under regulation 15 in respect of the construction site:

- *The plan was submitted under regulation 15 by the date specified in the notice;*
- *The plan was approved under regulation 15;and*
- *The construction work was carried out in accordance with the construction noise management plan approved under regulation 15.*

14. Noise from construction sites at other times of day

Noise emitted from a construction site as a result of construction work carried out-

a) between 7 pm and 7 am on a day; or

b) at any other time on a Sunday or public holiday,

is to be taken to comply with regulation 3[1] if the occupier of the construction site shows that –

c) The construction work was carried out in accordance with the control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites.

d) The equipment used on the construction site was the quietest reasonably available;

e) The construction work was carried out in accordance with a construction noise management plan in respect of the construction site-

i. submitted to the Chief Executive Officer not later than 7 days before the construction work commenced;

ii. approved by the Chief Executive Officer under regulation 15(5);

f) At least 24 hours before the construction work commenced, the occupier of the construction site gave written notice of the proposed construction work to the occupiers of all premises in relation to which it is likely regulation 3 would , apart from this regulation, not be complied with; and

g) It was reasonably necessary for the construction work to be carried out at that time."

[1] Note: Table 10.2.1 shows the Regulation 3 noise limits.

10.2.3 Road Traffic

The draft NT Regulation does not contain planning levels for public roads. For this study, the planning levels for road traffic noise in Queensland have been used for assessing the noise impacts of project traffic.

The Queensland Environmental Protection Policy (Noise) (EPP) refers to planning levels for road traffic noise. While these criteria are planning levels for new roads, they can be used for assessment of existing roads with increased traffic flows. The planning levels in Schedule 1 of the EPP are:

"The planning levels for a public road are the following noise levels, assessed 1 m in front of the most exposed part of an affected noise sensitive place –

1. the following levels assessed as the $L_{10\ (18\ hour)}$ level –

(i) for a state-controlled road - 68 dB(A)

(ii) for another public road – 63 dB(A)

2. 60 dB(A), assessed as the highest 1 hour equivalent continuous A-weighted sound pressure level between 10:00 p.m. and 6:00 a.m.;

3. 80 dB(A), assessed as a single event maximum sound pressure level."

10.2.4 Sleep Disturbance

The World Health Organisation (WHO) "*Guidelines for Community Noise*" contains criteria for the assessment of sleep disturbance. It states that health effects on sleep are negligible at levels below 30 dB(A) L_{Aeq} for a sources of a

continuous nature. It is suggested that for noise with a large low frequency content a level lower than 30 dB(A) L_{Aeq}[1] (inside bedrooms) is recommended, however no exact value is stipulated. For short duration, non-continuous noise levels, maximum noise levels should not exceed 45 dB(A) L_{Amax} (inside bedrooms) when background noise levels are low.

The "*Guidelines*" assume a noise reduction of a dwelling to be in the order of 15 dB(A) to determine sleep disturbance criteria for outside bedrooms. This is likely to be excessive for Northern Territory conditions as bedroom windows are typically open due to the warm climate. Noise reductions of at least 5 dB(A) and not more than 10 dB(A) are expected.

Consequently, it can be assumed that to comply with the WHO sleep disturbance guidelines, noise levels outside bedrooms need to be:

- 35 dB(A) L_{Aeq} for noise sources that are continuous in nature; and
- 50 dB(A) L_{Amax} for short duration, non-continuous noise levels.

10.3 Existing Noise Levels

10.3.1 Refinery Noise Sources

In June 2003, a noise survey was undertaken of the major noise sources at the refinery to identify their sound power levels for use in the subsequent noise modelling.

Table 10.3.1 indicates the refinery areas where measurements were taken and lists the major noise sources at each area. The locations of each of the areas are given in Figure 10.3.1.

Table 10.3.1
Major Refinery Noise Sources

Area	Major Noise Sources
1. Stationery Calciner	Blower rooms, pressurising fans for blower rooms
2. Steam Power Station	Inside building: boiler feed pumps, process air compressors, turbines Outside building: FD fans, exhaust stack
3. Hydrate	Pumps, stack, vacuum pump room
4. Precipitation	Transfer pumps and sump pumps
5. Pump House	Pumps including sump pumps and transfer pumps etc.
6. Deep Washer (Ferrosilt)	Sump pumps, warmer pumps, hydro feed pumps, slurry pumps, agitators, fans, thickener pumps, turbid liquor pumps, dilution pumps, overflow pumps, underflow pumps, heat exchangers, sand disposal pump, deep wash underflow pump, thickener overflow pump
7. Grinder (Mills)	Motors, mills, sump pumps, injection pumps
8. Evaporator	Pure condensate return pumps, strong liquor discharge pumps, recycle pumps, heat exchangers
9. Rotary Calciner	Rotary kilns, air blowers, blower room
10. Lime Plant	Blower room, pumps

[1] L_{Aeq} is the time average A weighted sound pressure level and can be considered as the average sound pressure level over the measurement period.

Area	Major Noise Sources
11. Digestion	Discharge pumps
12. Diesel Power Station	Diesel generators inside building
13. Security Filtration	Cleaning liquor pumps, sump pumps, monger pumps TLR pumps, red mud pumps, hydraulic pumps, Kelly filter, hydraulic pumps, PGL pumps
14. Tank Farms	SRL strong feed pumps, fresh caustic pumps, process condensate pumps, spent liquor pumps
15. Silo	Compressor room, blower room
16. Conveyor	Conveyors, motors, sirens
17. Cooling tower	Fans, water falling

Amongst these 17 areas, the most dominant noise emission areas are hydrate, calciners, cooling tower and steam power station. One of the most significant noise sources are the vacuum pumps from the hydrate area which emit low frequency noise at high sound pressure level (90 dB(A) overall and 83 dB(A) at 250 Hz at 10 m outside vacuum pump room). Due to its low frequency, this noise can travel significant distances particularly during calm nights.

Another significant noise source is the start-up alarm along the conveyor from the mine to the refinery. These alarms are essential for safety reasons. There are two types of sirens: (i) five impeller (air-raid) sirens mounted along the conveyor and (ii) building mounted sirens on transfer stations with lower noise level. The impeller sirens have a very high sound power level (138 dB(A)) and, for safety reasons, are audible over a long distance.

10.3.2 Unattended Noise Monitoring

Unattended background noise monitoring was conducted between 4-6 June 2003 at the following locations shown on Figure 10.3.2:

- Southern end of the refinery near the gate house (Site A); and
- Gunyangara Clinic (Site D).

Noise levels were measured in accordance with the draft NT Regulations. The background noise levels measured at these locations are presented in Table 10.3.2. These levels are the 75th percentile of the measured L_{A90} levels. Plots of the noise readings over the two days of monitoring are given in Figure 10.3.3.

Table 10.3.2
Summary of the Background Noise (dB(A))

Location	Day 7am-6pm	Evening 6pm-10pm	Night 10pm-7am
Southern end of refinery	51.9	52.1	53.5
Gunyangara Clinic	31.1	29.8	27.7

Meteorological data showed that the weather was fine during the monitoring period with moderate south-easterly and southerly wind.

10.3.3 Attended Noise Monitoring

Attended community noise measurements were carried out at around midnight on 5 and 6 June 2003 to determine the existing noise impact of the operations. As the refinery and conveyor are both 24 hour a day operations, measurements were carried out at around midnight when wind and insect noises were expected to be low.

Measurements were taken at Inverell Bay, Wallaby Beach, Galupa, Gunyangara and Nhulunbuy. The locations of the monitoring sites are given in Figure 10.3.2. During the monitoring, the weather was fine with moderate south-easterly and southerly wind. The monitoring results are summarised in Table 10.3.3.

Table 10.3.3
Summary of Manned Noise Measurements

Date	Time	Location[1]	L_{A1} dB(A)	L_{A10} dB(A)	L_{A90}[2] dB(A)	L_{Aeq} dB(A)	Comments
5-Jun-03	23:34	B. Inverell Bay	53.5	37.7	25.5	32.8	Surf, conveyor noise faintly audible
5-Jun-03	23:55	C. Wallaby Beach	53.5	51.4	49.8	50.7	Cicada, insect, conveyor, surf & traffic
6-Jun-03	0:13	A. Adjacent to Galupa on Melville Bay Road	65.3	59.1	52.7	53.6	Insect, refinery, pumps from wharf
6-Jun-03	0:21	D. Gunyangara Clinic	47.2	43.1	38.1	41.4	Dominated by insect noise, machinery noise faintly audible occasionally-unsure whether it was conveyor or refinery noise
7-Jun-03	0:04	E. Corner of Matthew Flinders Way & Arnhem Road	44.7	43.5	36.8	37.7	Insect, traffic
7-Jun-03	0:11	F. End of the bitumen section of Enalu Road	38.3	34	31.4	32.7	Whining sound from conveyor just audible, wind rustling leaves
7-Jun-03	0:15	F. Same as above	38.1	32.3	29.8	31.4	Whining sound from conveyor just audible
7-Jun-03	0:20	F. Boxal Street	37.8	32.6	30.3	32.3	Whining sound from conveyor just audible
7-Jun-03	0:40	F. Same as above	38.8	36.2	33.5	35.9	Whining sound from conveyor just audible, wind rustling leaves

[1]Refer to Figure 10.3.2.
[2] L_{A90} is the noise level exceeded for 90% of the time and is a common expression of the background noise level.

At Galupa, noise from the refinery was audible and the noise levels generally ranged between 52 dB(A) and 60 dB(A). These levels exceed the maximum noise levels specified for residential areas in the draft Regulation. The measured noise levels at sites B, C, D and E also exceed the draft Regulation levels for 10 pm to 7 am. The dominant noise source at these sites was generally insect noise.

10.4 Noise Modelling

10.4.1 Noise Model

A noise model was constructed using the SoundPLAN V6.0 environmental noise software to assess the noise impacts. The software is used worldwide by over 600 companies and is one of the leading software products available for road, rail and industry noise prediction. Further details are provided in Appendix C.

10.4.2 New Noise Sources

Increased refinery production will be achieved by installing new process equipment that will integrate into the existing refinery process. The locations of the major new noise sources are shown on Figure 10.4.1.

The noise limit for all new equipment will be specified as L_{Amax} 85dB(A) at 1m. However, the equipment inventory and their associated sound power level and spectra are not known at this stage. Therefore, the estimated sound power levels of the new equipment have been based on noise measurement of existing similar equipment. In addition, the following assumptions have been made:

- New sources are steady and do not have tonal, impulsive characteristics that could be detected in the community.
- Area A (Liquor Purification Plant) – noise spectra and the sound power level of the new equipment will be similar to the existing stationary calciner. The blower room and the pressurising fan will be located at the northern end of the area facing away from Galupa.
- Area B (Power Station) – noise spectra similar to the existing power station and the sound power level of the new equipment will be 5 dB(A) lower than the existing power station due to new technology and fewer new equipment than existing power station.
- Area C (Evaporation) – noise spectra similar to the existing evaporation area and the sound power level of the new equipment will be 3 dB(A) lower (half of the sound energy) than the existing equipment due to new technology and less new equipment than the existing evaporation area. A new cooling tower for the evaporation area will be located to the south of Area A. The noise spectra and the sound power level of the new cooling tower will be similar to the existing cooling tower to the west of the power station.
- Area D (Digesters) – the new equipment will be more than double of the existing equipment in this area. The sound power level of the new equipment will be similar to the existing digesters area due to new technology.
- Area E (Precipitators) – noise spectra similar to the existing precipitators and the sound power level of the new equipment will be 3 dB(A) lower (half of the sound energy) than the existing equipment due to new technology and fewer new equipment items than the existing precipitation area.
- Area F (Classifiers) – noise spectra similar to the existing hydrate area and the sound power level of the new equipment will be 10 dB(A) lower (1/10 of the sound energy) than the existing equipment due to quieter vacuum pumps, fewer new equipment items than the existing hydrate area, and use of acoustic enclosures.
- Area G (Stationary Calciner) – noise spectra similar to the existing stationary calciner and the sound power level of the new equipment will be 3 dB(A) lower (half of the sound energy) than the existing equipment due to new technology.

10.4.3 Meteorological Conditions

The noise levels at noise sensitive receivers can increase by 12 dB(A) under unfavourable meteorological conditions (i.e. wind speed, direction and atmospheric stability) and decrease by up to 7 dB(A) under favourable conditions.

Because of these variations, the model has predicted noise levels at night under both dry season (south-east winds) and wet season (north-west winds) conditions.

10.4.4 Model Accuracy

The existing refinery operations have been modelled and compared to measurements adjacent to Galupa and the monitoring result at the southern end of the refinery. The prediction results are continuous noise levels that are in terms of L_{Aeq}. At the monitoring locations inside the refinery and adjacent to Galupa, there are many local and intermittent noise sources such as sirens and alarms etc. which increase the L_{Aeq} level. At these locations, the continuous noise levels would be better represented by the L_{A90} levels. Thus, the predicted results are compared to the background L_{A90} measured noise levels. The predicted and measured results are tabulated in Table 10.4.1.

Table 10.4.1
Summary of prediction and measurement results

Location	Predicted Results L_{Aeq} dB(A)	Measured Results L_{A90} dB(A)
Refinery Entrance	54.1	53.5
Adjacent to Galupa on Melville Bay Rd	52.3	52.7

Table 10.4.1 shows that the predicted and measured results are within ±1 dB(A) and this level of accuracy is considered acceptable. The accuracy at other locations is expected to be within ±3-5 dB(A)

10.5 Operational Phase Noise Effects

10.5.1 Refinery Noise

Noise levels from the refinery have been modelled for both the existing and expanded case for both wet and dry season conditions. The results have been summarised in Table 10.5.1 and the predicted noise contours for the expanded refinery are shown on Figures 10.5.1 and 10.5.2. Note that the modelled existing noise levels in Table 10.5.1 are for refinery noise sources only and are different from the measured existing noise levels (Table 10.3.3) which lists recorded noise from all sources and was dominated by insect noise.

Table 10.5.1
Predicted Refinery Noise Levels (L_{Aeq}) in dB(A)

Location	Wet Season		Difference	Dry Season		Difference
	Existing	Expanded		Existing	Expanded	
F. Boxal Street	27.6	27.6	0	27.5	27.5	0
F. Enalu Road	28.9	29.0	0.1	28.7	28.7	0
B. Inverell Bay	38.3	38.6	0.3	33.3	33.5	0.2
A. Galupa	48.2	49.0	0.8	47.7	48.4	0.7
D. Gunyangara Clinic	27.6	28.4	0.8	23.4	24.0	0.6
C. Wallaby Beach	37.6	38.1	0.5	37.8	38.0	0.2

Galupa is located immediately adjacent to the refinery and while the existing noise levels at this location are not harmful they exceed the levels proposed in the draft Regulation. To assess the noise impact of the expanded refinery, a comparison has been made between the current noise levels and those predicted for the expanded operation. As can be seen in Table 10.5.1, the difference at Galupa is 0.8 dB(A). Normally a 3 dB(A) increase is required to be significant. A 0.8 dB(A) increase will be undetectable by residents.

As it is not practicable to reduce noise emissions from the refinery Alcan Gove has committed to provide a noise attenuation barrier at Galupa to reduce noise impacts.

The predicted noise levels at the other communities do not exceed those proposed in the draft Regulation (Section 10.2.1).

The predicted noise levels from the expanded refinery at Galupa, Wallaby Beach and Inverell Bay (dry season only) exceed the sleep disturbance criterion discussed in Section 10.2.4 for continuous noise. However, the predicted existing noise levels also exceed this criterion. As discussed above, as the increase from the expansion is less than 1 dB(A) it is unlikely to be detected by residents.

10.5.2 Conveyor Alarms

Impeller sirens are intermittent noise sources that operate for several minutes along the mine-refinery conveyor as a warning when the conveyor is about to start. This only occurs a few times a week. Table 10.5.2 summarises the predicted noise levels at the nominated receptor locations from the sirens.

Table 10.5.2
Predicted Conveyor Noise Levels dB(A)

Location	Dry season		Difference	Wet season		Difference
	Without Alarm	With Alarm		Without Alarm	With Alarm	
F. Boxal Street	27.5	33.1	5.6	27.6	33.3	5.7
F. Enalu Road	28.7	33.8	5.1	29.0	34.3	5.3
B. Inverell Bay	33.5	34.5	1.0	38.6	39.1	0.5
A. Galupa	48.4	48.5	0.1	49.0	49.0	0
D. Gunyangara Clinic	24.0	24.9	0.9	28.4	28.7	0.3
C. Wallaby Beach	38.0	39.4	1.4	38.1	39.9	1.8

The predicted effects from the alarm at Inverell Bay, Galupa and Gunyangara Clinic are minor as the noise levels at these locations increase by 1 dB(A) or less when the sirens wail. The only area where the alarm has had a noticeable effect is at Location F in the southern part of Nhulunbuy. Here the noise levels from the alarm are predicted to be 33-34dB(A) at Boxal Street and Enalu Road. As these noise levels are greater than 5 dB(A) above background, they are noticeable. However the predicted noise levels from the alarms comply with the specified noise levels contained in the draft Regulation and the WHO sleep disturbance criteria (Section 10.2).

It should be noted that expansion of the refinery is not going to result in any significant increase in the frequency of the alarms. Consequently there will be no significant increase in alarm noise levels even at Location F following the refinery expansion.

10.5.3 Road Traffic

The refinery currently employs approximately 1,100 people. Assuming 700 employees commute between Nhulunbuy and the refinery every day and 400 of them travel by bus, the current daily traffic volume going in and out of the refinery is approximately 700-800 movements per day.

Areas that are sensitive to traffic noise along this route include Galupa (Location A) and residences to the south of Melville Bay Road in Nhulunbuy (Location F). Wallaby Beach (Location C) has not been considered because housing in this area will be removed in the next few years. The distance between the closest residences in these areas and the road is approximately 20 m. At this distance, with a daily traffic volume of 700 vehicles per day, the traffic noise levels is calculated to be $L_{A10(18\ hour)}$ 55 dB(A).

After the expansion, there will be additional operational workers who will generate up to an additional 105 vehicles per day. This will increase the traffic noise level by 0.6 dB(A) to 55.6 dB(A) at the closest residences to the road. This increase complies with the $L_{A10(18\ hour)}$ 63dB(A) criterion (Section 10.2.3) and hence the increase is insignificant and is unlikely to be noticed by the residents.

10.6 Construction Noise Effects

10.6.1 Refinery Construction

Table 10.6.1 contains a list of typical of equipment likely to be operating during construction phase. This table includes the predicted noise levels for each item of assessed equipment. Clearly the noisiest items are jackhammers and pile hammers.

Table 10.6.1 also shows the predicted noise levels from each item of equipment at Galupa on the assumption that most of the construction activities occur at a distance of 350 m or greater. These predictions do not include additional attenuation from terrain shielding effects. It is likely that actual shielding effects will be in the order of 10 dB(A) to 15 dB(A) depending on the location of the construction activity. Therefore the predicted levels in this table are considered to be a conservative estimate of the noise levels at Galupa.

Table 10.6.1
Typical Construction Equipment and Predicted Receiver Noise Levels

Item	L_{Amax} at 7m	Predicted L_{Amax} at Galupa
Bulldozers	85 dB(A)	51dB(A)
Jackhammers	105 dB(A)	71 dB(A)
Compactors	85 dB(A)	51 dB(A)
Excavators	80 dB(A)	46 dB(A)
Trucks	83 dB(A)	49 dB(A)
Compressors	75 dB(A)	41 dB(A)
Pile hammer	105 dB(A)	71 dB(A)
Concrete pumps	84 dB(A)	50 dB(A)
Concrete saws	93 dB(A)	59 dB(A)

The predicted construction noise levels are generally the same as or less than the background noise levels at Galupa (~50 dB(A)) except for the jackhammers, pile hammers and concrete saws. These activities will only occur intermittently and generally at distances greater than 350 m away from Galupa. Therefore, most of the construction noise during the daytime is likely to be inaudible or faintly audible.

The maximum noise levels specified in the draft Regulation (Table 10.2.1) also apply to construction noise. As Galupa is considered to be an "Area 5", the noise criteria are L_{A10} 50dB(A), L_{A1} 60dB(A), L_{Amax} 70dB(A) between 7am to 7pm Monday to Saturday. Pneumatic rock breakers, pile hammers and concrete saws are intermittent noise sources which are best described by L_{A1} and L_{Amax} levels. The predicted L_{A1} and L_{Amax} noise levels from jackhammers and pile hammers are 71 dB(A) at Galupa which exceed the L_{A1} and L_{Amax} criteria by 11dB(A) and 1dB(A), respectively. However, building and terrain shielding effects are not considered which might further reduce the noise levels by 10 to 15 dB(A), resulting in general compliance with these noise criteria.

Furthermore, construction noise impact can be mitigated by restricting the use of jackhammers, pile hammers and concrete saws to 9am to 5pm Monday to Saturday at construction areas that are close and have direct line of sight to Galupa. In this way any noise annoyance effects will be further reduced.

The draft Regulation also specifies other controls to apply to construction noise. These are discussed in Section 10.2.2. These controls will be complied with and will be incorporated into the noise environmental management plan for the construction phase (Section 25).

10.6.2 Construction Traffic

During the peak construction period, up to 1,200 additional people will be accommodated at Nhulunbuy and the majority of them will be bussed to the site each day. Assuming one 10-hour shift per day, this would generate approximately 70 extra bus movements per day. In addition, up to an additional 150 light vehicle and 100 heavy vehicle movements could be expected. On this basis, the daily traffic volume will be increased by approximately 320 per day. This will increase the traffic noise level by 1.7 dB(A) to 56.7 dB(A) at the closest residences along Melville Bay Road which is well within the $L_{A10(18\ hour)}$ 63 dB(A) criterion (Section 10.2.3). This increase is insignificant and is unlikely to cause any annoyance.

10.7 Noise Management

Strategies for the management and monitoring of noise effects for both construction and operations are outlined in the strategic management plan given in Section 25.

1. Stationery Calciner
2. Steam Power Station
3. Hydrate
4. Precipitation
5. Pump House
6. Deep Washer
7. Grinder
8. Evaporation
9. Rotary Calciner
10. Lime Plant
11. Digestion
12. Diesel Power Station
13. Security Filtration
14. Tank Farms
15. Silo
16. Conveyor
17. Cooling Tower

SOURCE: ALCAN ENGINEERING PTY LTD

ALCAN

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ALCAN GOVE REFINERY EXPANSION
ENVIRONMENTAL IMPACT STUDY

MAJOR EXISTING NOISE SOURCES

Project No. **12373-021-559**	Date 10-12-2003		Figure **10.3.1**
CAD File No. -G-045b.CDR	Rev. B	A4	

SOURCE: ALCAN ENGINEERING PTY LTD.

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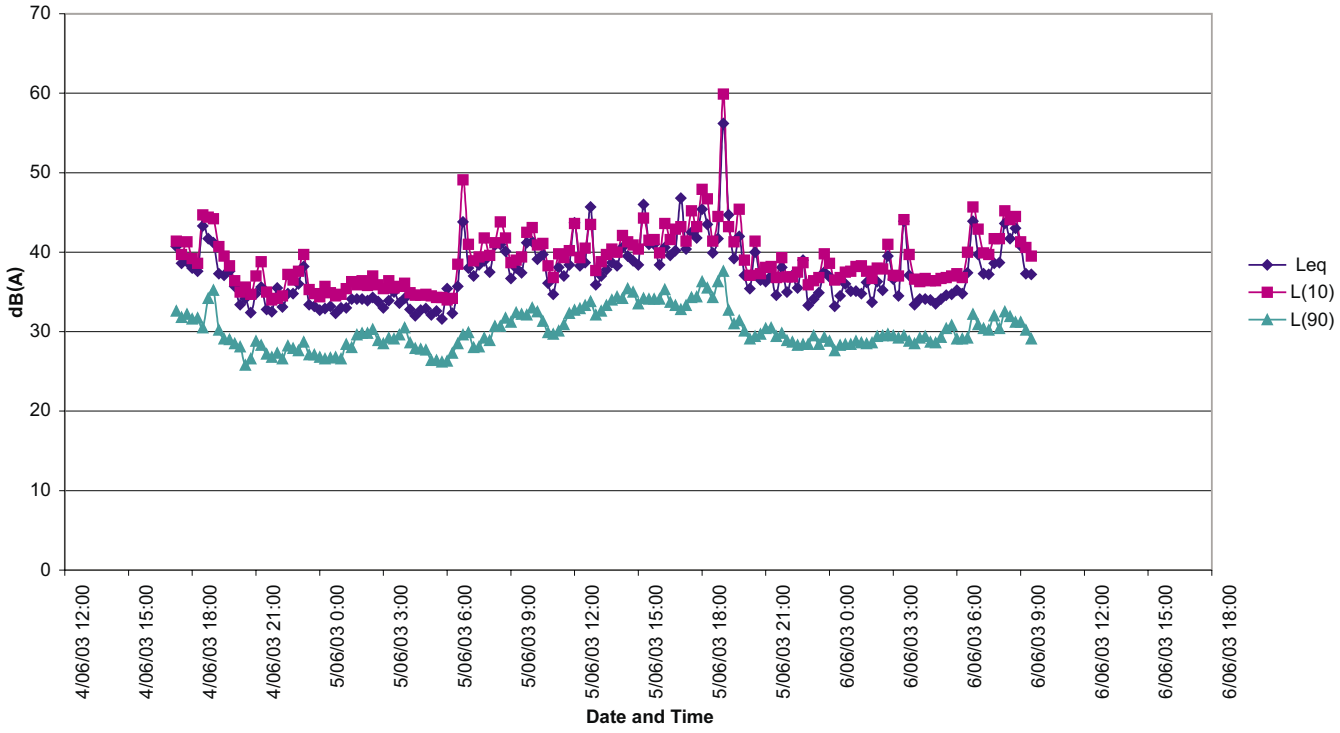
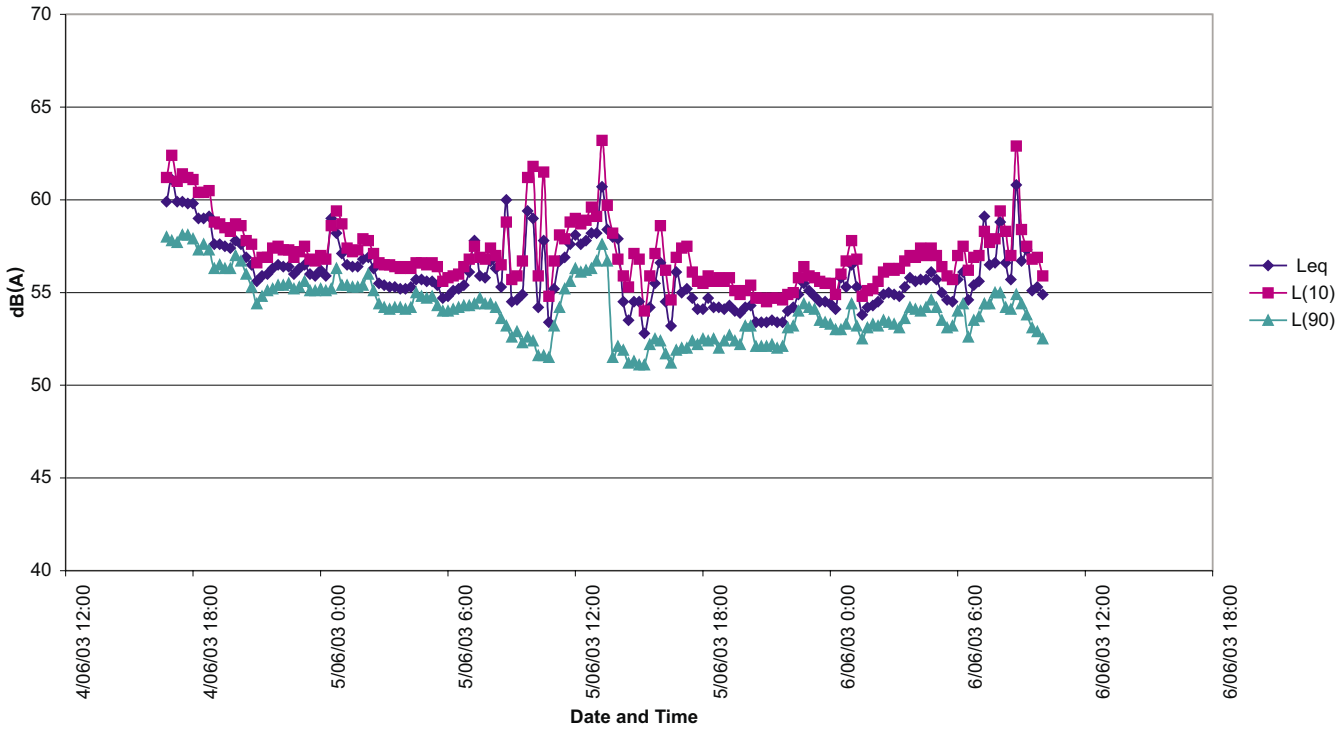
ALCAN GOVE REFINERY EXPANSION ENVIRONMENTAL IMPACT STUDY

NOISE MONITORING SITES

Project No. **12373-021-559**	Date 05-09-2003	Figure **10.3.2**
CAD File No. -g-046.cdr	Rev. A	A4



Noise levels at Gunyangara between 4 & 6 June 2003



Noise levels at 30m to the west of the gate house between 4 & 6 June 2003

SOURCE: VIPAC ENGINEERS & SCIENTISTS LTD

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ALCAN GOVE REFINERY EXPANSION ENVIRONMENTAL IMPACT STUDY

UNATTENDED NOISE MONITORING RESULTS

Project No. **12373-021-559**	Date 15-10-2003		Figure **10.3.3**
CAD File No. -g-058.CDR	Rev. A	A4	

A. Liquor Purification
B. Power Station
C. Evaporation
D. Digestion and Separation
E. Precipitation
F. Classification
G. Calcination

SOURCE: ALCAN ENGINEERING PTY LTD

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ALCAN GOVE REFINERY EXPANSION
ENVIRONMENTAL IMPACT STUDY

MAJOR NEW NOISE SOURCES

Project No. **12373-021-559**	Date 02-12-2003	
CAD File No. -G-066.CDR	Rev. A	A4

Figure **10.4.1**

SOURCE: ALCAN ENGINEERING PTY LTD.

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ALCAN GOVE REFINERY EXPANSION
ENVIRONMENTAL IMPACT STUDY

PREDICTED NOISE CONTOURS FOR EXPANDED REFINERY (WET SEASON)

Project No. **12373-021-559**	Date 20-10-2003		Figure **10.5.1**
CAD File No. -g-047c.cdr	Rev. C	A4	

SOURCE: ALCAN ENGINEERING PTY LTD.

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ALCAN GOVE REFINERY EXPANSION
ENVIRONMENTAL IMPACT STUDY

PREDICTED NOISE CONTOURS FOR EXPANDED REFINERY (DRY SEASON)

Project No. **12373-021-559**	Date 04-12-2003		Figure **10.5.2**
CAD File No. -g-048c.cdr	Rev. C	A4	