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Environmental Noise Assessment

Perdaman Urea Project, Burrup Peninsula

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PERDAMAN INDUSTRIES
CHEMICALS & FERTILISERS

FOREWORD

CLARIFICATION OF PROJECT AREA

Some technical reports, including this one, were completed in the early planning and design phases of the Project. As such, some of the maps / and aerial views depict the following anomalies associated with the actual Project area:

i. The Project boundary of Site F does not have an extension from the south west corner.

ii. The southern alignment of Hearson Cove Road is not applicable. Only the alignment on the north side of Site F will apply to the Project.

iii. The footprint of the port area is limited to the area depicting the *Storage Shed – Port* and *Shiploader – Feed Conveyor.* It does not extend out along the Bulk Liquids Berth Jetty.

Figures A and B below provides further clarification of this discrepancy.

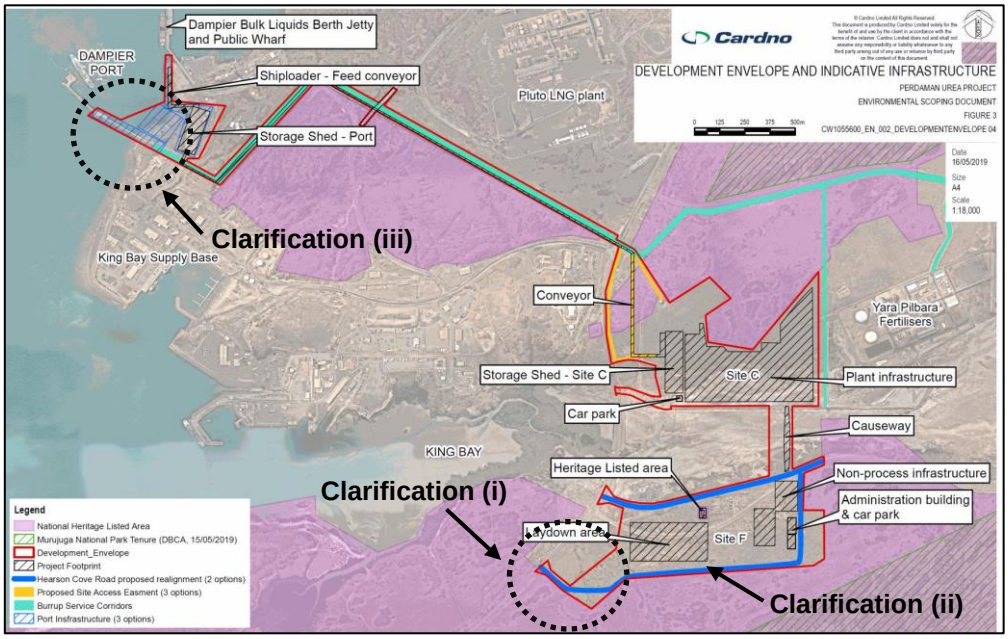

Figure A: Incorrect / superseded Project Area.

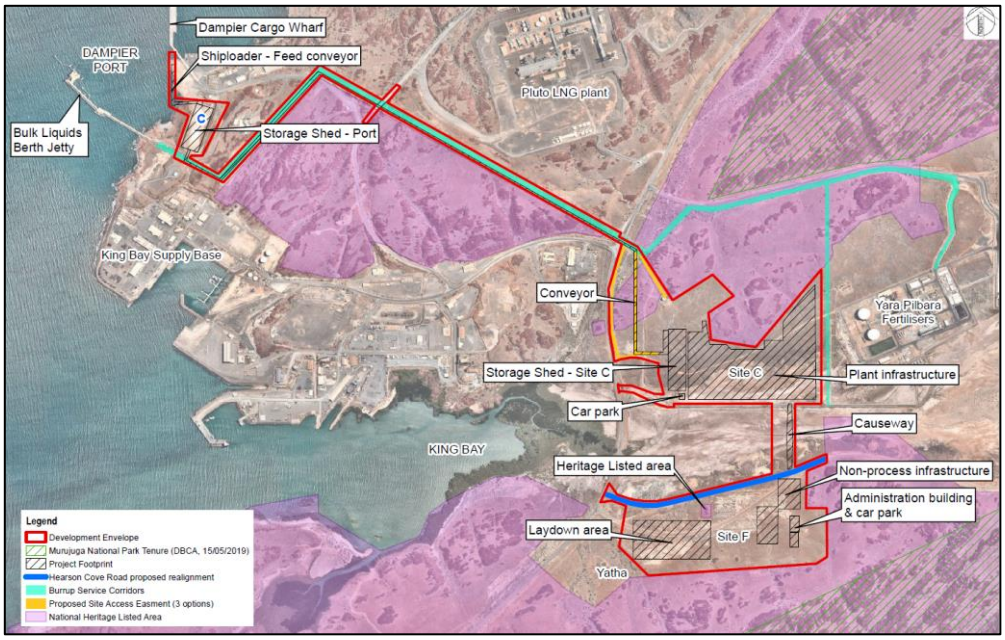

Figure B: Correct Project Area.

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1 INTRODUCTION

The Project involves the development of a urea plant with a production capacity of approximately 2 million tonnes per annum (Mtpa), located on Sites C and F within the Burrup Strategic Industrial Area (BSIA) on the Burrup Peninsula (refer *Figure 1-1)*.

The chemical process used to manufacture urea will involve:

- Conversion of natural gas to produce separate hydrogen rich and CO_2 streams;
- Hydrogen is blended with nitrogen to the correct mixture required for ammonia (NH_3) synthesis; and
- Urea in solution is produced by reacting NH_3 and CO_2 at elevated pressure, and then dried and granulated to make the final product.
- The product will be transported via closed conveyor along the existing East West Common User Service Corridor through to product storage and ship loading facilities at Dampier Port.

The Project will apply proven process technology that successfully operates elsewhere in the world, and is considered equivalent to the industry best practice specific to each processing stage.

It is understood the plant is laid out so that all process plant, and therefore noise sources, are located within Site C, while Site F would be used as offices, storage and lay down areas.

As part of the environmental studies undertaken for the project, ambient noise monitoring and noise modelling was carried out by Lloyd George Acoustics. This report presents the methodology, results and assessment of the ambient monitoring and noise modelling studies carried out.

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

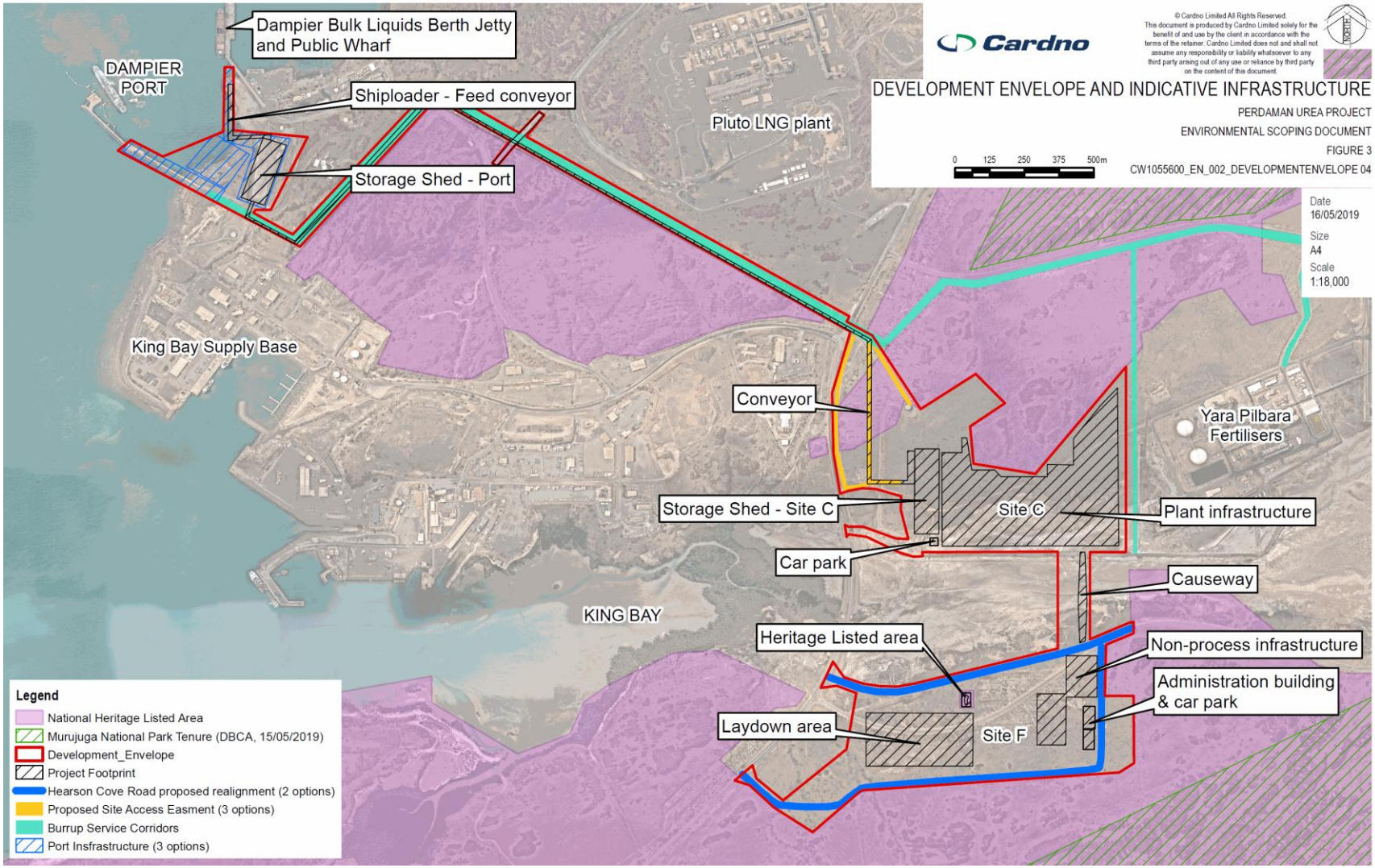


Figure 1-1 Project Locality and Indicative Infrastructure/Layout (Courtesy of Cardno)

2 CRITERIA

2.1 Operational Noise

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

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

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

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

(b) Must be free of –

i. tonality;

ii. impulsiveness; and

iii. modulation,

when assessed under regulation 9"

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

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

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

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

Table 2-1 Adjustments Where Characteristics Cannot Be Removed

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

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

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

Table 2-2 Baseline Assigned Noise Levels

Premises Receiving Noise	Time Of Day	Assigned Level (dB)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area[1]	0700 to 1900 hours Monday to Saturday (Day)	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays (Sunday)	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days (Evening)	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays (Night)	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Industrial	All hours	65	80	90

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

The project is located in a remote area with no residential areas in the vicinity. Based on our experience of previous industrial developments in the area, and discussions with the Department of Water and Environment Regulation (DWER), the following receiver locations were considered relevant for this assessment:

- Hearson Cove – located approximately 2 kilometres to the east, it is understood to be a known local attraction and would be considered a sensitive use. However, although there are no buildings associated with the sensitive use, it is understood that an assigned noise level of 45 dB L_{A10} at all hours has been applied by DWER at that location for the assessment of past and recent projects in the area. This level has been used in this assessment for consistency.
- Deep Gorge – located approximately 1.5 kilometres to the south east of the proposed plant, it is an area known for rock art formations. The location could be considered noise sensitive, however it has no building associated with the sensitive use and is only a 'day use' area.
- Proposed urea plant and Yara industrial site boundaries. And,
- Eastern part of the industrial area located off Burrup Road.

In addition to the above, noise levels were predicted at several points along the proposed urea plant boundary. All locations mentioned above are shown on *Figures 2-1 and 2-2*.

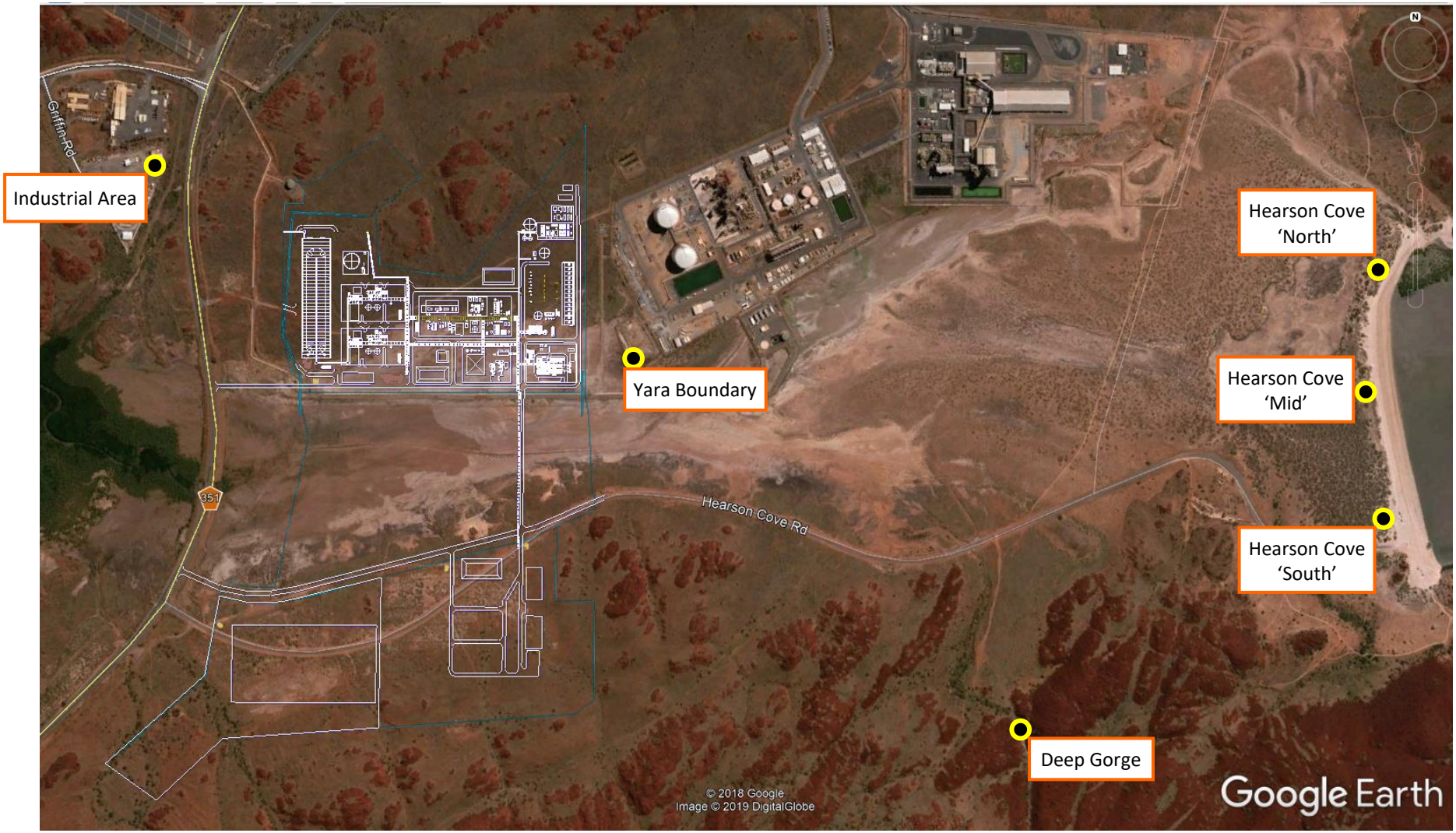


Figure 2-1 Receiver Locations For Noise Assessment

Figure 2-2 Receiver Locations Around Urea Plant Boundary (Indicative Layout)

It is further noted that due to the 24/7 nature of the proposed operations, only the L_{A10} assigned noise level is considered relevant to this assessment. The applicable L_{A10} assigned noise level at each of the locations above are summarised in *Table 2-3*.

Table 2-3 Assigned Noise Levels

Premises Receiving Noise	Time Of Day	L_{A10} Assigned Level (dB)
Hearson Cove	All hours	45
Deep Gorge	All hours	60
Urea and Yara Industrial Plant Boundary	All hours	65
West Industrial Area	All hours	65

Noise levels were also predicted at several points along the proposed urea plant boundary. These locations are shown on *Figure 2-2* on the previous page.

It is also noted that under regulation 3, some noise emissions are exempt and nothing in the Regulations applies to the following noise emissions –

(g) noise emissions –

(i) from a device for warning pedestrians installed at a pedestrian crossing on a road; or

(ii) from a device for warning of the passage of a train installed at a level crossing; or

(iii) from a safety warning device fitted to a building as a requirement of the Building Code as defined in the *Building Regulations 2012* regulation 3; or

(iv) for the purpose of giving a warning required under the *Mines Safety and Inspection Regulations 1995* regulation 8.26,

if every reasonable and practicable measure has been taken to reduce the effect of the noise emission consistent with providing an audible warning to people;

(h) noise emissions from –

(i) a reversing alarm fitted to a motor vehicle, mobile plant, or mining or earthmoving equipment; or

(ii) a start-up or movement alarm fitted to plant,

if

(iii) it is a requirement under another written law that such an alarm be fitted; and

(iv) it is not practicable to fit an alarm that complies with the written law under which it is required to be fitted and emits noise that complies with these Regulations;

2.2 Construction Noise

In Western Australia construction noise is regulated under the *Environmental Protection Act 1986* through the *Environmental Protection (Noise) Regulations 1997* (the Regulations). Specifically within the Regulations is regulation 13, which refers to noise from construction sites and states the following:

Regulation 7 does not apply to … construction work carried out between 0700 hours and 1900 hours on any day which is not a Sunday or public holiday if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 4 of AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites;

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

c) If the occupier was required to prepare a noise management plan … in respect of the construction site –

i. The noise management plan was prepared and given in accordance with the requirement, and approved by the Chief Executive Officer; and

ii. The construction work was carried out in accordance with the management plan, excluding any ancillary measure.

Regulation 7 does not apply to … construction work carried out other than between the [above] hours if the occupier of the premises … shows that –

a) The construction work was carried out in accordance with control of environmental noise practices set out in section 4 of AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites; and

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

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

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

ii. Approved by the Chief Executive Officer;

d) 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 at which noise emissions received were likely to fail to comply with the standard prescribed under regulation 7; and

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

To summarise the noise requirements, there is no noise level limit for construction activities, provided that best practice measures are implemented and specifically:

- Construction work complies with AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*; and
- The equipment used was the quietest reasonably available.

2.3 Blasting

It is understood that blasting may occur as part of the construction activities. With regard to airblast levels due to blasting, regulation 11 prescribes that:

(4) Subject to subregulation (5), no airblast level resulting from blasting on any premises or public place, when received at any other premises between 0700 hours and 1800 hours on any day, may exceed —

(a) for an airblast level received at noise sensitive premises —

(i) when received at a sensitive site — 120 dB $L_{Z\,peak}$; or

(ii) when received at a location other than a sensitive site — 125 dB $L_{Z\,peak}$;

or

(b) for an airblast level received at any other premises — 125 dB $L_{Z\,peak}$.

(5) The levels specified in subregulation (4) do not apply in respect of an airblast level when received at premises, or a part of premises, on which the blaster believes on reasonable grounds no person is present at the time of the blast.

(6) Despite subregulation (4), airblast levels for 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other single premises between 0700 hours and 1800 hours on any day, must not exceed —

(a) for airblast levels received at noise sensitive premises —

(i) when received at a sensitive site — 115 dB $L_{Z\,peak}$; or

(ii) when received at a location other than a sensitive site — 120 dB $L_{Z\,peak}$;

or

(b) for airblast levels received at any other premises — 120 dB $L_{Z\,peak}$.

(8) Subject to subregulation (9), no airblast level resulting from blasting on any premises or public place, when received at other premises outside the periods between 0700 hours and 1800 hours on any day, may exceed 90 dB LZ peak except where that blasting is carried out in accordance with the Mines Safety and Inspection Regulations 1995 *regulation 8.28(4).*

It is noted the Regulations do not prescribe ground vibration limits. Vibration criteria for buildings around the site potentially impacted by vibration was therefore taken from *Australian Standard AS 2187.2 Explosives – Storage, Transport and Use (ANZECC 2006)*, and are reproduced in *Table 2-4*.

Rock-art (petroglyhs) formations are also known to be located around the proposed site. However, there are no known ground vibration criteria for such rock formation. Therefore guidance from German Standard DIN 4150.3:1999 was used in this assessment. In particular, DIN 4150.3 provides guideline values for vibration velocity for intermittent events on sensitive structures e.g. heritage listed buildings. A range is provided as the permissible value depends on the frequency of the vibration. These levels are also provided in *Table 2-4* on the next page.

Table 2-4 Blast Vibration Levels Criteria

Blasting (Inhabited Dwelling)		Vibration PPV, mm/s
AS 2187.2		
Residential	Day	3
	Night	1
Offices		3
Site Buildings/Workshop		5
DIN 4150.3		
Heritage Listed Building		3 (1 Hz to 10 Hz) 8 (10 Hz to 50 Hz)

3 METHODOLOGY

3.1 Noise Predictions

Computer modelling has been used to predict noise levels at the various receivers during normal operations. The software used was *SoundPLAN 8.1* with the CONCAWE (ISO 171534-3 improved method) algorithms selected. These algorithms have been selected as they include the influence of wind and atmospheric stability. Input data required in the model are:

- Meteorological Information;
- Topographical data;
- Ground Absorption; and
- Source sound power levels.

3.1.1 Meteorological Information

Meteorological information utilised is provided in *Table 3-1* and is considered to represent worst-case conditions for noise propagation.

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

Table 3-1 Modelling Meteorological Conditions

Parameter	Night (1900-0700)	Day (0700-1900)
Temperature (^{o}C)	15	20
Humidity (%)	50	50
Wind Speed (m/s)	3	4
Wind Direction*	All	All
Pasquil Stability Factor	F	E

* Note that the modelling package used allows for all wind directions to be modelled simultaneously.

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

3.1.2 Topographical Data

Topographical data was based on that provided by the project in the form of LiDAR data. The local topography is mostly flat with the exception of the rocky formation to the south and south east.

3.1.3 Ground Absorption

Ground absorption varies from a value of 0.0 to 1.0, with 0.0 being for an acoustically reflective ground (e.g. water or bitumen) and 1.0 for acoustically absorbent ground (e.g. sand). A value of 0.0 has been used for the plant area, waterways and all other industrial areas. A value of 0.5, e.g. compacted earth with loose rocks and dense shrubs, has been used elsewhere.

3.1.4 Source Sound Levels

The sound power levels used in the modelling are provided in *Table 3-2*. All sources are located within Site C.

Table 3-2 Source Sound Power Levels, dB

Description	Source Height	Octave Band Centre Frequency (Hz)								Overall dB(A)
		63	125	250	500	1k	2k	4k	8k	
Reformer	75 m	98	99	95	99	101	104	96	89	**107**
Air Separation Unit	10 m	93	93	88	93	96	99	90	83	**102**
Acid Gas Recovery	30 m	101	101	97	101	104	106	98	91	**110**
Ammonia Synthesis	10 m	109	109	105	109	112	114	106	99	**118**
Urea Synthesis	10 m	109	109	105	109	112	114	106	99	**118**
Urea Granulation	10 m	109	109	105	109	112	114	106	99	**118**
Urea Granulation Stack	50 m	88	88	88	93	98	103	108	108	**112**
Urea Conveyor	*varying*	76	81	77	74	67	64	52	42	**75/m**
Urea Conveyor Drive	*varying*	95	93	87	82	79	77	70	59	**86**
Power Station	20 m	107	103	101	99	97	95	93	87	**103**
Power Station Air Inlet	20 m	115	117	115	97	79	75	99	91	**109**
Power Station Exhaust	35 m	119	113	105	95	87	81	83	81	**101**
Cooling Towers	6 m	90	93	93	92	92	91	92	93	**99**
Flare	50 m	115	112	111	109	105	104	99	105	**112**

With regards to the above, please note the following:

- At this stage of the design, the sound power levels used in the noise model reflect whole plant processes, not single items of plant. All sources were modelled as point sources.
- The sound power levels above are based on previous urea project which were reviewed by Perdaman and adjusted where practicable based on their experience with urea plant.
- It is assumed that all noise sources will be operating simultaneously. This will be conservative as the use of the flare would normally be associated with a problem with the plant, and so would usually be mutually exclusive of full plant load. It is noted that the source noise level of the flare is lower than the most significant pieces of plant and therefore 'upset' plant noise levels may be lower than under normal operations.
- It is assumed that all urea conveyors, drives and transfers will be enclosed with standard 0.42 mm base metal thickness (BMT) steel and close fitting joints.
- The urea storage shed is assumed to be of metal construction and approximately 6 metres high. In terms of external noise emissions, it is assumed that the building will adequately attenuate any noise sources inside the shed.
- Sources heights are relative to natural ground.

3.2 Blasting

3.2.1 Airblast Levels

Airblast is calculated using equations provided in Australian Standard A*S 2187.2-2006 Explosives - Storage and use*.

The accurate estimation of airblast levels is a complex task. The blasting process is highly non-linear and the variability of most rock types also contributes to the difficulty in accurate predictions of the environmental outcomes. In the absence of either field data or the opportunity to conduct blasting trials in the region of interest, it is possible to estimate likely airblast levels using simple charge weight scaling laws. Such laws incorporate the charge weight per delay and the distance from the blast to the monitoring location. The prediction formula is detailed below:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

where

P = pressure, in kilopascals
Q = explosives charge mass, in kilograms
R = distance from charge, in metres
K_a = site constant
a = site exponent

It is noted that Q is also referred to as the Maximum Instantaneous Charge (MIC), which is the mass of explosives detonating within a defined time period, usually approximately 8 milliseconds. Therefore, when delay blasting occurs, the MIC (or Q) may be relatively small compared to the overall amount of explosive used for each blast.

For confined blast hole charges, a site exponent a of −1.45 is used, and the site constant K_a is commonly in the range 10 to 100.

3.2.2 Ground Vibration

For ground vibration, it is assumed that the blasting conditions are for 'free-face average rock' formation. In the absence of specific blast vibration measurements at the site, the following scaled distance site law has been used:

$$PPV = 1140 \left(\frac{\sqrt{Q}}{R} \right)^{1.6}$$

Where:

PPV = Peak particle velocity (mm/s)
Q = Charge mass per hole or per delay (kg)
R = Distance from blast (m)

3.3 Ambient Noise Monitoring

Ambient noise monitoring was undertaken between the 10 and 24 of May 2019 to characterise the existing noise emissions at Hearson Cove, Deep Gorge and the Yara plant boundary. It is noted that a the Hearson Cove location, the noise monitoring had to be repeated between the 17 and 24 May following an equipment malfunction.

Figure 3-1 shows the location of each noise logger on aerial photography, which are also summarised in *Table 3-1,* and *Figure 3-2* to *Figure 3-4* showing the logger setup and field of view at each location.

Table 3-3 Noise Logger Details

Logger S/N	Description	Easting (MGA94, Zone 50)	Northing (MGA94, Zone 50)
87802F	Hearson Cove, 17-24 May 2019	478840	7718502
87802F	Yara's Deep Gorge sampling station, 10-17 May 2019	477944	7718044
87803E	Yara Plant Boundary, 10-15 May 2019	476895	7719097

Under the Regulations, there are certain requirements that must be satisfied when undertaking measurements and are defined in Regulations 19, 20, 22 and 23 and Schedule 4. In undertaking the measurements, these have been satisfied, specifically noting the following:

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

All loggers were setup to record the overall A-weighted, Slow, noise levels and audio.

Meteorological conditions during the ambient noise survey were taken from the Bureau of Meteorology's Karratha site.

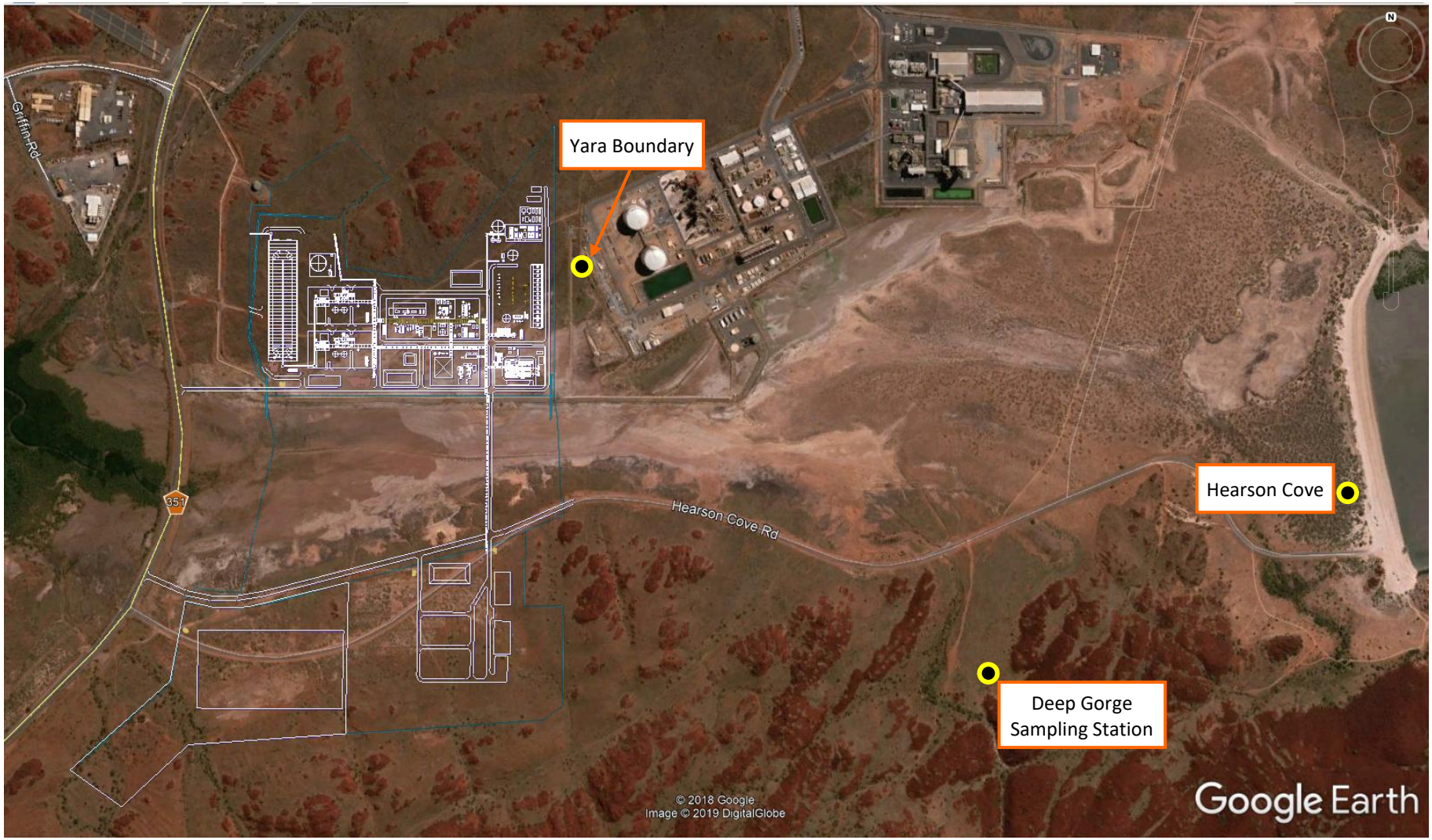


Figure 3-1 Noise Logger Locations

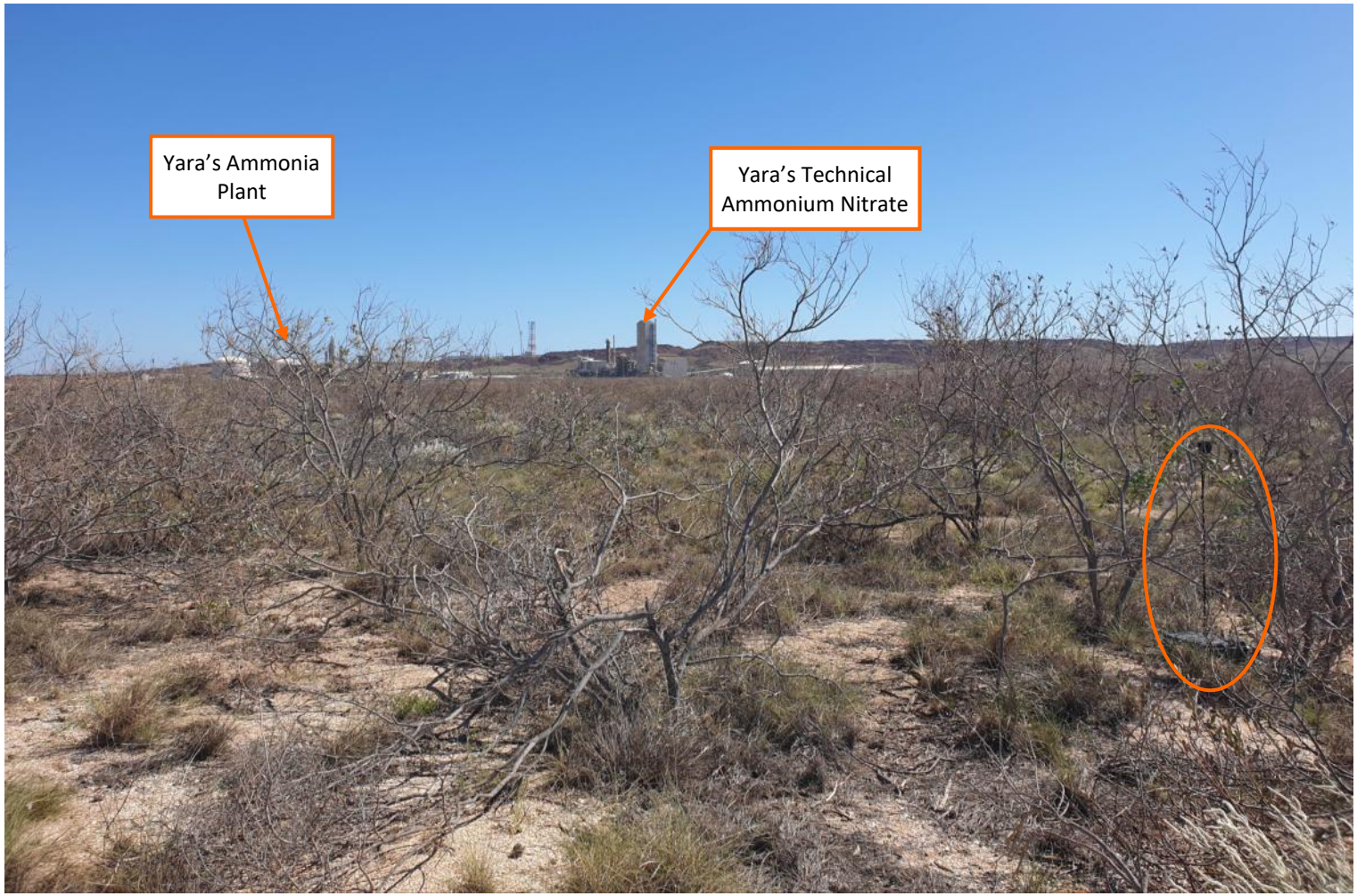


Figure 3-2 Logger at Hearson Cove (Looking West)

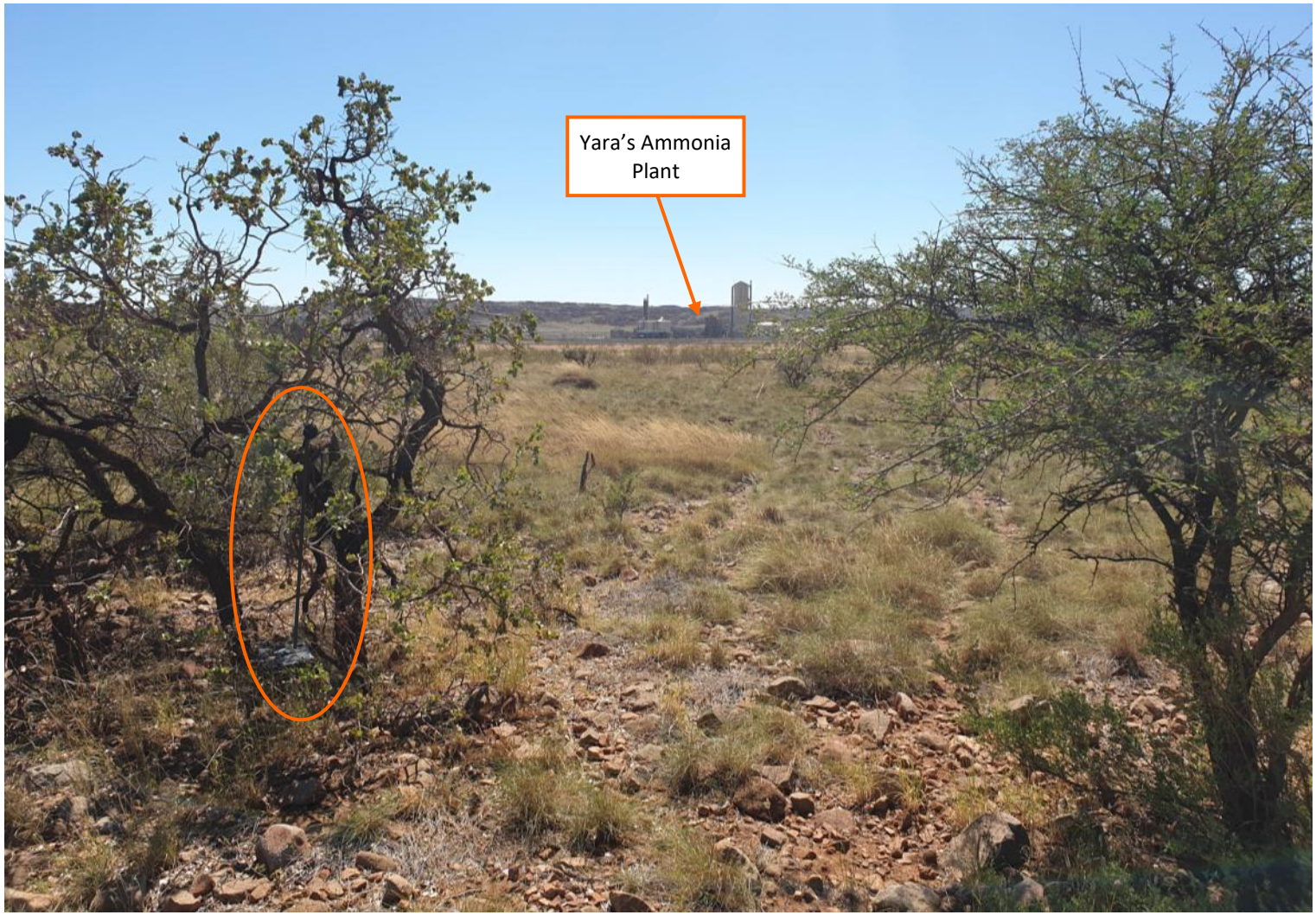


Figure 3-3 Logger at Yara Sampling Station (Looking North)

Figure 3-4 Logger at Yara Boundary (Looking East)

4 RESULTS

4.1 Operational Noise Modelling

The noise levels under 'worst-case' meteorological conditions were predicted for normal operations, including the flare and assuming the overland conveyor is operating. The predicted noise levels are presented in *Table 4-1*.

Table 4-1 External Receivers 'Worst-case' Predicted Noise Levels

Receiver	Night, dB L_{A10}	Day, dB L_{A10}
Hearson Cove 'South'	41	40
Hearson Cove 'Mid'	41	40
Hearson Cove 'North'	41	40
Deep Gorge	43	42
Yara Plant Boundary	64	64
Industrial Estate (west)	59	59

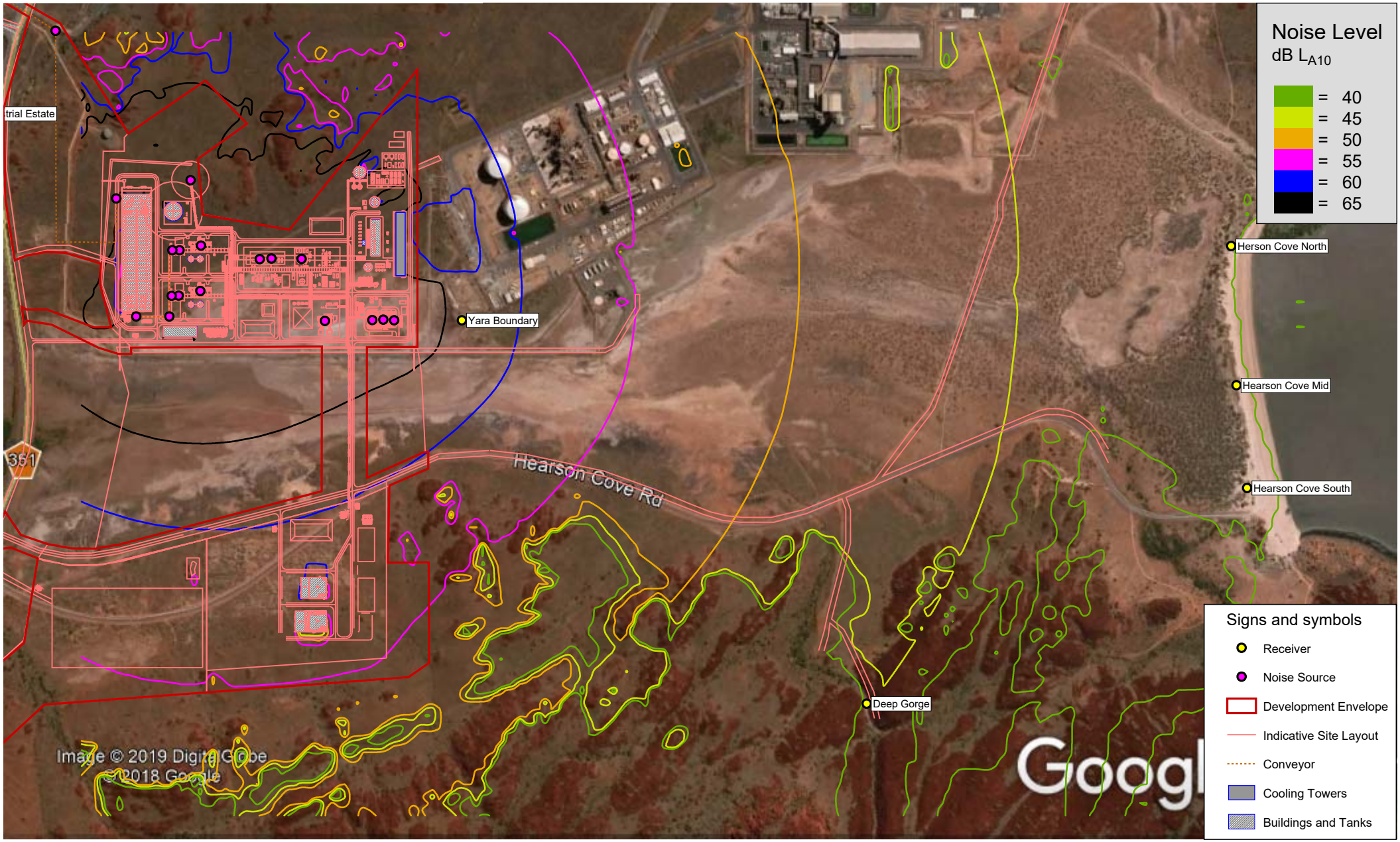
It can be seen from the above results that at distant receivers e.g. Deep Gorge and Hearson Cove, there is a noise level difference of 1 dB between 'daytime' and 'night-time'. This is the result of the slightly different weather conditions used in the modelling for both periods. At closer receivers, the difference in noise levels is less than 0.5 dB.

Figure 4-1 and *Figure 4-2* also show the predicted noise levels for the night-time weather conditions as contour maps at 1.5 metres above ground level to the east and west of the proposed plant respectively.

From *Figure 4-2* it can also be seen that the noise levels at the boundary of the service corridor from the conveyor are predicted to be in the order of 55 dB(A).

Perdaman Urea - Plant Noise Emissions (Inc. Flare) to East
Burrup Peninsula

Figure 4-1



N

Length Scale 1:12000
0 50 100 200 300 m

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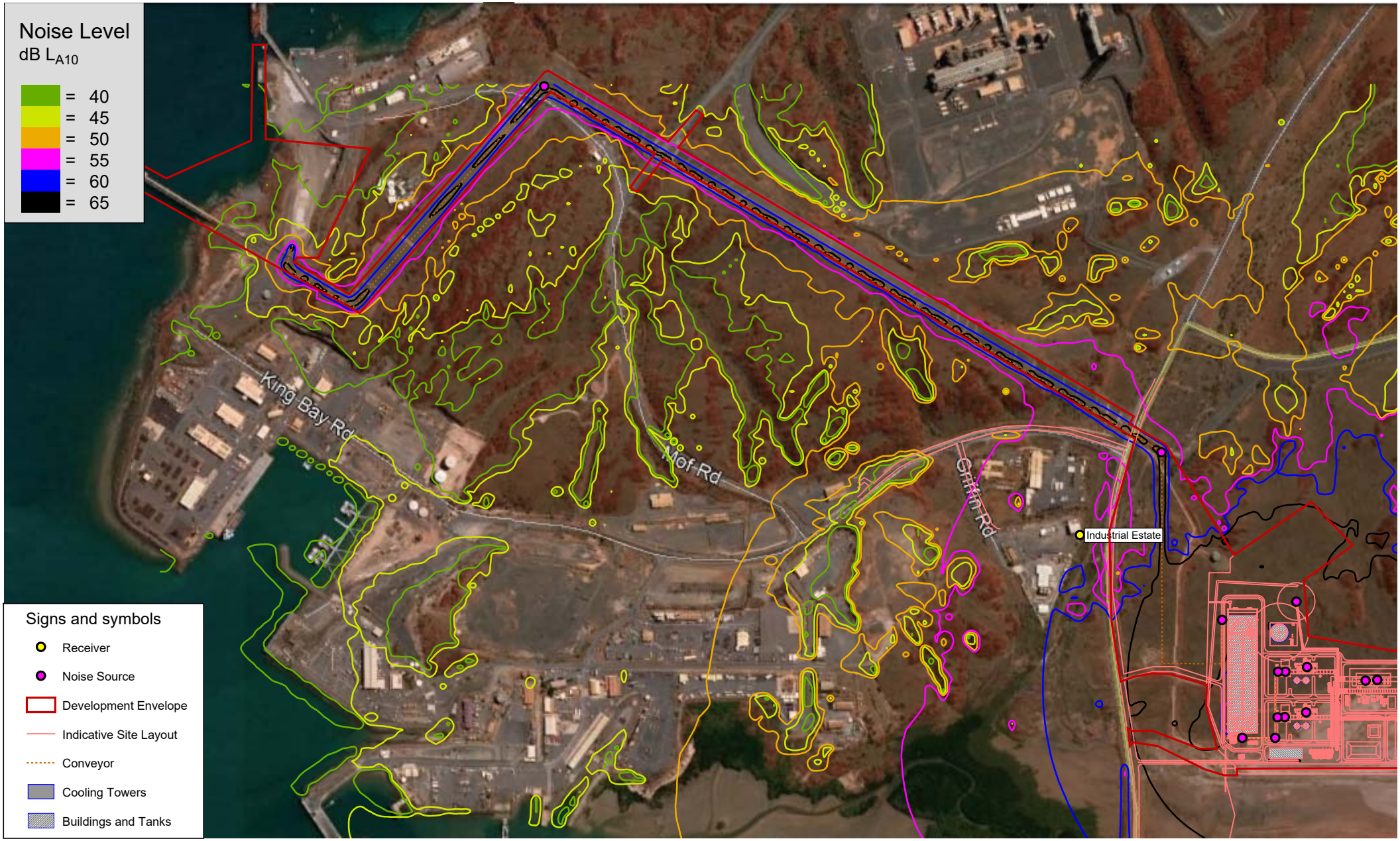
27-May-19

Perdaman Urea - Plant Noise Emissions (Inc. Flare) to West
Burrup Peninsula

Figure 4-2



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The noise levels predicted at the various boundary locations around the urea plant are presented in *Table 4-2* for the night weather conditions, noting that there are no significant differences between day and night levels at those receivers.

Table 4-2 Boundary Locations Predicted Noise Levels

Receiver	Predicted Level, dB L_{A10}
B1	67
B2	66
B3	58
B4	75
B5	78
B6	72
B7	63
B8	65
B9	67
B10	68
B11	67
B12	65
B13	70

4.2 Blasting Noise and Vibration

4.2.1 Blast Over-Pressure

As discussed in *Section 3.2,* the blasting process is highly non-linear and the variability of most rock types also contributes to the difficulty in accurate predictions of the environmental outcomes. This variability is incorporated into the prediction formula by using site-specific constants and these constants are determined by conducting multiple test blasts. Generally, the site constant will range from 10 to 100.

Table 4-3 presents the buffer distances required to achieve the criterion of 115 dB $L_{Z\,peak}$ based on various site constants, K, and charge mass. Those buffer distances may be narrowed following the first blasts, should noise levels be recorded.

Table 4-3 Buffer Distances Required to Achieve Airblast Criterion of 115 dB $L_{Z,peak}$

Site Constant	Charge mass per delay, kg		
	20	40	60
10	293 m	370 m	423 m
25	552 m	695 m	796 m
50	890 m	1121 m	1284 m
75	1177 m	1483 m	1698 m
100	1436 m	1809 m	2071 m

4.2.2 Ground Vibration

It was assumed that blasting occurs under 'free-face average conditions'. *Table 4-4* presents the buffer distances required to achieve the various vibration criteria from *Table 2-4* depending on the MIC.

Table 4-4 Buffer Distances Required to Achieve Blast Vibration Criteria

PPV, mm/s	Charge mass per delay, kg		
	20	40	60
1	364 m	515 m	630 m
3	183 m	259 m	317 m
5	133 m	188 m	231 m
8	99 m	140 m	172 m

4.3 Construction Noise

At this stage details of construction activities are not known however, it is understood that activities such as rock breaking and sheet piling may occur on site.

It is noted the only potential sensitive receiver e.g. Hearson Cove, is located more than 2 kilometres from the project site and is a 'day use' area only. Therefore, noise impacts from construction noise are considered negligible and were not specifically assessed.

4.4 Ambient Noise Monitoring

The logged noise data over the duration of the survey at each location are graphed on *Figure 4-3* to *Figure 4-5*, and show the L_{A90} and L_{A10} noise levels determined over a 30 minute period. Also shown are the 30 minute average wind speed and direction recorded at the Bureau of Meteorology's Karratha Airport station.

Ambient noise data at the Yara Plant Boundary and the Deep Gorge Sampling Station were recorded between the 10 and 17 May 2019. At Hearson Cove, noise data was recorded the following week, from the 17 to 24 May following an equipment malfunction the prior week.

From the time history data (*Figure 4-3* to *Figure 4-5*), it can be seen that the noise levels recorded at Hearson Cove and Deep Gorge Sampling Station generally follow an 'inverted day-night' pattern whereby night-time noise levels are mostly higher than during the day. Based on observations on site and the audio recordings, the background noise levels at these locations mostly consisted of wind induced noise (for wind speeds over 5 m/s), wildlife noise (e.g. crickets), some industrial noise and local or distant vehicular traffic. At Hearson Cove, it is also noted that local works have been carried out on the beach over the survey period, which involved mobile plant with reversing alarms. Therefore the daytime noise levels recorded at that location are likely to have been influenced by these works.

The background noise data (L_{90}) recorded at Hearson Cove were also further analysed to show the daytime and night-time noise levels for the various wind directions, including calm conditions, recorded over the survey period. This is shown on *Figure 4-6* and *Figure 4-7* for the daytime and night-time respectively. It can be seen that the L_{90} noise levels fluctuated significantly during either time period, and for most wind directions.

During the night period, background noise levels over 45 dB L_{A90} were consistently recorded at both Hearson Cove and Deep Gorge Sampling Station given that some local wildlife (e.g. crickets) became more active in the evening and through the night, or from early morning. This resulted in the overall noise levels being significantly different over the entire night period but generally dropping to their lowest later in the morning/early in the day. The lowest 30-minute background noise levels (L_{A90}) during the day period (7am-7pm) were recorded as follows:

- At Hearson Cove, 26 dB L_{A90} under pre-dominantly easterly winds (i.e. receiver is upwind) and 27 dB L_{A90} under calm conditions. Under mostly north-western wind conditions, noise levels up to 45 dB L_{A90} were recorded however these were influenced by local wildlife noise.
- At Deep Gorge Sampling Station it is noted that downwind conditions for this location (e.g. north westerly) did not occur during the daytime. Under calm conditions, the lowest noise level was 31 dB L_{A90}.

During the night period (7pm-7am), noise levels were ranging from 26 dB L_{A90} (no wildlife noise) to 45 dB L_{A90} (wildlife noise) at Hearson Cove, and from 27 dB L_{A90} (no wildlife noise) to 54 dB L_{A90} (wildlife noise) at the Deep Gorge Sampling Station.

At the Yara Plant Boundary, the daytime noise levels were dominated by local works on site with background noise levels between 55 dB L_{A90} and 60 dB L_{A90} recorded over the duration of the survey.

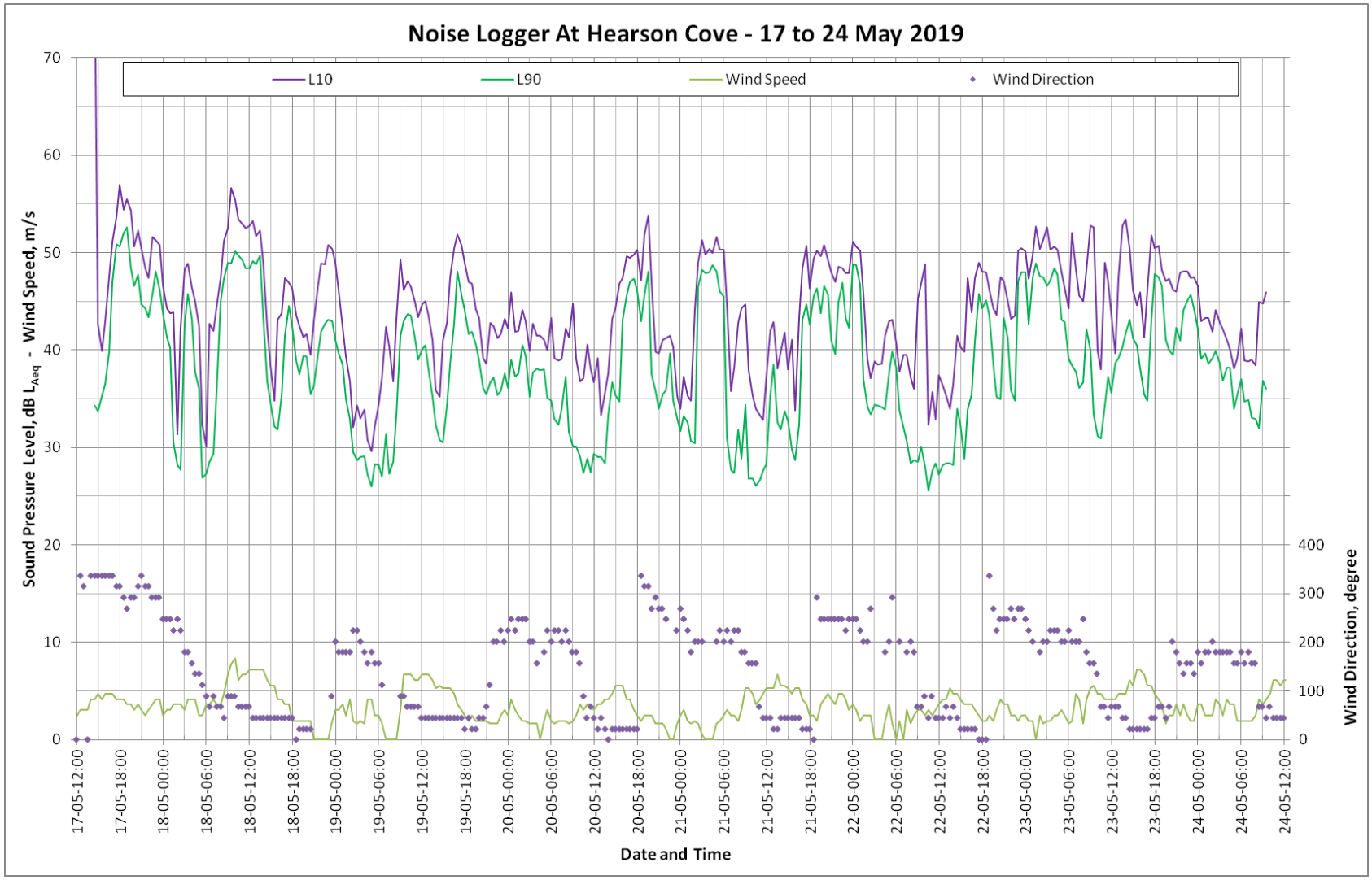


Figure 4-3 Ambient Noise Levels at Hearson Cove (17-24 May 2019)

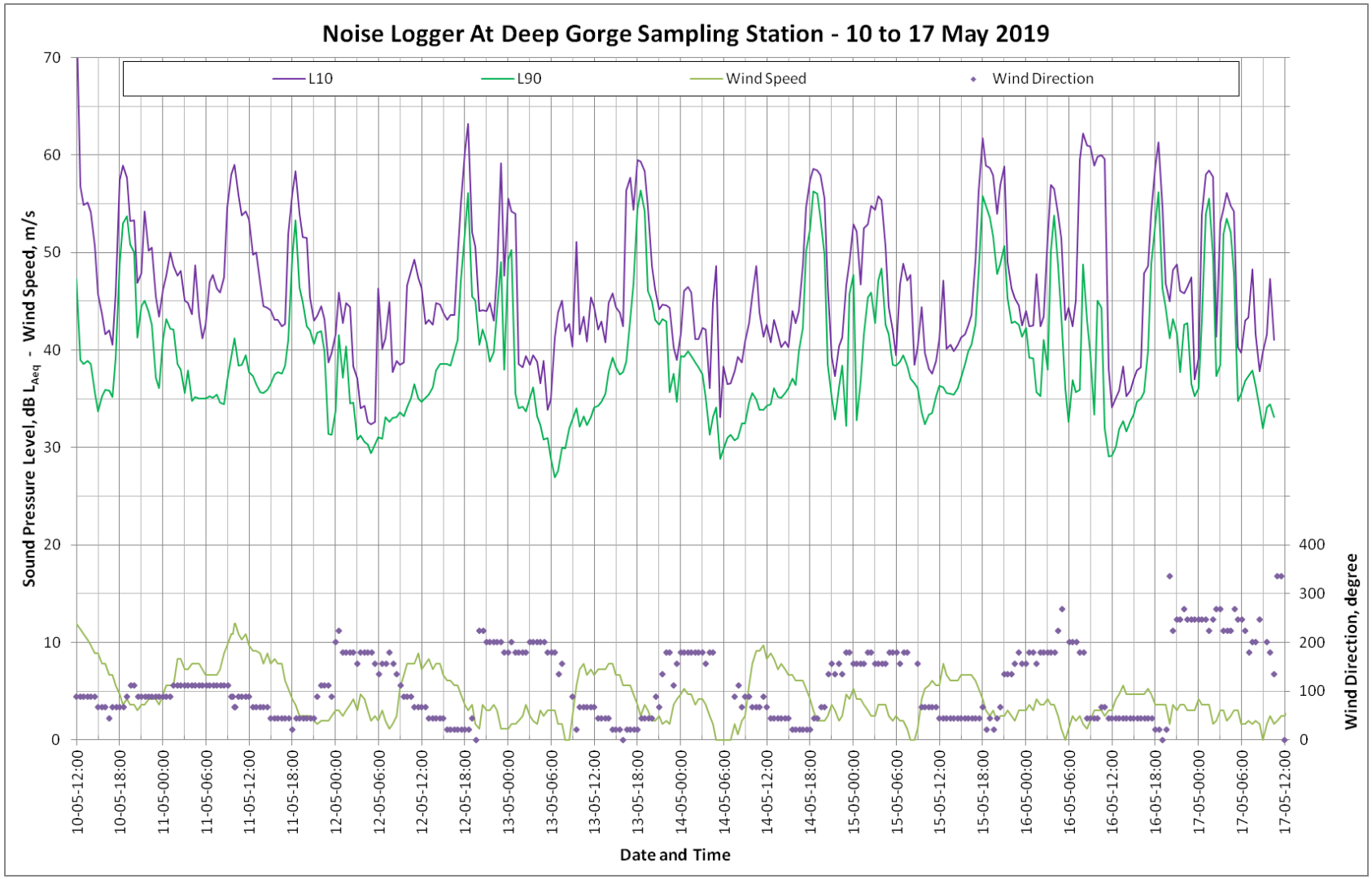


Figure 4-4 Ambient Noise Levels at Deep Gorge Sampling Station (10-17 May 2019)

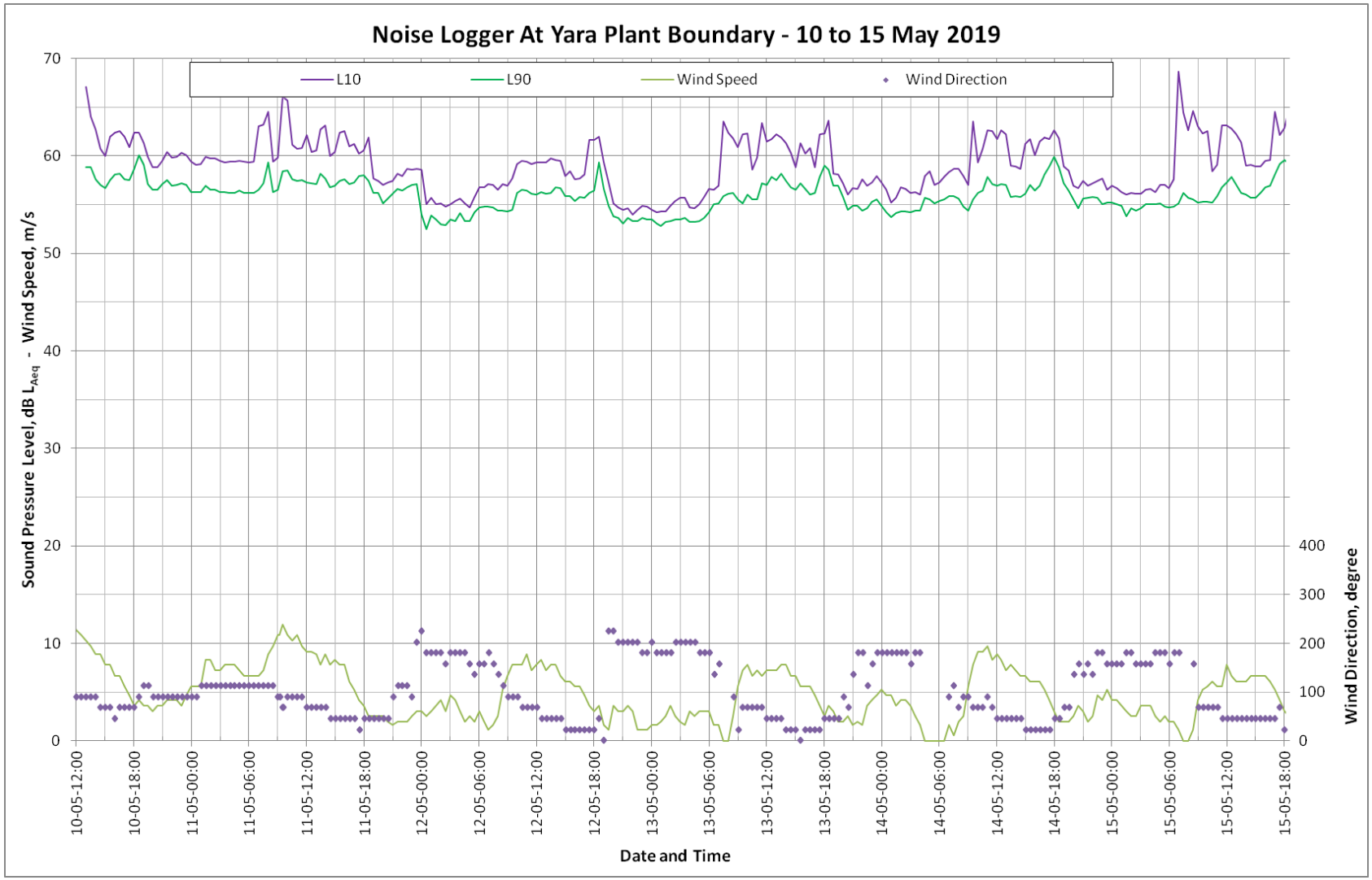


Figure 4-5 Ambient Noise Levels at Yara Plant Boundary (10-15 May 2019)

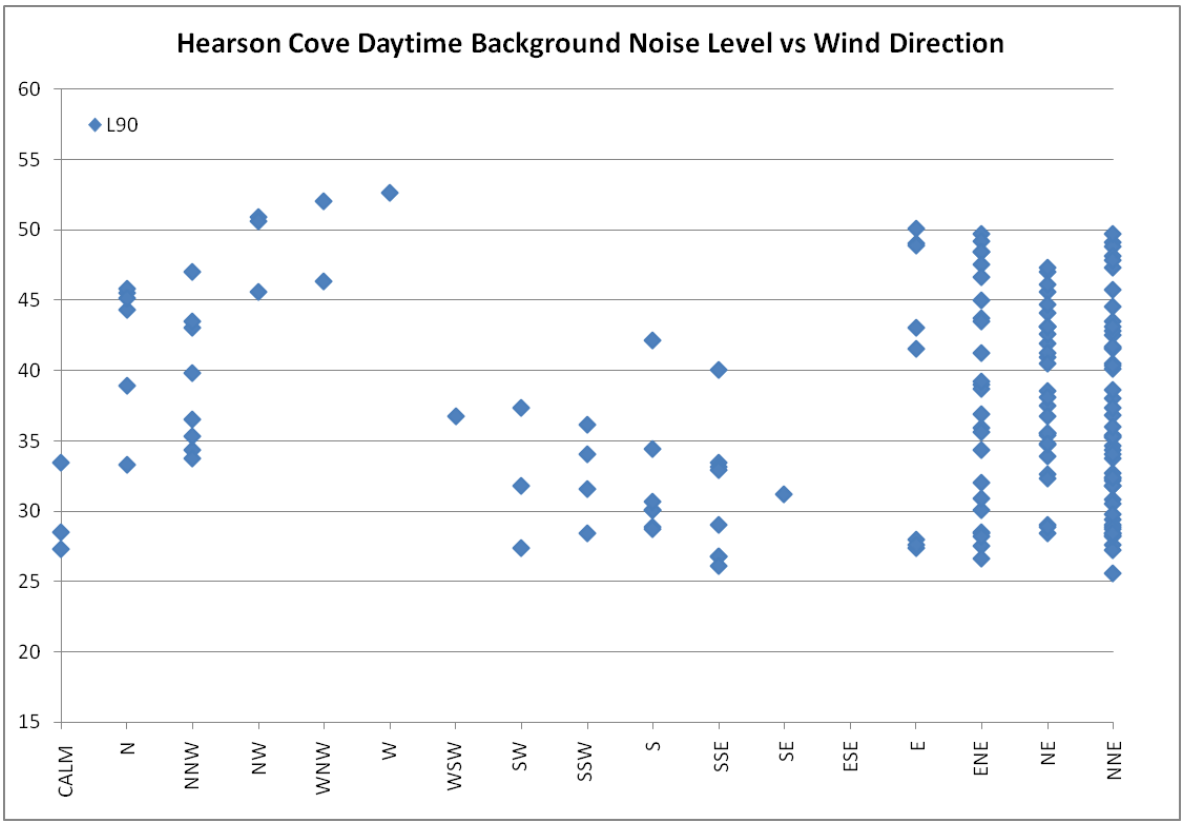


Figure 4-6 Hearson Cove Daytime L_{90} Noise Levels Distribution vs Wind Direction

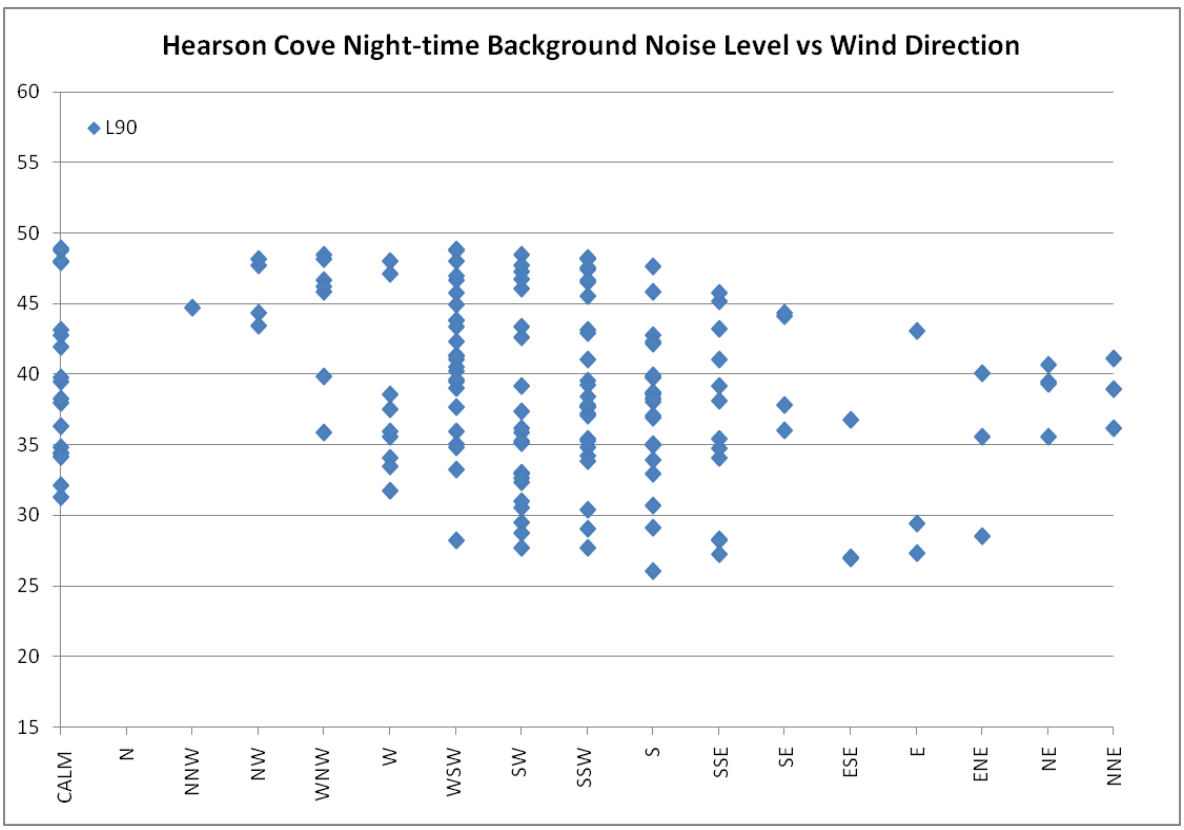


Figure 4-7 Hearson Cove Night-time L_{90} Noise Levels Distribution vs Wind Direction

For reference, the data recorded at Hearson Cove under mostly north-westerly winds (20 May 2019 around 1800) was also processed to obtain the average noise levels (L_{eq}) in one-third octave bands. The spectral data of the lowest 30 minute L_{eq} is presented in *Figure 4-7*. It can be seen the noise contribution from the local wildlife is significant (e.g. noise levels at 5 kHz) and dominates the overall levels. Considering only the noise levels between (and including) 31.5 Hz to 800 Hz, which could be considered representative of the existing industrial plant noise levels, the noise levels are 30 dB L_{Aeq}.

Finally, it must be noted that although noise from both Yara plant was audible in the background, therefore indicating both plant are operational, the operational conditions and throughput of either plant could not be verified.

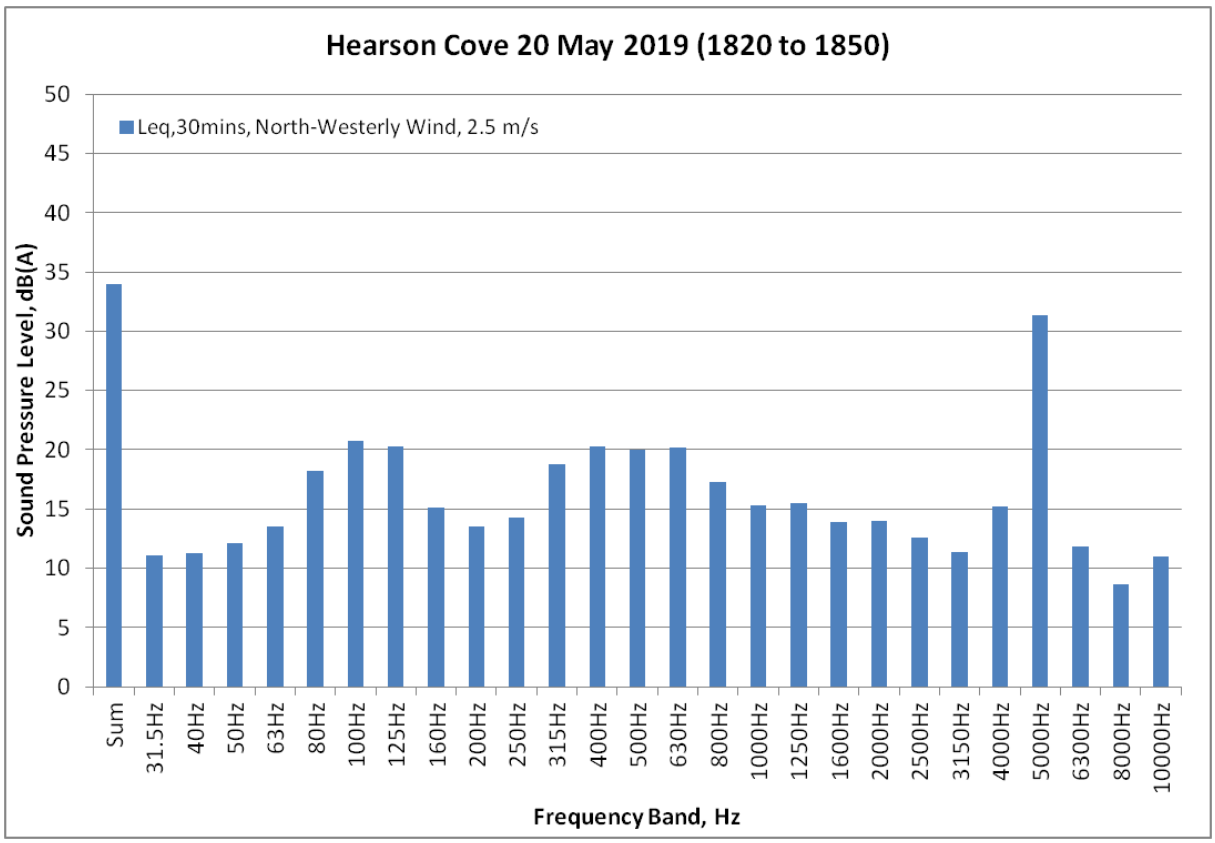


Figure 4-8 Sample Daytime Spectral Data At Hearson Cove (20 May 2019)

5 ASSESSMENT

5.1 Normal Operations

At the receiver locations of Hearson Cove and Deep Gorge, the noise emissions from the urea plant are not expected to contain annoying characteristics given the nature of the noise sources and the distance to the sensitive receiver locations.

From *Table 4-1,* the predicted noise levels at Hearson Cove are 41 dB(A) under worst-case meteorological conditions during the night and 40 dB(A) during the day. These levels comply with the assigned noise level of 45 dB(A) prescribed by the Department of Water and Environment Regulation (DWER) for past and recent projects. It is further noted that this location is expected to be occupied only during the daytime, and therefore the predicted daytime noise level would also be considered to "not significantly contribute" to the overall noise levels received at that location, given the predicted level of 40 dB(A) is 5 dB below the assigned noise level of 45 dB(A). From the monitoring data recorded at that location, background noise levels as low as 27 dB L_{A90} were recorded during the daytime and under calm conditions. Therefore the noise emissions from the proposed plant may be audible depending on the local weather conditions and local wildlife activity.

At the Deep Gorge location, the predicted noise levels are 42-43 dB(A) and therefore comply with the assigned noise level of 60 dB L_{A10}. Background noise levels in the order of 31 dB L_{A90} were recorded under calm weather conditions and therefore the noise emissions from the proposed plant will likely be audible.

At the Yara industrial plant boundary, noise levels up to 64 dB(A) were predicted. Compliance would therefore be achieved with the assigned noise level of 65 dB L_{A10} in a case where no annoying characteristics are present in the noise emissions. From the modelling it is noted that the most significant noise sources at that location are the Ammonia and Urea Synthesis plant with a contribution of 57 dB(A) each, followed by the power station at 56 dB(A). As such, any tonal component from the power station is likely to be masked by the ammonia and urea synthesis plant noise emissions.

At, and within, the industrial area to the west, noise levels below 60 dB(A) are predicted and therefore compliance with the assigned noise level of 65 dB(A) will be achieved, even if noise was found to contain tonal characteristics.

It must be noted the predicted noise levels in this study are based on preliminary plant design and indicative sound power levels. These assumptions should be confirmed through subsequent noise modelling as the detailed plant design progresses.

5.1.1 Boundary Noise Levels

For completeness, noise levels at various locations around the proposed boundary of the urea plant were also predicted. From *Table 4-2*, noise levels above 65 dB(A) are predicted at most locations, with the highest levels predicted close to the Ammonia and Urea Synthesis plant (e.g. locations B4, B5, B6 and B13).

As noted above, the predicted noise levels in this study are based on preliminary plant design and indicative sound power levels. Therefore opportunities for noise control can be identified and implemented as the detailed plant design progresses to ensure that noise emissions are kept as low as is reasonably practicable.

The following measures should be considered for plant designers and engineers during the detailed design:

- Select quietest plant available,
- Use pipe lagging around noisy valves and associated piping where practicable,
- Provide sheet metal cladding around particularly noisy plant areas or processes,
- Enclose pumps and fit silencers to motors, and
- Provide silencers to power station air inlet(s) and exhaust.

5.2 Blasting

The Hearson Cove site would be considered a sensitive site under regulation 11, and is located approximately 2 kilometres east from the proposed urea plant. At such distance, compliance with the airblast limit would be achieved with a charge mass per delay up to 60 kg.

With regard to ground vibration, the 3 mm/s PPV criterion would be achieved at a distance of at least 317 metres.

5.3 Construction Noise

Given the location of the proposed development and its surroundings, construction noise is not likely to adversely impact on surrounding sensitive receivers e.g. Hearson Cove.

In addition, as prescribed in *Section 2.2* construction noise does not have to specifically comply with the assigned noise levels in regulation 8 provided that:

- Construction work complies with AS 2436-2010 *Guide to noise and vibration control on construction, demolition and maintenance sites*; and
- The equipment used was the quietest reasonably available.

The management of noise emissions from construction activities is well documented and includes:

- Schedule noisiest works to occur during the daytime,
- Source quietest equipment available e.g. enclosed generators and pumps,
- Provide temporary noise barriers where warranted e.g. impact hammers / rock breakers could be shrouded around the hammer mechanism or mobile plant,
- Broadband reversing alarms could be installed on mobile plant.

The management of blasting to minimise vibration impacts includes:

- Use alternative rock-breaking method to blasting;

- Optimise blast design (changing burden and spacing) and adjusting maximum instantaneous charge (effective charge mass per delay); and,
- Use a combination of appropriate delays.

6 CONCLUSIONS

Environmental noise monitoring and modelling of the proposed urea plant to be located within the Burrup Strategic Industrial Area has been undertaken to predict the potential noise impacts at several key locations, including around the proposed plant boundaries.

The key receiver location in the study, based on past and recent projects, is the publicly accessible site of Hearson Cove. Noise levels of 40-41 dB(A) were predicted at that location under 'worst-case' meteorological conditions, and therefore comply with the L_{A10} assigned noise level of 45 dB(A). Background noise levels under similar wind conditions were measured to be 45 dB L_{A90}, however this included the influence of local wildlife. Considering only the lower frequency noise levels (31.5 Hz – 800 Hz) indicate that noise levels in the order of 30 dB(A) are expected from the existing industrial noise. As such, whilst the noise levels from the proposed development may be compliant, they may be audible above background at times.

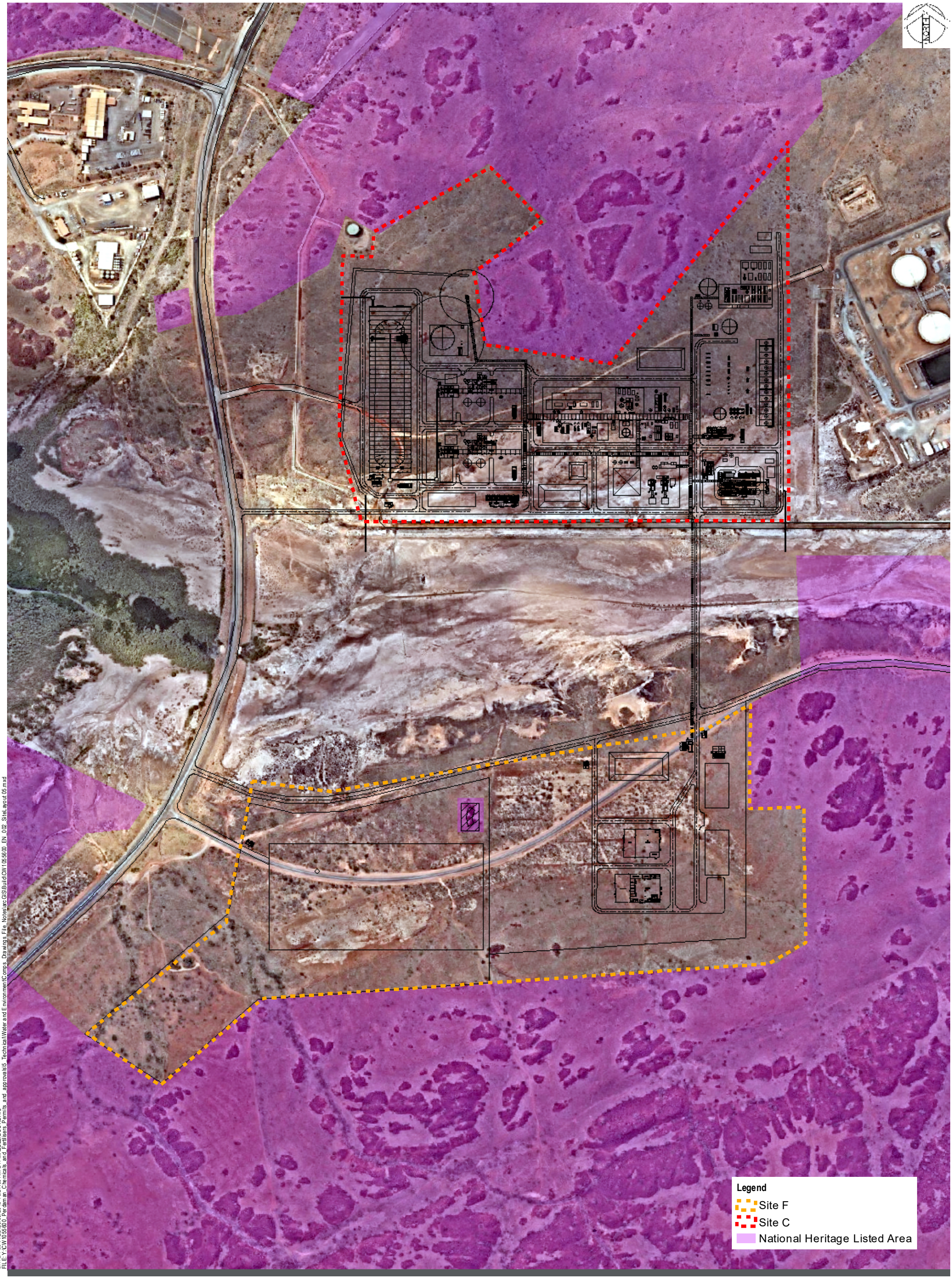
At other external locations of interest such as Deep Gorge and the boundary of Yara industrial plant, the predicted noise levels are below the applicable assigned noise levels at those locations. At Deep Gorge, background noise levels were in the order of 31 dB L_{A90} (under calm conditions) and as such, whilst compliant, the noise emissions from the proposed plant may be also audible at times.

Noise levels around the proposed plant west and north boundaries exceed 65 dB L_{A10}, but are predicted to comply with the 65 dB L_{A10} assigned noise level for industrial premises at the Yara site. However, the predicted noise levels in this study are based on preliminary plant design and indicative sound power levels. These assumptions should be confirmed through subsequent noise modelling as the detailed plant design progresses. Noise reduction measures will be investigated during the detailed design phase to ensure that noise emissions are kept as low as is reasonably practicable.

In addition to the above, based on the predicted airblast noise and vibration levels associated with construction activities, and the mitigation measures proposed, adverse impacts on sensitive receivers such as Hearson Cove, and rock-art formations in the vicinity of the proposed site are not considered likely.

Appendix A

Indicative Plant Layout



DATE PLOTTED:29/03/2019 10:21:38 AM BY: MAELLE BOURDAIS
FILE: Y:\CW1055600_Perdaman_Chemicals and Fertilisers\Permits and approvals\5_Technical\Water and Environment\Comps_Drawings_File_Notes\arcGIS\Build\CW1055600_EN_002_SiteLayout 05.mxd

Cardno

Date
29/03/2019

Size
A3

Scale
1:6,000

0 150 300Meters

INDICATIVE SITE LAYOUT

PERDAMAN UREA PROJECT

ENVIRONMENTAL REVIEW DOCUMENT

FIGURE X

CW1055600_EN_002_SITELAYOUT 05

Appendix B

Terminology

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

This is relatively common in most noise sources.

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

a variation in the emission of noise that —

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

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

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

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

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

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

Influencing Factor (IF)

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

where :

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a100m radius of the premises receiving the noise

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

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a100m radius of the premises receiving the noise

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

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

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

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

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

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

Peak Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a peak response. Peak velocity is normally used for the assessment of structural damage from vibration.

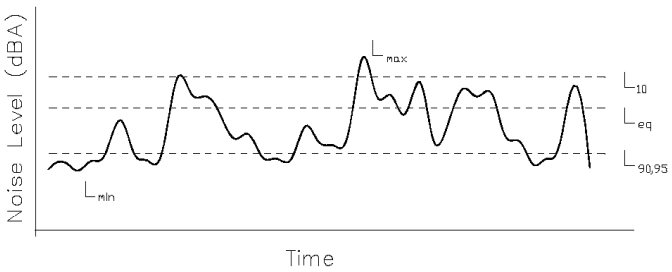
RMS Component Particle Velocity (PCPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and in one of the three orthogonal directions (x, y or z) measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Peak Particle Velocity (PPV)

The maximum instantaneous velocity in mm/s of a particle at a point during a given time interval and is the vector sum of the PCPV for the x, y and z directions measured as a root mean square (rms) response. RMS velocity is normally used for the assessment of human annoyance from vibration.

Chart of Noise Level Descriptors



Typical Noise Levels