Appendix B

Noise

QUEENSLAND PACIFIC METALS

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QPM Energy Project

Noise Impact Assessment

Prepared for QPM Energy

October 2022

QPM Energy Project

Noise Impact Assessment

QPM Energy

E210671 RP1

October 2022

Version	Date	Prepared by	Approved by	Comments
1	31 August 2022	James Small	Najah Ishac	Final Draft for QPM sign off
2	5 October 2022	James Small	Najah Ishac	

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Abbreviations

Table 1 Abbreviations

Abbreviation	Term
AHD	Australian Height Datum
BoM	Bureau of Meteorology
DES	Department of Environment and Science
EA	Environmental Authority
EAR	Environmental Assessment Report
EMM	EMM Consulting
EP Act	*Environmental Protection Act 1994*
EP Reg	Environmental Protection Regulation 2019
EPP	Environmental Protection Policy
GCF	gas compression facility
ha	hectare
km	kilometres
NMA	Noise Mapping Australia
NMM	Noise Measurement Manual
NQGP	North Queensland Gas Pipeline
PCNG	Planning for Noise Control Guideline
QPM Energy	Queensland Pacific Metals Energy
TECH	Townsville Energy Chemicals Hub Project
VDI	Verein Deutscher Ingenieure

1 Introduction

1.1 Project overview

The QPM Energy Project (the Project) involves the design, construction and operation of a gas compression facility (GCF) and a high-pressure pipeline that links the proposed GCF to the nearby existing and operational North Queensland Gas Pipeline (NQGP).

The Project proposes to collect waste coal mine gas at the proposed GCF via waste gathering lines from existing coal mines located adjacent to the proposed site. At the GCF, waste coal mine gas will be dehydrated and filtered, with the remaining clean gas then compressed and transported via high-pressure pipeline to the existing and operational NQGP. The NQGP will then transport the compressed gas north to Townsville, where in turn it will be depressurised and distributed, by a third party, to industrial users, including the QPM Townsville Energy Chemicals Hub (TECH) Project.

The Project is located approximately 43 kilometres (km) north of Moranbah.

1.2 Purpose of this report

This noise impact assessment has been prepared by EMM Consulting Limited (EMM) on behalf of QPM Energy in support of an application for a new Environmental Authority (EA) for a resource activity, as part of the Project. The purpose of this document is to provide sufficient detail to support an application for a site-specific EA. The key objectives of this noise impact assessment are to:

- assess the potential noise impacts associated with the operation of the GCF; and
- determine suitable acoustic treatment to mitigate such impacts if required.

The assessment has been conducted in accordance with the Department of Environment and Science (DES) guideline *Prescribing noise conditions for environmental authorities for petroleum activities.*

1.3 Project footprint and study area

The Project footprint is comprised of the following components and land areas:

- Gas Compression Facility (GCF) – 200 m by 300 m, an area of 6 ha.
- Pipeline – easement initially a 30 m wide construction right of way (an area of 51 ha) which reduces to a 15 m wide operating easement (an area of 25 ha) after the first 3.2 km from the GCF.
- Access road – 8 ha being a 30 m wide easement from Red Hill Road to the GCF – a distance of 2.8 km.
- Other incidental/ancillary activities, within the above footprint.

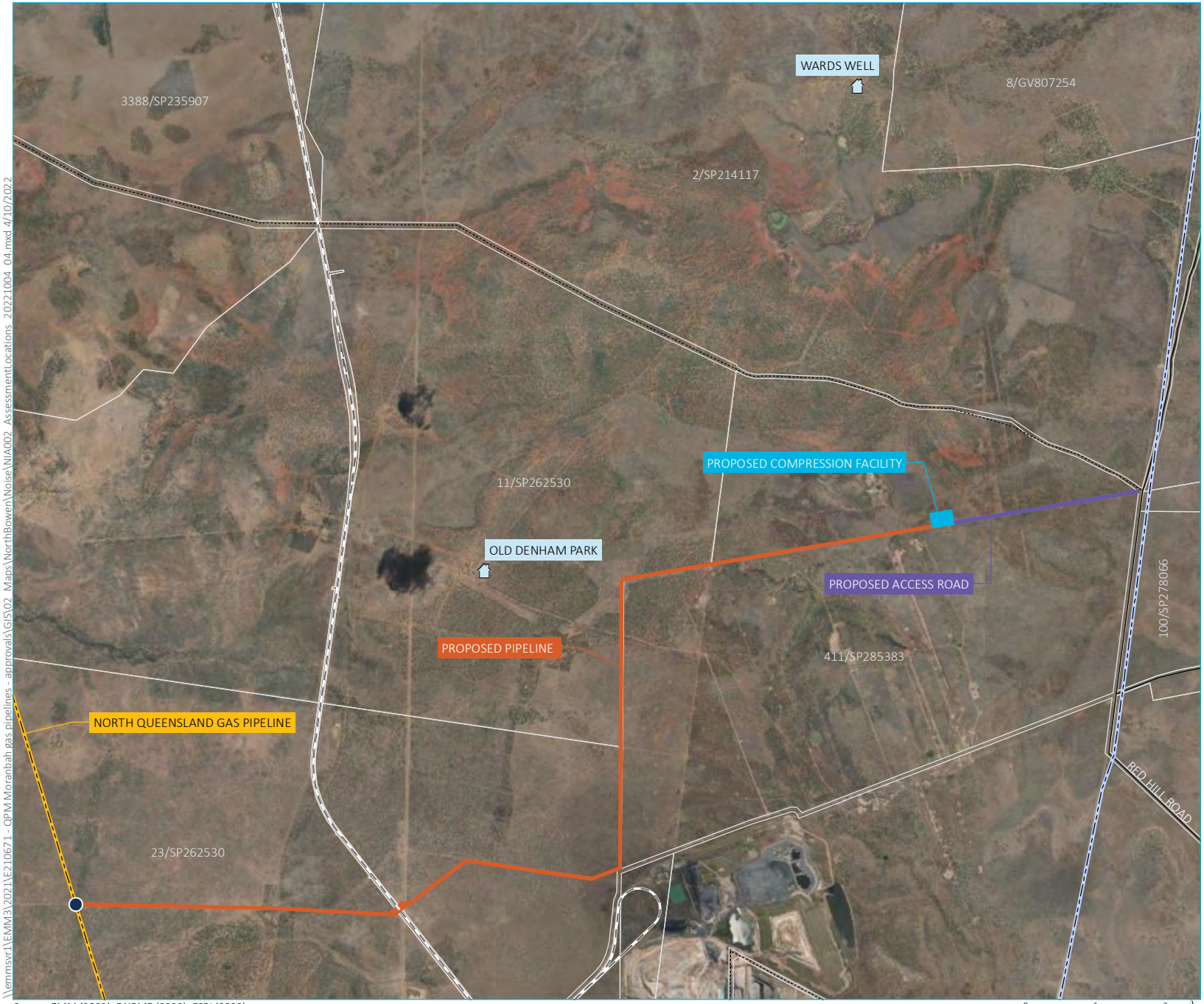
A detailed project description is provided in Section 3 of the Environment Assessment Report (EAR).

The land surrounding the Project is predominantly vacant with no industrial or agricultural industry in proximity. The land surrounding the Project is predominantly rural. There are two homesteads within 7 km of the Project.

The North Goonyella Coal Mine (previously Eaglefield Coal Mine) is approximately 6 km south of the Project. The open-cut coal mine spans approximately 20 km of terrain and is currently operational.

The terrain immediately surrounding the Project is relatively flat with few distinguishing features. The elevation ranges from approximately 280 m Australian Height Datum (AHD) to 350 m AHD within approximately 5 km of the Project.

The Project footprint and study area are shown in Figure 1.1.



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Source: EMM (2022); DNRME (2022); ESRI (2022)

Local context

QPM Energy Project
Noise
Figure 1.1

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2 Project description

2.1 Overview

The Project involves the design, construction, and operation of a GCF and a high-pressure pipeline that links the proposed GCF to the nearby existing and operational NQGP.

The Project proposes to collect waste coal mine gas at the proposed GCF via waste gas gathering lines located at adjacent coal mines. At the GCF, waste coal mine gas will be dehydrated and filtered, with the remaining clean gas then compressed and transported via high-pressure pipeline to the existing and operational NQGP. The NQGP will then transport the compressed gas north to Townsville, where in turn it will be depressurised and distributed, by a third party, to industrial users, including QPM's TECH Project.

Access to the GCF will be provided via the construction of a 2.8 km all-weather access road from Red Hill Road.

Ancillary activities will also occur within the defined Project footprint.

The Project is proposed 43 km north of Moranbah.

It should be noted that the Project involves capturing and converting methane in waste coal mine gas (a greenhouse gas) into carbon dioxide that would otherwise be released into the atmosphere by the relevant coal mining operator. The Project proposes to capture and convert waste coal mine gas through a process of filtration to remove water slugs and fine coal dust, compression, dehydration to remove water vapour, and flaring, in the event of a shutdown. It does not involve refining natural gas or coal seam methane gas.

For further detail on the Project description refer to Section 3 of the Environmental Assessment Report (EAR).

2.2 Key project components

Table 2.1 summarises the key components of the Project.

Table 2.1 Project components

Component	Description
Gas Compression Facility	• Captures and converts waste coal mine gas to clean gas which is then compressed to 15.3 megapascal for transport within the high-pressure gas pipeline. • Proposed to be located at Dabin Station on the southern boundary of Lot 2 SP214117 and 2.8 km west of the Red Hill Road reserve. • Sited on a 200 m by 300 m pad. • 6 ha disturbance footprint.
High-pressure pipeline	• High-pressure pipeline to transport clean compressed gas from the GCF to the NQGP. • 16.8 km in length, running along fence lines and property boundaries. • During construction, a 30 m wide construction right of way (disturbance area of 51 ha). • During operations, a 15 m wide operating easement (disturbance area of 25 ha) after the first 3.2 km.
Access road	• Road to provide all-weather access to the GCF from Red Hill Road reserve. • 2.8 km long and 30 m wide. • 8 ha disturbance footprint.

A detailed project description is provided in Section 3 of the EAR.

2.3 Project description influencing noise matters

The Project will be staged with an initial installation of five compressors, associated compressor engines and ancillary facilities and plant. It is noted that four of the five will be operational, with one provided in redundancy. The following two stages will incorporate an additional four compressors each to an ultimate capacity of thirteen compressors (twelve operational). This assessment addresses the ultimate capacity at Stage 3 which is summarised in Table 2.2.

Table 2.2 Staging

Stage	Capacity	Compressors (cumulative)	Flares
1	8PJ/year	5 (4 operational)	1
2	16PJ/year	9 (8 operational)	2
3	24PJ/year	13 (12 operational)	2

2.3.1 Proposed operation

The facility is proposed to operate 24 hours a day, 7 days a week to deliver gas to the NQGP. Ancillary activities including maintenance would occur sporadically but largely during the daytime period. Noise associated with such activities are not addressed in this report given the expected minor generation of noise.

2.3.2 Previous noise studies

Noise studies undertaken in the vicinity of the development which have been reviewed to inform the assessment includes the Noise Mapping Australia (NMA) 2010 *Eaglefield Expansion Project – Noise and Vibration Assessment* prepared for MET Serve.

The study includes noise monitoring conducted at sensitive land uses in the vicinity of the Eaglefield/North Goonyella mine complex which are also relevant to this assessment.

2.4 Assessment locations

The land surrounding the Project is predominantly rural. There are a few isolated residences within 7 km of the development. The nearest residence is located 6,238 m to the north of the development. The Eaglefield/North Goonyella mine complex is located to the south of the Project. Noise impacts have been addressed to residential uses only given their inherent sensitivity to noise.

Noise sensitive receivers in the vicinity of the Project are provided in Table 2.3 and in Figure 1.1.

Table 2.3 Assessment locations

Receiver no.	Receiver address	Receptor type	Coordinates (MGA 55)		Distance to site boundary
			Easting	Northing	
R1	'Old Denham Park' 535 Mabbin Road, Moranbah (11SP262530)	Residential	596292	7608543	6,635 m to the west
R2	'Wards Well' 8595 Suttor Development Road, Burton (2SP214117)	Residential	601805	7615530	6,238 m to the north

3 Legislation, policy, standards and guidelines

3.1 Referenced guidelines, standards and regulations

The assessment of noise impacts from the Project has been undertaken with consideration to the guidelines, standards and regulations provided in Table 3.1.

Table 3.1 Regulatory framework relevant to this assessment

Legislation, policy or guideline	Relevance to the assessment
Environmental Protection Act 1994 (EP Act)	The EP Act provides the legal framework for avoiding environmental nuisance due to an environmentally relevant activity. Provides noise objectives to be applied in the assessment.
Environmental Protection Regulation 2019 (EP Reg)	The EP Reg provides the environmental objective to be met to achieve the requirements of the EP Act. Provides background context to noise emission requirements applicable to the Project.
Environmental Protection (Noise) Policy 2019 (EPP (Noise))	The EPP (Noise) provides the framework for achieving the objectives of the EP Act by identifying specific environmental values to be enhanced. Provides noise objectives to be applied in the assessment.
QLD Department of Environment and Science (DES) 2022, *ESR/2016/1935 - Guideline – Noise Assessment - Prescribing noise conditions for environmental authorities for petroleum activities* (ESR/2016/1935 Guideline)	This report has been prepared in accordance with the requirements of ESR/2016/1935 Guideline.
DES 2020, *Noise Measurement Manual*, (NMM)	The NMM prescribes the processes required to measure noise in accordance with the EP Reg under Section 59 and 60. Provides noise measurement methodologies to be followed in the assessment.
DEHP 2016, *Planning for Noise Control Guideline* (PCNG) Department of Environment and Heritage Protection	The PCNG provides guidance on determining meteorological effects on noise propagation for use in noise modelling. Meteorological effects have been reviewed in accordance with the PCNG as applicable to the Project.

3.2 Applicable assessment criteria

The acoustic quality objectives derived from the EPP (Noise) for assessment locations relevant to the Project are provided in Table 3.2 which will be used to formulate noise emission criteria to govern the Project.

Table 3.2 Schedule 1 Acoustic Quality Objectives EPP (Noise)

Sensitive receptor	Time of day	Acoustic quality objectives (measured at the receptor) dB(A)			Environmental value
		$L_{Aeq,adj,1hr}$	$L_{A10,adj,1hr}$	$L_{A1,adj,1hr}$	
Residence (for outdoors)	Daytime and evening	50	55	65	Health and wellbeing
Residence (for indoors)	Daytime and evening	35	40	45	Health and wellbeing
	Night-time	30	35	40	Health and wellbeing, in relation to the ability to sleep
Library and educational institution (including a school, college and university) (for indoors)	When open for business or when classes are being offered	35	-	-	Health and wellbeing
School or playground (for outdoors)	When the children usually play outside	55	-	-	Health and wellbeing

The ESR/2016/1935 Guideline provides guidance on the establishment of best practice noise emission limits to govern petroleum-based projects. Further, the guideline describes assessment methods for determining noise from the operation of such projects and the formulation of suitable noise mitigation methods to meet best practice noise emission limits.

Noise limits applicable to petroleum activities are provided in Table 5 of the ESR/2016/1935 Guideline which are reproduced in Table 3.3. The limits in Table 5 are considered to protect the acoustic values of a sensitive receptor in rural or isolated areas and achieve acoustic quality objectives in the EPP (Noise) whilst considering cumulative impacts and background creep.

Table 3.3 Best practice measured noise emission limits

Time period	Metric	Best practice noise limits		
		Short term	Medium term	Long term
7.00 am–6.00 pm	$L_{Aeq, adj, 15mins}$	45 dB(A)	43 dB(A)	40 dB(A)
		35^+10 dB(A)	35^+8 dB(A)	35^+5 dB(A)
6.00 pm–10.00 pm	$L_{Aeq, adj, 15mins}$	40 dB(A)	38 dB(A)	35 dB(A)
		30^+10 dB(A)	30^+8 dB(A)	30^+5 dB(A)
10.00 pm–6.00 am	$L_{Aeq, adj, 15mins}$	28 dB(A)	28 dB(A)	28 dB(A)
		25^+3 dB(A)	25^+3 dB(A)	25^+3 dB(A)
	Max $L_{pA, 15mins}$	55 dB(A)	55 dB(A)	55 dB(A)

Table 3.3 Best practice measured noise emission limits

Time period	Metric	Best practice noise limits		
		Short term	Medium term	Long term
6.00 am–7.00 am	$L_{Aeq, adj, 15mins}$	40 dB(A)	38 dB(A)	35 dB(A)
		30^+10 dB(A)	30^+8 dB(A)	30^+5 dB(A)

(^) deemed background noise level

The project noise component and the background noise component are to be logarithmically added to meet the best practice noise emission limits. For instance, the night-time project noise component should not exceed 25 dB which, when added to the background level of 2 5dB, would meet the 28dB noise limit.

In this regard we note:

- where the best practice noise limit is the background +10 dB, the project component noise limit will be the best practice noise limit;
- where the best practice noise limit is the background +8 dB, the project component noise limit will be the background noise level +7 dB;
- where the noise limit is background + 5 dB, the project component noise limit will be the background noise level +3 dB; and
- where the noise limit is background + 3 dB, the project component noise limit will be the background noise level.

With consideration to the minimum deemed background levels, the project noise component is then summarised in Table 3.4.

Table 3.4 Project component noise limits

Time period	Metric	Short term	Medium term	Long term
7.00 am–6.00 pm	$L_{Aeq, adj, 15mins}$	45 dB(A)	42 dB(A)	38 dB(A)
6.00 pm–10.00 pm	$L_{Aeq, adj, 15mins}$	40 dB(A)	37 dB(A)	33 dB(A)
10.00 pm–6.00 am	$L_{Aeq, adj, 15mins}$	25 dB(A)	25 dB(A)	25 dB(A)
	Max $L_{pA, 15mins}$	55 dB(A)	55 dB(A)	55 dB(A)
6.00 am – 7.00 am	$L_{Aeq, adj, 15mins}$	40 dB(A)	37 dB(A)	33 dB(A)

The duration of events as described by the ESR/2016/1935 Guideline are summarised in Table 3.5.

Table 3.5 Summary description of event duration

Length of event	Description	Example event
Short term	A short term noise event is a noise exposure, when perceived at a receptor premise, which persists for an aggregate period not greater than eight hours and does not re-occur for a period of at least seven days. Reoccurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or source location.	Flaring associated with pipeline purge for planned maintenance.
Medium term	A medium term noise event is a noise exposure, when perceived at a receptor premise, which persists for an aggregate period not greater than five days and does not re-occur for a period of at least four weeks. Reoccurrence is deemed to apply where a noise of comparable level is observed at the same receptor location for a period of one hour or more, even if it originates from a different source or source location.	Flaring due to an unplanned event.
Long term	A long term noise event is a noise exposure, when perceived at a receptor premise, which persists for a period of greater than five days, even when there are respite periods when the noise is inaudible within those five days.	General operation of the facility.

4 Assessment methodology

Noise from the operation of the development has been assessed against the best practice measured noise emission limits described in the ESR/2016/1935 Guideline.

There are no specific provisions in the ESR/2016/1935 guideline that addresses construction noise. Restrictions on construction noise are provided in Section 440R of the EP Act which nominates the following:

> 440R Building work
>
> (1) A person must not carry out building work in a way that makes an audible noise—
>
> (a) on a business day or Saturday, before 6.30a.m. or after 6.30p.m; or
>
> (b) on any other day, at any time.
>
> (2) The reference in subsection (1) to a person carrying out building work—
>
> (a) includes a person carrying out building work under an owner-builder permit; and
>
> (b) otherwise does not include a person carrying out building work at premises used by the person only for residential purposes.

Noise generated by the development will be generally associated with the operation of GCF plant and engines. Ancillary power generator sets will typically be significantly quieter or can be provided in proprietary enclosures.

Flaring activities will typically occur rarely (eg quarterly during manual shutdowns) or during emergency shutdowns. Given the infrequency of such events, noise from flaring has been assessed against the ESR/2016/1935 Guideline short term criteria.

The indicative site layout in Figure 6.1 has been utilised as a basis for the assessment to determine likely levels of noise at surrounding assessment locations from the use of the Project as proposed.

This may be used to inform:

- acoustic treatment which may be employed to reduce noise emissions from the site; and
- noise management which may be employed to reduce noise from the use as practically possible.

Modelling parameters, modelling scenarios and meteorological conditions are presented in Section 6.

5 Existing environment

5.1 Surrounding land uses

The Project is located within the local government area of Isaac Regional Council in Central Queensland. The landscape can be broadly characterised as:

- rural land used for cattle grazing;
- predominantly flat terrain with undulations, melon holes and cracking clays leading to gilgai;
- cleared of native vegetation with some remnant regrowth;
- established resources locality with mining tenements and gas interests located throughout (and adjoining) the Project footprint; and
- containing limited sensitive receptors with two homesteads within 7 km – one 6.5 km (approx.) to the west and the other 6.2 km (approx.) to the north of the Project.

5.2 Locality characteristics and meteorology

The topography in the vicinity of the Project is generally flat with minor undulations. An elevated ridge exists between the GCF and the Denham Park which has been considered using land elevation data.

A review of the Bureau of Meteorology's (BoM) climate database was undertaken and information was sourced from two representative weather stations proximal to the site, Moranbah Airport (BoM: 0434035) and Moranbah Water Treatment Plant (BoM: 034038), both of which are located approximately 45 km south of the Project footprint.

Rainfall is seasonally distributed with a distinct wet season occurring during the summer months of December through February and an extended dry season occurring during the months of April through September. Monthly and annual rainfall data sourced from BoM 0434035 indicates that the region receives a range in annual rainfall totals of between 280 and 833 mm per year.

Conversely, evaporation data sourced from BoM 034038 indicates a similar seasonal trend, albeit monthly average totals significantly exceed monthly average rainfall totals. This is indicative of a sub-tropical climate with hot, moist summers and warm, dry winters.

5.3 Existing acoustic environment

Noise monitoring was undertaken for the purposes of the Eaglefield North expansion and reported in the NMA (2010) report. Unattended monitoring was undertaken at Denham Park (new) Homestead, approximately 7.4 km south of the nearest noise sensitive receiver to the Project.

The measured ambient noise levels are presented in Table 2 of the NMA (2010) report which is reproduced in Table 5.1.

Table 5.1 Measured ambient noise levels (NMA 2010)

Date	$L_{A90\ (60minute)}$ background noise level			$L_{Aeq\ (60\ minute)}$ noise level				$L_{A10\ (60\ minute)}$ noise level		
	Day	Evening	Night	24 hour	Day	Evening	Night	Day	Evening	Night
8 April 2009	-	36	36	-	-	42	42	-	43	43
9 April 2009	38	37	33	45	47	42	40	47	43	41
10 April 2009	36	37	31	49	43	43	35	43	44	38
11 April 2009	33	34	35	50	45	39	38	47	40	40
12 April 2009	35	36	38	47	43	41	41	42	43	44
13 April 2009	32	32	32	45	48	41	48	46	43	50
14 April 2009	31	32	29	47	44	39	36	41	41	38
15 April 2009	30	35	35	40	41	41	40	39	42	41
16 April 2009	32	34	32	54	39	40	39	39	41	41
Rating background level/ median	32	35	33	47	43	41	42	42	43	41

With regard to the established rating background noise levels, the NMA (2010) report notes the following:

> It is likely the noise levels at these homesteads are due to residential activity noise or farming noise rather than existing mining operations.

The contamination of the background noise data at Denham Park (new) may not be prevalent at other receivers and as such should not be adopted for these receivers.

Furthermore, the rating background noise level is lowest during the day, followed by the night and evening. This suggests significant activity during the evening period (eg insects) which would normally be excluded from monitoring data.

It is further noted that background noise levels are typically higher than one would expect for a rural setting in the absence of any significant noise source (eg mining).

In the absence of reliable rating background noise levels, the minimum deemed background noise levels of ESR/2016/1935 Guideline have been adopted.

5.4 Deemed background noise levels

The ESR/2016/1935 Guideline identifies deemed background noise levels which would be adopted for areas with exceptionally low background noise levels which would render unreasonably low noise emission limits.

The deemed background noise levels presented in Table 5.2 are commonly adopted for the assessment of noise from petroleum-based activities.

Table 5.2 Deemed background noise levels (ESR/2016/1935)

Time of day	Deemed background noise level, dB L_{A90}
7.00 am–6.00 pm	35
6.00 pm–10.00 pm	30
10.00 pm–6.00 am	25
6.00 am–7.00 am	30

6 Assessment of noise impacts

6.1 Project operational noise description

As noted above in Section 2.3, this assessment addresses the ultimate capacity at Stage 3 for the GCF.

The Stage 3 ultimate capacity arrangement allows for 12 reciprocating compressors with associated compressor gas motors. There are two gas flares noted on the current arrangement drawings (refer to Figure 6.1). It is expected that flaring will only occur during maintenance and upset conditions.

Predicted noise levels are provided for two scenarios, namely:

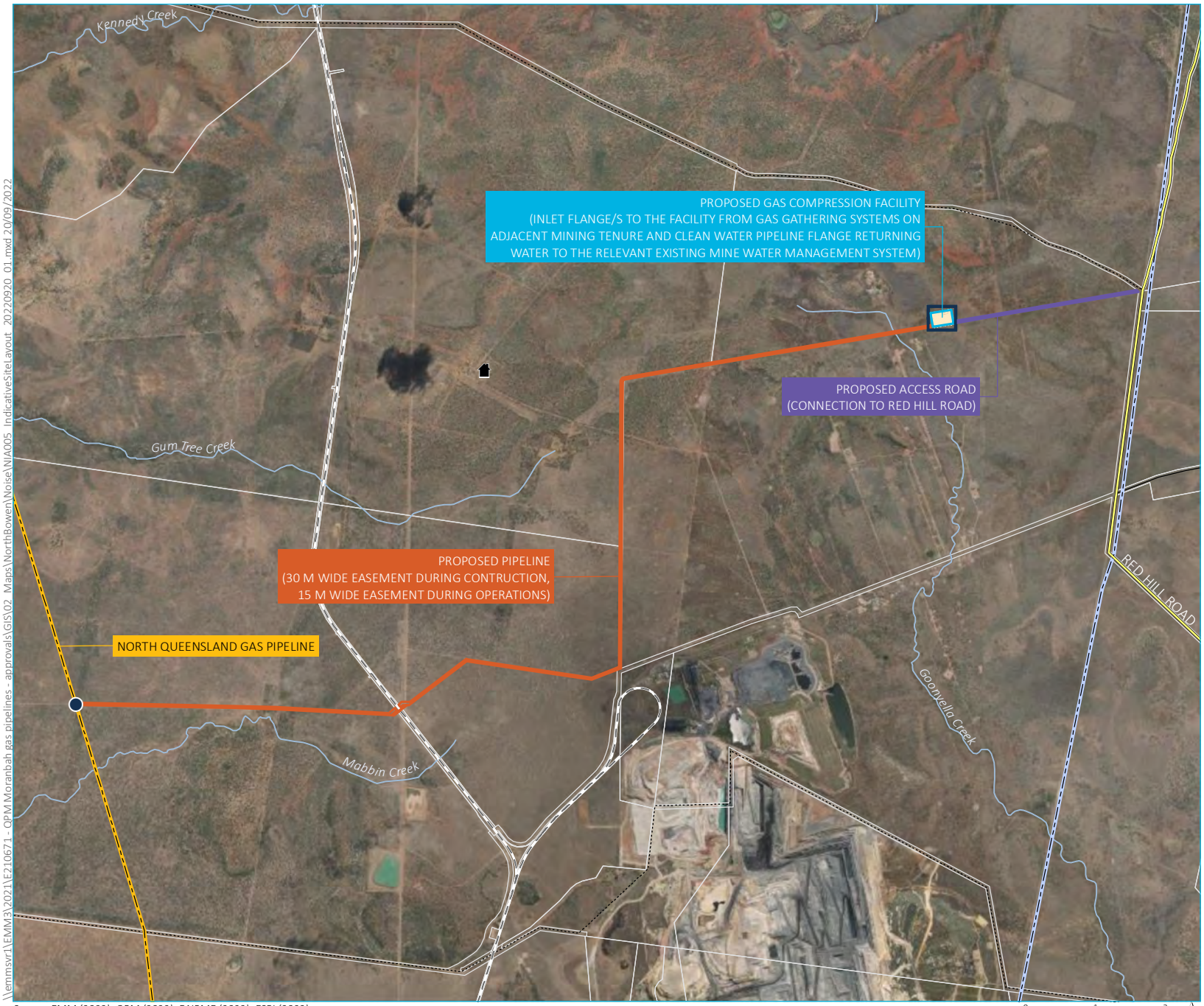
- normal operation which considers reciprocating compressors and gas driven compressor engines; and
- upset conditions includes the use of flares and a general shutdown of compression equipment.

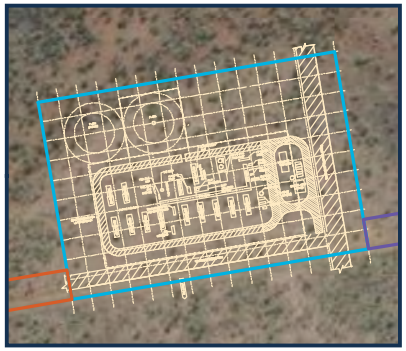
The flares serve for two purposes:

- It provides a “field to flare” function and allows the safe disposal of gas to keep the gas wells flowing (prevent water build-up) during a planned or unplanned plant shutdown. The flaring/gas disposal is managed by the pressure control valve monitoring the pressure at the facility inlet.
- It provides a safe disposal of flammable gas during manual or emergency blowdown.

The flare is projected to operate four times per year including one forced start to test the system. A 30 minute full burn is expected for each shutdown.

Backpressure on gas inflow will result in slowing inflowing gas. This will lead to increasing pressure in field lines leading to field flaring in accordance with conventional field procedures.





KEY

Proposed project components
- Hot tap
- Gas compression facility layout
- Gas compression facility
- Pipeline
- Access road

Existing environment
- Homestead
- North Queensland Gas Pipeline
- Water pipeline
- Rail line
- Red Hill Road
- Minor road
- Vehicular track
- Named watercourse
- Cadastral boundary

Project components

QPM Energy Project
Noise
Figure 6.1

EMM
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Source: EMM (2022); QPM (2022); DNRME (2022); ESRI (2022)

0 1 2 km
GDA 1994 MGA Zone 55
N

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6.2 Equipment noise levels

Equipment noise levels which have been used for assessment purposes have been provided to EMM by QPM Energy. Assessment source noise levels presented in Table 6.1 do not incorporate acoustic treatment.

Table 6.1 Project source noise data

Description	Sound power level, octave band centre frequency, dB									dBA
	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Reciprocal compressor Enerflex JGK/4	110	106	111	110	108	111	116	113	106	120
Compressor engine Waukesha L7044GSI	103	126	128	120	119	118	119	118	110	125
Gas generator Cummins GFEB KTA19SLB	86	86	95	97	99	97	96	92	88	102

6.3 Flare noise

The loudest potential A-weighted noise source associated with gas compression stations is that associated with flaring. Flaring would be required during the life of the GCF operation but typically only for planned (maintenance) or planned shutdown.

Source noise levels associated with flaring has been established using the predictive models provided in Verein Deutscher Ingenieure (VDI) *3732 – Standard noise levels for technical sound sources – Flares* 1999.

VDI 3732 provides a calculation method for determining indicative sound power levels associated with flares based on flow rates as described by Equation 1.

$$LWA = 112 + 17 \cdot \log(\frac{Q}{Q0}) \qquad \text{Equation 1}$$

Where:

Q = flow rate in tonnes per hour

Q_0 = reference flow rate (1)

The noise spectrum has been adopted from Figure 4 of VDI 3732. Based on the flow rates for the project which are in the order of 49 t/h per flare, the sound power levels in Table 6.2 can be established.

Table 6.2 Project source noise data (flares)

Description	Octave band centre frequency, dB								dBA
	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	
Flaring noise (per flare)	147	143	139	135	134	135	134	127	141

6.4 Assessed meteorological conditions

Noise propagation over distance can be significantly affected by weather conditions. Of most interest are effects due to source to receiver winds and the presence of temperature inversions, as these conditions can enhance received noise levels.

To account for these phenomena, the processes identified in the PCNG provides procedures for identifying prevailing noise enhancing meteorological conditions at a site, with a view to determining whether they can be described as a feature of the project footprint.

Meteorological data has been determined using the BoM weather station at Moranbah Airport (station ID: 034035). Weather patterns have been based on a five-year analysis between 2017–2022.

6.4.1 Wind

Wind effects can have a significant impact on noise propagation. The PCNG provides guidance on assessing potential wind effects and establishing whether wind is a significant feature of an area. In this regard, the PCNG notes the following:

> Wind is considered to be a feature where source-to-receiver wind speeds (at 10m height) of 3ms or below occur for 30 percent of the time or more in any assessment period (day, evening, night) in any season.

Wind effects can be assessed under the PCNG utilising the following methods:

- by using a wind rose to determine whether wind is a feature based on the frequency of occurrence and wind speed and assessing the source-to-receiver components of wind that are relevant; or
- by assuming that wind is a feature of the area (foregoing the need to use a wind rose) and applying a 'maximum impact' scenario.

For the purposes of this assessment, potential wind effects have been addressed using a wind rose for each season and time of day.

An analysis of wind data indicates that wind (source to receiver) is not a feature of the area and as such has not been included in the noise calculation.

6.4.2 Temperature inversions

Temperature inversions, when they occur, can increase noise levels by focusing sound waves. Temperature inversions generally occur during the night-time and early morning periods during the winter months. The PCNG provides the following guidance in determining whether temperature inversions occur for significant periods to warrant incorporation into the noise model:

> An occurrence of 30 percent of the total night-time period during winter (June, July and August) has been selected as representing a significant noise impact warranting further assessment.

The "night-time" period for the purposes of assessing temperature inversions is between 6.00 pm–7.00 am hours which differs from the normal night-time assessment period.

An assessment of temperature inversions has been undertaken with consideration to prevailing atmospheric stability classes during the winter months. Stability classes have been established using the wind direction standard deviation (Sigma Theta) method.

The assessment has determined that significant inversion strength (moderate (F-class stability) to strong (G-class stability)) does not occur for more than 30% of the evening and night time period during the winter months. Accordingly, inversions have not been incorporated into the prediction model.

6.4.3 Drainage-flow wind (katabatic wind)

Drainage flow winds (or also known as katabatic winds) can be described as localised cold air travelling in a direction of decreasing altitude. The PCNG provides the following guidance in the assessment of drainage-flow winds:

> The drainage-flow wind default value should generally be applied where a development is at a higher altitude than a residential receiver, with no intervening higher ground (for example, hills). In these cases, both the specified wind and temperature inversion default values should be used in the noise assessment for receivers at the lower altitude.

Assessment locations R1 (approximately RL 338) and R2 (approximately RL325) are higher in altitude than the GCF (approximately RL320). Accordingly, drainage-flow winds have not been incorporated into the prediction model.

6.5 Summary of noise modelling parameters

Noise modelling was conducted using the SoundPlan™ noise modelling software. Noise propagation models typically adopted in Queensland for modelling industrial noise include international standard ISO 9613-2:1996 'Acoustics – Attenuation of sound during propagation outdoors' and the CONCAWE propagation model.

The ISO 9613-2:1996 prediction model incorporates either downwind noise propagation from source to receiver or a "well developed moderate ground-based temperature inversion". The meteorological conditions established at the site indicate generally neutral conditions. As such, CONCAWE was selected for this assessment in preference to ISO 9613-2 to account for site specific meteorological conditions.

The acoustic model prepared for the Project utilises the CONCAWE noise model to determine noise at surrounding assessment locations. The CONCAWE model allows for propagation to be determined under neutral conditions (D class stability). The modelling parameters adopted for the assessment are provided in Table 6.3.

Table 6.3 Modelling standard parameters

Modelling Parameter	Input
Model	CONCAWE
Environmental conditions	Humidity 70% Temperature 10°C Air pressure [mbar] 1013.3
Elevation contours	Contours adopted from 1 Second Digital Surface Model Version 3
Receiver height and position	1.5 m above ground at residence
Ground absorption factor	50% over open remote rural areas (generally dirt and shrubs) 70% over open rural areas (generally grass)

The noise-enhancing meteorological conditions common to the area have been assessed in Section 6.4. The analysis has determined that wind, temperature inversions and katabatic winds are not a feature of the area and as such have not been included in the assessment.

6.6 Modelling scenarios

Noise emissions from the Project have been assessed using the modelling scenarios presented in Table 6.4 Normal conditions describe of the operation of the compression facility in the absence of irregular events such as flaring.

During upset conditions the majority of plant equipment will shut down (eg for maintenance) and flaring will occur. Gas powered generators (for site power) will continue to run.

Table 6.4 Modelling scenarios

Scenario	Noise sources	Meteorological conditions
Normal	Reciprocating compressors Compressor engines Power generation units	Neutral (D class stability)
Manual shutdown	Flaring	Neutral (D class stability)
Emergency shutdown	Flaring	Neutral (D class stability)

6.7 Predicted noise levels

Predicted noise levels from the operation of the compressor station are provided in Table 6.5. Operational conditions will be consistent during the day, evening and night-time period. Given the neutral weather conditions applicable to the area (D class stability), predicted noise levels are expected to be consistent for the day, evening and night.

Table 6.5 Predicted noise levels

Conditions	Receiver location	Predicted noise level, dB $L_{Aeq\ 15min}$	Comparison with component noise objective dB $L_{Aeq\ 15min}$					
			Day	Exceedance	Evening	Exceedance	Night	Exceedance
Normal	R1 - Old Denham Park	31	38	-	33	-	25	6
	R2 – Wards Well	32	38	-	33	-	25	7
Manual shutdown[1]	R1 – Old Denham Park	40	45	-	40	-	25	15
	R2 – Wards Well	41	45	-	40	1	25	16
Emergency shutdown[2]	R1 – Old Denham Park	40	42	-	37	3	25	15
	R2 – Wards Well	41	42	-	37	4	25	16

1. Noise objective based on short term noise limit.
2. Noise objective based on medium term noise limit.

6.8 Assessment of sleep disturbance

There is no specific L_{Amax} noise data for the proposed equipment, however like most compressors and generator engines under constant load, the operation of the compressor facility is expected to be steady-state. In this regard, there will likely be very little variance in noise level between the L_{Aeq} parameter and the L_{Amax} parameter.

The worst-case predicted noise level at any assessment location is at Wards Well which has an untreated predicted noise level in the order of 32 dB $L_{Aeq\ 15min}$ during normal operation and 41dB $L_{Aeq\ 15min}$ during flaring.

The sleep disturbance criteria for loud instantaneous noise events, is 55 dB L_{Amax}. Given that only marginal variance between the L_{Aeq} and L_{Amax} level is expected from the operation of the engines and compressors, noise levels of between:

- 35–37 dB L_{Amax} at Wards Well would be expected during general operation; and
- 44–47 dB L_{Amax} during flaring.

Accordingly, L_{Amax} noise events associated with the project's normal operation are expected to meet the 55 dB L_{Amax} noise criteria.

6.9 Discussion

Predicted noise levels indicate:

- noise during normal operation is predicted to result in an exceedance of the night-time component noise objective of 6dB and 7dB for R1 and R2;
- noise during manual shutdown events is expected to meet component noise objectives during the day-time period, with minor exceedance at Wards Well during the evening period (1dB). Manual shutdowns during the night-time period are expected to exceed component noise objectives by up to 16dB; and
- noise during emergency shutdown events is expected to meet component noise objectives during the day-time period. Exceedance of up to 4dB is expected during the evening period. Emergency shutdowns during the night-time period are expected to exceed component noise objectives by up to 16dB.

Accordingly, noise mitigation measures have been determined in accordance with the EPP (Noise) noise management hierarchy.

7 Mitigation measures

Predicted noise levels demonstrate noise objectives may be exceeded at both receiver locations during the day and evening period. As such, further noise mitigation will be required.

7.1 Noise management hierarchy

The noise management hierarchy provided in the EPP (Noise) has been utilised to determine reasonable acoustic treatments for plant equipment which should be employed in individual plant selection, siting and determining noise mitigation treatment. The following should be considered where practical and reasonable to do so.

1. Avoid

The proximity of the project to residential dwellings has been maximised as practically possible whilst remaining within the bounds of the developable area.

2. Minimise

a) Noisy equipment has been located along the southern edge of the project, maximising distance to the nearest noise sensitive receiver (R2).

b) Plant equipment may be acoustically treated such that noise to sensitive noise receivers is minimised as practically possible. This includes:

i) enclosing or screening compressor plant; and

ii) pre-packaged engine enclosures for compressor motors and site power generation.

3. Manage

Avoid intensive operations during the night-time period. For example, planned shutdown periods for maintenance is to be undertaken during the day to minimise noise impacts from flaring.

7.2 Analysis of noise generating equipment

Noise predictions indicate an exceedance of the project component noise objective of 6dB and 7dB at assessment locations R1 and R2 respectively. It is noted that predicted exceedances are largely due to the compressor engines. Site ancillary equipment (eg gas generators) have negligible contribution to the overall noise level.

A review of practical and reasonable acoustic treatments for the loudest contributing plant equipment has been undertaken to target noise reduction.

The noise mitigation measures provided in Table 7.1 have not been incorporated into the noise model unless explicitly stated. Strategies identified in Table 7.1 would be explored as part of the detailed design.

Table 7.1 Review of noise mitigation measures (normal conditions)

Conditions	Receiver location	Predicted night-time noise level, dB $L_{Aeq\ 1hour}$	Exceedance of night-time noise objective, dB	Main contributing plant	Contributing noise level, dB $L_{Aeq\ 1\ hour}$	Mitigation		
						Avoid	Minimise	Manage
Normal operation	R1 Old Denham Park	31	6	Compressor engines	30	Equipment located on site to maximise distance to noise sensitive receptors.	Enclose compressor engines and incorporate attenuators/silencers on intake and exhaust discharge.	No management proposed.
				Reciprocating compressors	18	Equipment located on site to maximise distance to noise sensitive receptors.	No treatment required.	No management required.
	R2 Wards Well	32	7	Compressor engines	31	Equipment located on site to maximise distance to noise sensitive receptors.	Enclose compressor engines and incorporate attenuators/silencers on intake and exhaust discharge.	No management proposed.
				Reciprocating compressors	19	Equipment located on site to maximise distance to noise sensitive receptors.	No treatment required.	No management required.

Table 7.2 Review of noise mitigation measures (upset conditions)

Conditions	Receiver location	Predicted night-time noise level, dB $L_{Aeq\ 1hour}$	Exceedance of component noise objective, dB			Main contributing plant	Mitigation		
			Day	Evening	Night		Avoid	Minimise	Manage
Manual shutdown	R1 Old Denham Park	40	- (45) [1]	- (40) [1]	15 (25) [1]	Flares	Relocating the flares on the project site will have minimal acoustic benefit.		Planned use of the flares (maintenance) is to be undertaken during the day-time period. Refer to Section 7.5.
	R2 Wards Well	41	- (45)[1]	- (40) [1]	16 (25) [1]	Flares			
Emergency shutdown	R1 Old Denham Park	40	- (42)[2]	3 (37) [2]	15 (25) [2]	Flares	Relocating the flares on the project site will have minimal acoustic benefit.		Notification of affected stakeholders in the event of an emergency shutdown and consultant as to likely duration of shutdown and subsequent flaring. Refer to Section 7.5.
	R2 Wards Well	41	- (42)[2]	4 (37)[2]	16 (25) [2]	Flares			

3. Based on short term noise limit.
4. Based on medium term noise limit.

7.3 Acoustic treatment to compressor engines

A 7dB reduction in noise from compressor engines will be required to meet the component noise level of 25dB $L_{Aeq\ 15min}$.

This could be satisfied with the installation of basic attenuation package (eg sealed steel enclosures ≥ 1 mm thickness, single stage acoustic louvres at the inlet and discharge and upgraded engine exhaust mufflers on engines.

Alternatively, the manufacturer is to provide an attenuated engine package with a sound pressure level not exceeding 98dB L_{Aeq} when measured at 1m from any side or exhaust point.

7.4 Community consultation and complaint handling procedures

A complaints management system will be put in place that documents:

- name of persons receiving complaint;
- name of person making the complaint;
- date and time of complaint;
- nature of the complaint;
- actions taken to rectify;
- actions to minimise risk of reoccurrence; and
- name of person(s) responsible for undertaking the required actions.

Nearby landholders will be provided a dedicated point of contact for the duration of the project.

The existing stakeholder engagement plan will continue to be implemented to facilitate ongoing consultation with relevant stakeholders, including local businesses, throughout the project so that stakeholders have access to information regarding the nature of the proposed project activities and their likely impacts.

7.5 Consultation during shutdown events

Flaring due to manual shutdown events which may occur during the evening period would likely meet component noise objectives however should be avoided if practical. It is recommended in such instances that stakeholders be informed on the duration of the associated flaring event if this occurs during the evening period. Manual shutdown events during night-time period are not to occur.

Emergency shutdown events may result in flaring for significantly longer periods. Notification of affected stakeholders in the event of an emergency shutdown and consultant as to likely duration of shutdown and subsequent flaring should be undertaken.

8 Conclusions and recommendations

EMM has completed a review of potential noise impacts associated with the proposed QPM Energy GCF to be located at Eaglefield, Queensland.

The assessment considered the potential for noise impacts of the project and has been prepared in accordance with the methodologies outlined in the DES *ESR/2016/1935 – Guideline – Noise Assessment – Prescribing noise conditions for environmental authorities for petroleum activities* which considers the noise requirements of the EP Act and EPP (Noise) 2019.

A noise model has been prepared for the Project to determine likely levels of noise impact at surrounding noise sensitive assessment locations. Noise modelling has been undertaken based on preliminary selections of reciprocating compressor plant, compressor engines and ancillary services. An assessment of flaring noise has been undertaken using the source prediction methods of VDI 3732.

Historical meteorological conditions in the area have been reviewed. The review indicates that neither wind nor moderate to strong temperature inversions are characteristic of the area. Accordingly, adverse meteorological conditions have not been used in the noise prediction model.

Findings of the assessment are summarised as follows:

- the cumulative noise from all plant (untreated) on the premises is predicted to exceed the night-time noise limits by up to 6 dB at assessment location R1 and 7dB at assessment location R2;
- noise from flaring during manual shutdowns are predicted to meet daytime noise limits, marginally exceed the evening noise limits at Wards Well (1dB) and exceed the night-time noise limits by up to 16 dB; and
- noise from flaring during emergency events are predicted to exceed the evening and night-time noise limits by up to 4 dB and 16 dB respectively.

An analysis of noise from individual project equipment types indicates that the predominant source of noise is associated with compressor engines. By reducing source noise from the compressor engines using an acoustically rated enclosure, noise emissions associated with the general operation of the project is expected to comply with the project noise limits. No additional acoustic treatment is expected to be required to the reciprocating compressors or on-site ancillary equipment.

Noise associated with flaring during manual shut downs can be suitably managed by limiting such events to daytime periods. Noise associated with flaring during emergency shut downs can be suitably managed with community consultation in the absence of practical noise mitigation treatments.

The acoustic assessment of plant equipment during the detailed design phase is to be undertaken to ensure that plant selections and locations meet the project noise emission objectives.

Glossary

Several technical terms are required for the discussion of noise. These are explained in Table G.1.

Table G.1 Glossary of acoustic terms

Term	Description
ABL	The assessment background level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured L_{90} statistical noise levels.
dB(A)	Noise is measured in units called decibels (dB(A)). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
L_{A1}	The A-weighted noise level exceeded for 1% of the time.
L_{A10}	The noise level which is exceeded 10% of the time. It is roughly equivalent to the average of maximum noise level.
L_{A90}	The noise level that is exceeded 90% of the time. Commonly referred to as the background noise level.
L_{Aeq}	The energy average noise from a source. This is the equivalent continuous sound pressure level over a given period. The $L_{eq,15\ minute}$ descriptor refers to an L_{eq} noise level measured over a 15-minute period.
L_{Amax}	The maximum root mean squared sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single value background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (L_w)	A measure of the total power radiated by a source. The sound power of a source is a fundamental property of the source and is independent of the surrounding environment.

It is useful to have an appreciation of decibels, the unit of noise measurement. Table G.2 gives an indication as to what an average person perceives about changes in noise levels:

Table G.2 Perceived change in noise

Change in sound level (dB(A))	Perceived change in noise
1 to 2	typically indiscernible
3	just perceptible
5	noticeable difference
10	twice (or half) as loud
15	large change
20	four times (or quarter) as loud

Examples of common noise levels are provided in Figure G.1.

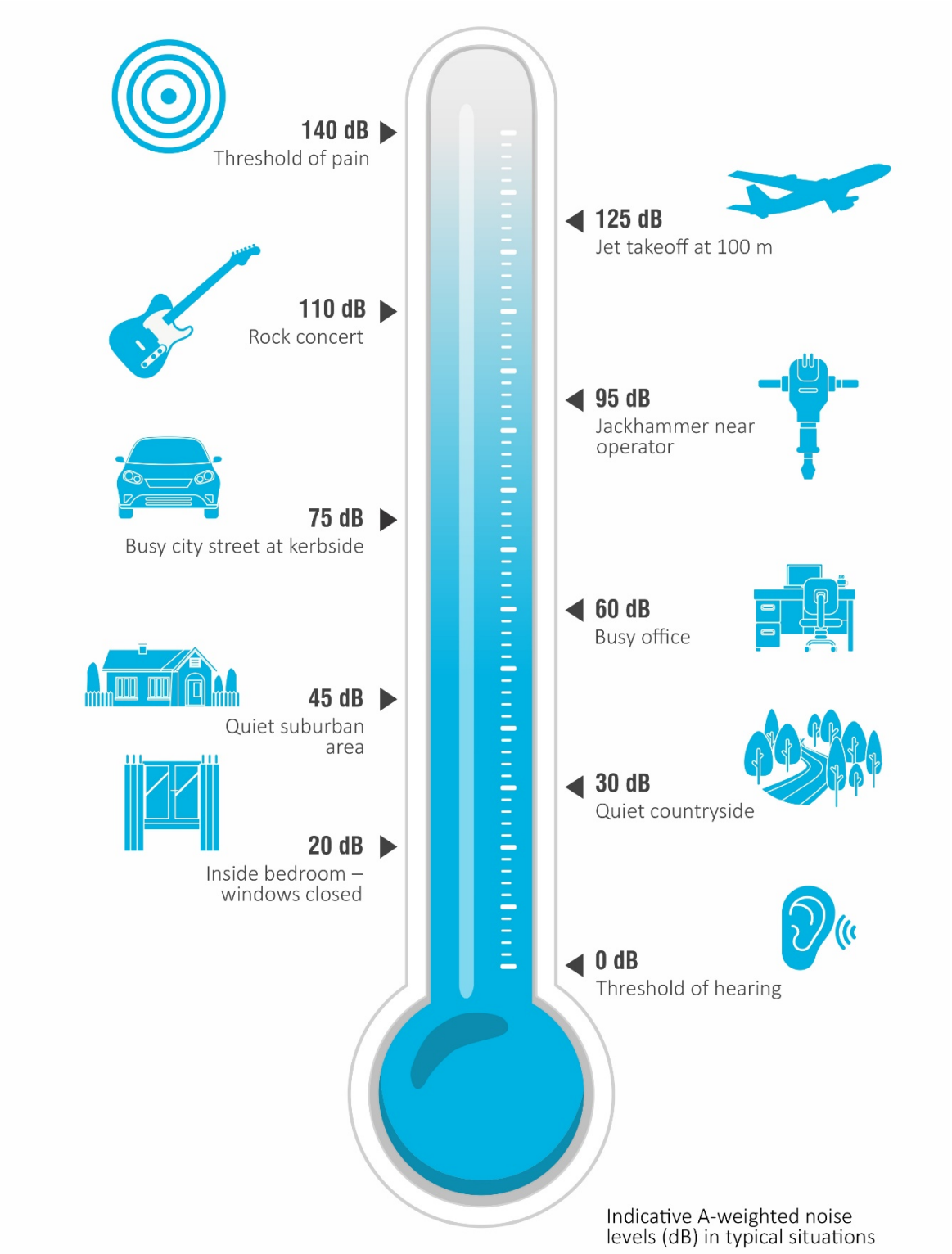


Figure G.1 **Common noise levels**

References

DEHP 2016, *Planning for noise control guideline* (PNCG) Department of Environment and Heritage Protection

DES 2020, *Noise measurement manual* (NMM) Department of Environment and Science

DES 2022, *ESR/2016/1935 - Guideline – Noise Assessment - Prescribing noise conditions for environmental authorities for petroleum activities* Department of Environment and Science

Noise Mapping Australia (NMA) 2010 *Eaglefield Expansion Project – Noise and Vibration Assessment* prepared for MET Serve.

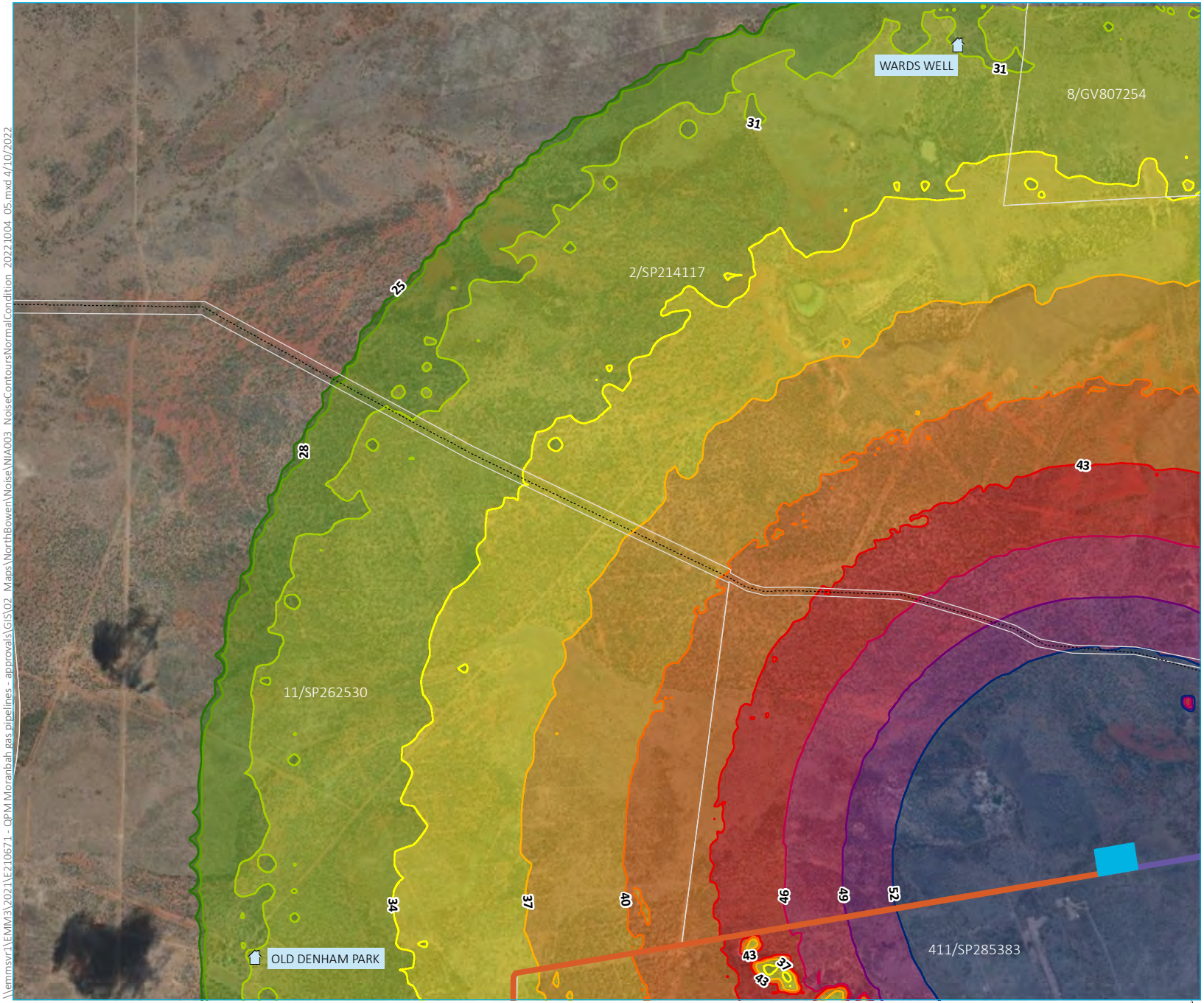
Qld Environmental Protection Act 1994 – EP Act

Qld Environmental Protection (Noise) Policy 2019 – EPP (Noise)

Annexure A

Noise contour plots

EMM
creating opportunities



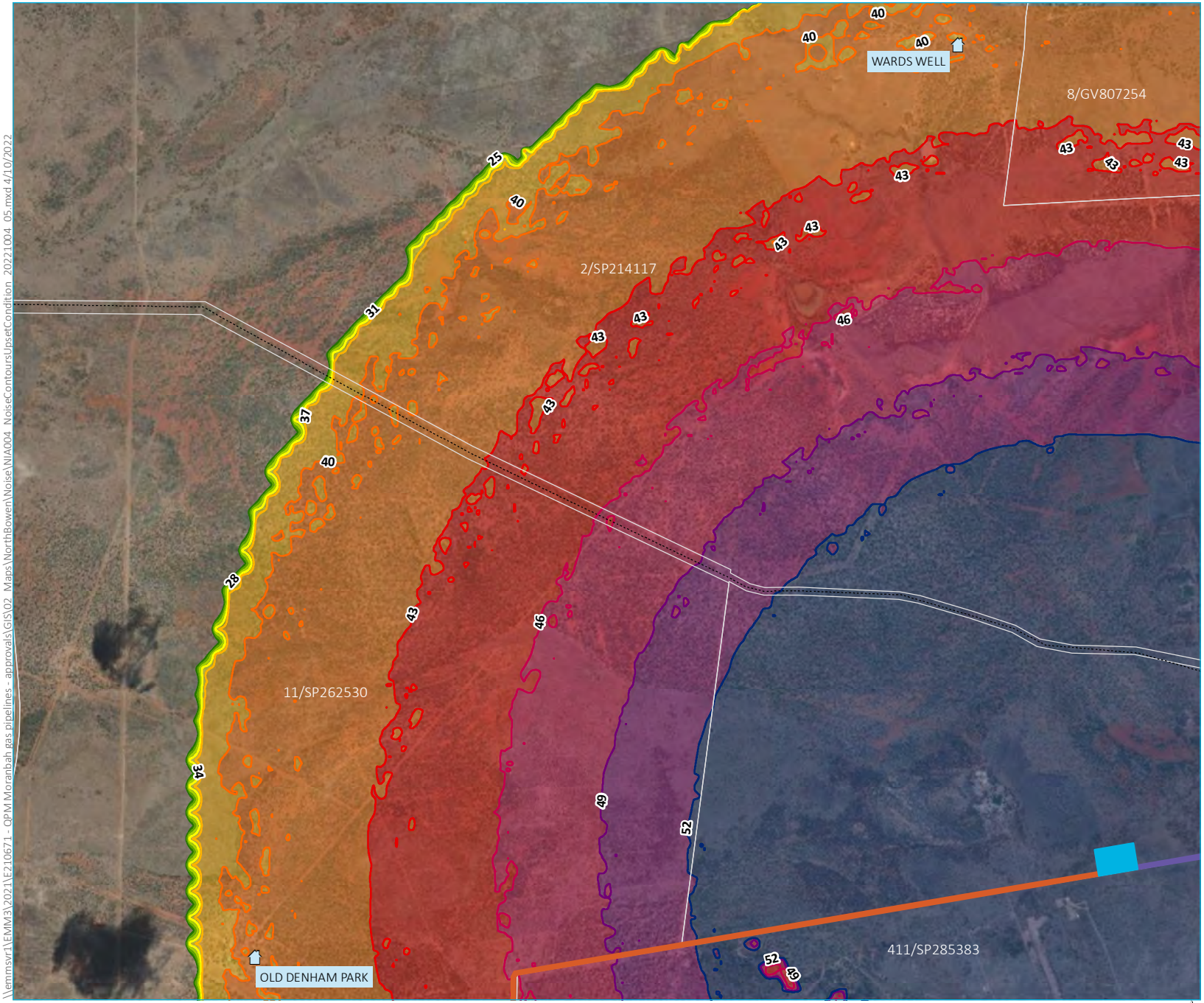
\\emmsvr1\EMM3\2021\E210671 - QPM Moranbah gas pipelines - approvals\GIS\02_Maps\NorthBowen\Noise\NIA003_NoiseContoursNormalCondition_20221004_05.mxd 4/10/2022

Source: EMM (2022); DNRME (2022); ESRI (2022)

Noise contour plot - operation normal conditions (24 hours)

QPM Energy Project
Noise
Appendix A.1

EMM
creating opportunities



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Source: EMM (2022); DNRME (2022); ESRI (2022)

Noise contour plot - operation upset conditions

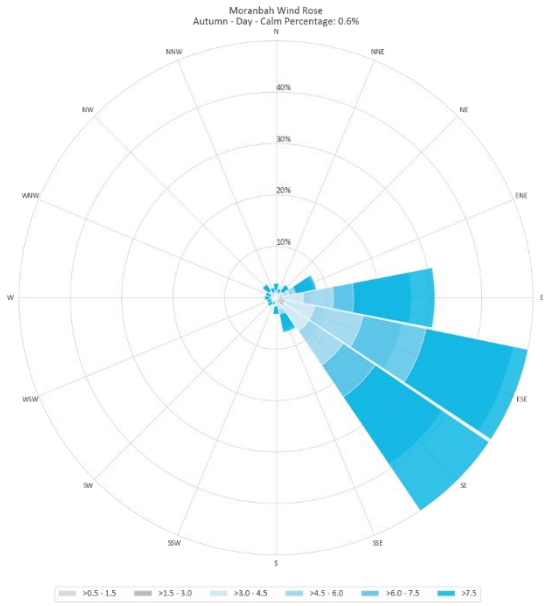
QPM Energy Project
Noise
Appendix A.2

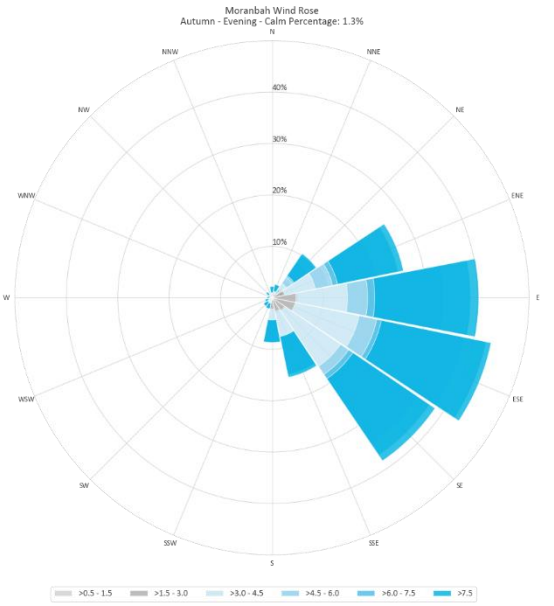
EMM
creating opportunities

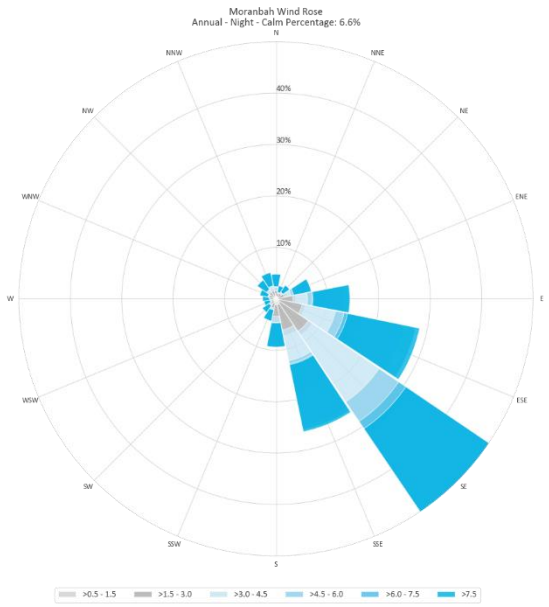
Annexure B

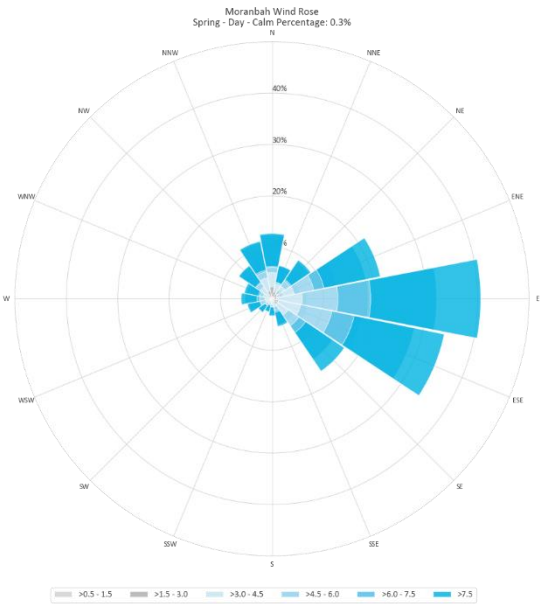
Moranbah wind roses

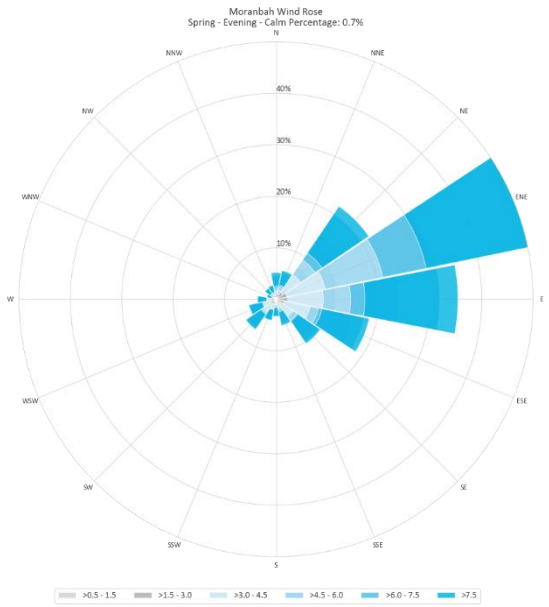
EMM
creating opportunities

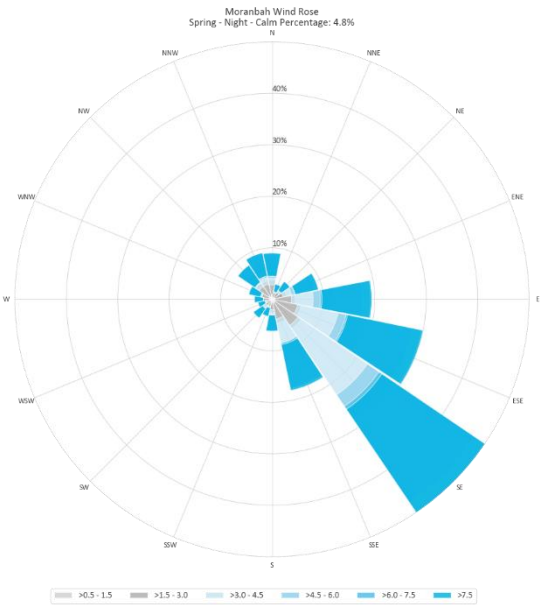

Moranbah Wind Rose
Autumn - Day - Calm Percentage: 0.6%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

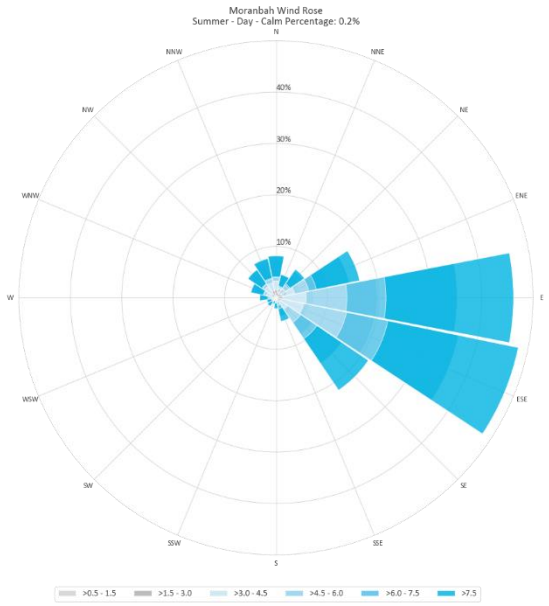

Moranbah Wind Rose
Autumn - Evening - Calm Percentage: 1.3%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

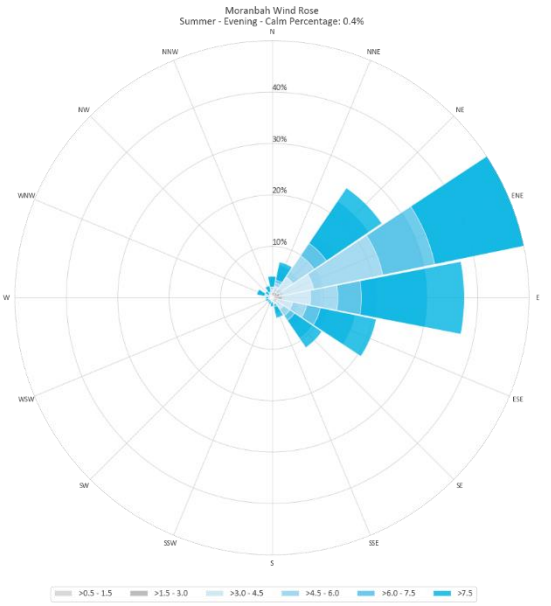

Moranbah Wind Rose
Annual - Night - Calm Percentage: 6.6%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

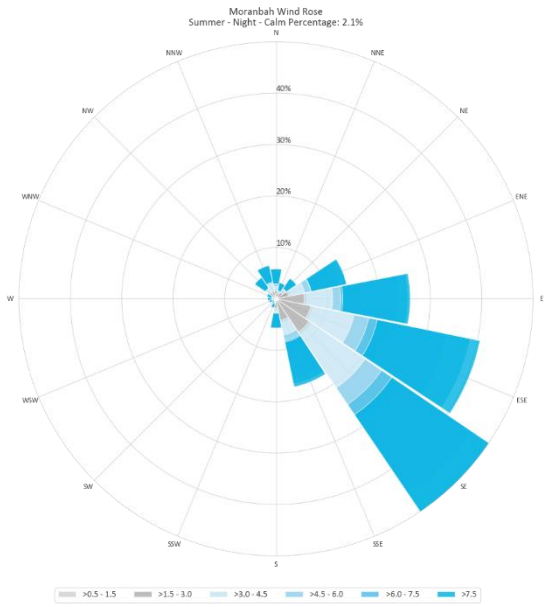

Moranbah Wind Rose
Spring - Day - Calm Percentage: 0.3%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

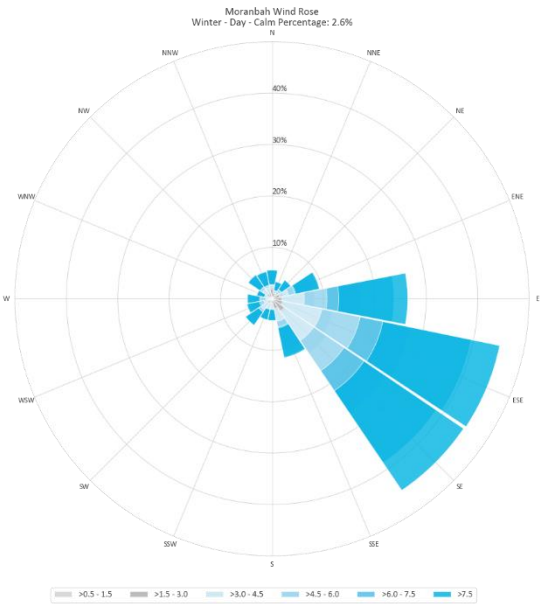

Moranbah Wind Rose
Spring - Evening - Calm Percentage: 0.7%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

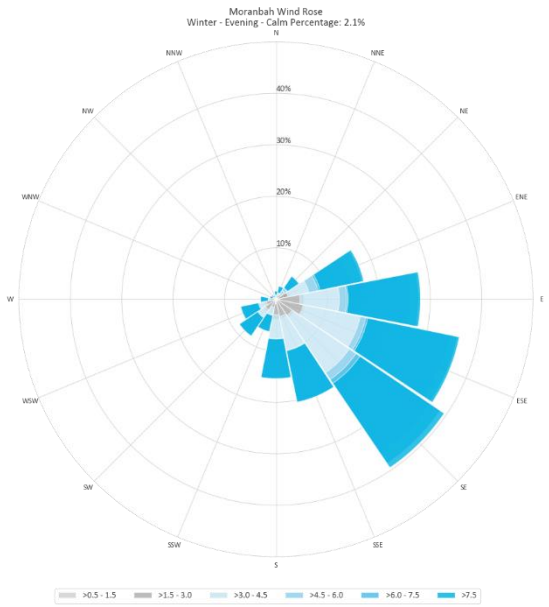

Moranbah Wind Rose
Spring - Night - Calm Percentage: 4.8%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

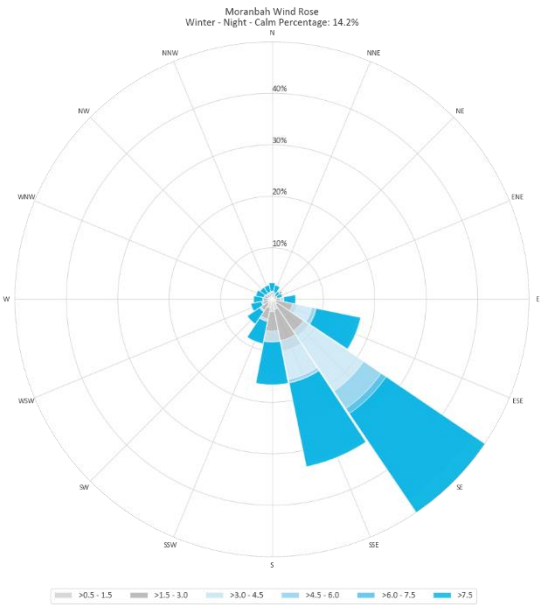

Moranbah Wind Rose
Summer - Day - Calm Percentage: 0.2%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5


Moranbah Wind Rose
Summer - Evening - Calm Percentage: 0.4%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5


Moranbah Wind Rose
Summer - Night - Calm Percentage: 2.1%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5


Moranbah Wind Rose
Winter - Day - Calm Percentage: 2.6%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5


Moranbah Wind Rose
Winter - Evening - Calm Percentage: 2.1%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5


Moranbah Wind Rose
Winter - Night - Calm Percentage: 14.2%
N
NNW
NNE
NW
NE
WNW
ENE
W
E
WSW
ESE
SW
SE
SSW
SSE
S
40%
30%
20%
10%
>0.5 - 1.5
>1.5 - 3.0
>3.0 - 4.5
>4.5 - 6.0
>6.0 - 7.5
>7.5

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