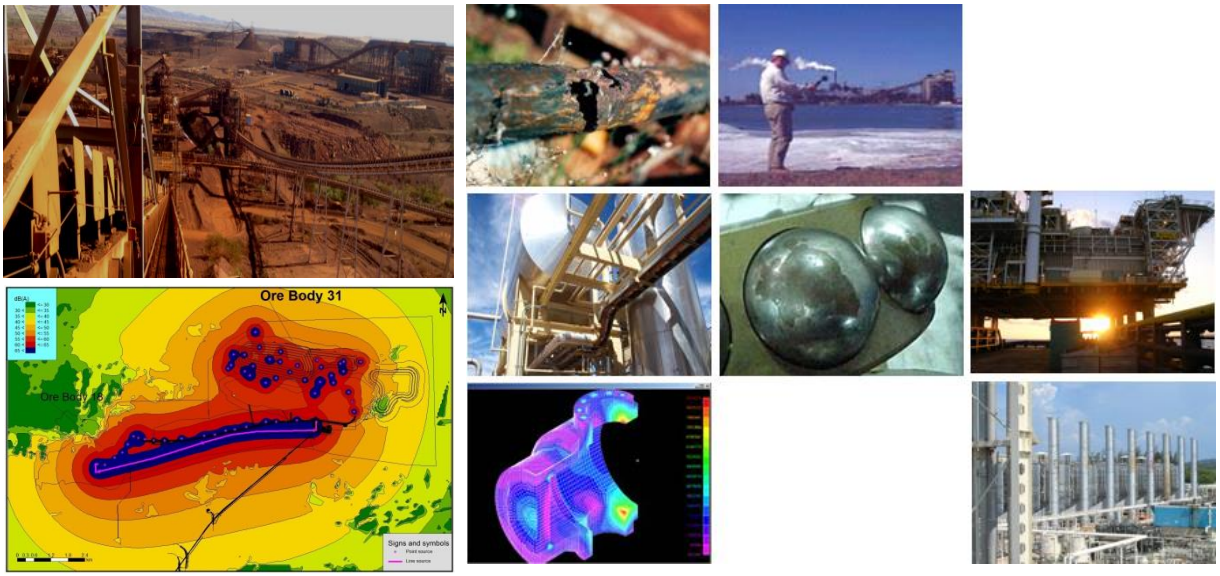
SVT ENGINEERING CONSULTANTS

ENVIRONMENTAL NOISE ASSESSMENT: ORE BODY 31



BHP BILLITON IRON ORE

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EXECUTIVE SUMMARY

SVT have been engaged by BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) to undertake an environmental noise impact assessment of the proposed Ore Body 31 (OB31) development.

The aim of this environmental noise assessment was to determine the noise impacts of OB31 operations at the nearest noise sensitive receivers when operating at a maximum output of 15 Million tonnes per annum (Mtpa).

Noise Sensitive Receivers

The nearest noise sensitive receivers are:

- The Eastern Pilbara Accommodation village, located approximately 16 km west of OB31.
- The Township of Newman, located approximately 40 km west of OB31.

Noise Objectives

The objectives of the noise assessment were to:

- develop a noise model for each of the four development scenarios at OB31;
- quantify the received noise levels at the Eastern Pilbara Accommodation Village and at the Township of Newman for each scenario; and
- assess the noise impacts against the *Environmental Protection (Noise) Regulations 1997* for the receivers listed above.

The assigned noise levels applicable to this assessment are summarised in Table E 1. Detailed information regarding the Regulations are presented in section 3 and Appendix A.

Table E 1 Noise criteria used for this assessment (night-time L_{A10})

Receiver	Noise Criteria, L_{A10} in dB(A)
Eastern Pilbara Accommodation Village	35
Newman	30

As can be seen in Table E1, the noise criteria is different for the sensitive receivers assessed. This is because the regulations require that for OB31 operations to be considered a 'non-significant' contributor to noise levels in the Town of Newman, the received noise level must be 5dB less than the assigned noise levels of 35dB(A). Therefore, the applicable noise criteria used for Newman is **30 dB(A).**

The Regulations are not applicable to the Eastern Pilbara Accommodation Village[1]. Therefore, in accordance with EPA Guidance Note 8, the assigned noise levels have been considered a 'noise

[1] As discussed in section 3.2, the Noise Regulations are not applicable at the East Pilbara Accommodation Village because it is within the boundary of the mining premises.

target' only. Therefore, the 'non-significant' contributor penalty is not applicable and the appropriate noise criteria for the Eastern Pilbara Accommodation Village is **35 dB(A).**

Noise Modelling

A SoundPlan noise model has been developed for the OB31 operations and has been used to predict noise levels at the Eastern Pilbara Accommodation Village and at the Township of Newman.

The model has been setup to provide conservative noise predictions, by applying worst case weather conditions (see section 5.3.1) and worst case operational conditions (i.e. all noise sources assumed to be operating simultaneously) for all modelled scenarios.

A noise model has been setup for each of the following proposed operating scenarios:

Scenario 1: 15 Mtpa hauled via road from OB31 to OB18 and crushed at OB18.

Scenario 2: 15 Mtpa crushed at OB31 and hauled via road from OB31 to OB18.

Scenario 3: 15 Mtpa transported via overland conveyor from OB31 to OB18 and crushed at OB18.

Scenario 4: 15 Mtpa crushed at OB31 and transported via an overland conveyor to OB18.

The noise results for each scenario have been used to assess the received noise levels against the relevant noise criteria (see section 6.2), and create noise contour maps for the surrounding area (see section 6.3).

Conclusions

Based on the noise modelling undertaken, the following has been concluded:

- Received noise levels at the Eastern Pilbara Accommodation Village are predicted to range from 15 dB(A) to 20 dB(A) and are therefore below the 35 dB(A) noise target[1].
- Received noise levels at the Newman Township are predicted to be below 10 dB(A) and are therefore compliant with the 30 dB(A) assigned noise level. The received noise levels predicted in Newman as a result of OB31 operations, are much lower than ambient noise in the town and therefore do not contribute to overall noise levels in Newman.
- At the noise levels predicted, the OB31 operations will not be audible in the Eastern Pilbara Accommodation Village or Newman Township.
- Blasting noise and vibration impacts are expected to be limited to within 1km from the blast (see section 7). As the OB31 nearest noise sensitive receivers are greater than 10km away, blasting noise and vibration levels are not expected to impact the Eastern Pilbara Accommodation and Newman above the limits outlined by the Environmental Protection (Noise) Regulations 1997 or Australian Standard AS2187.2 for vibration.

TABLE OF CONTENTS

1. INTRODUCTION

SVT have been engaged by BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) to undertake an environmental noise impact assessment of the proposed mining operations at Ore Body 31 (OB31).

The noise study will assess the noise impacts at the nearest noise sensitive receivers for various development scenarios for OB31. The nearest sensitive receivers are the Eastern Pilbara Accommodation Village which is located approximately 16 kilometres (km) west of OB31 and the Township of Newman which is located approximately 40 km west of OB31. The locations of these receivers are shown Figure 1-1.

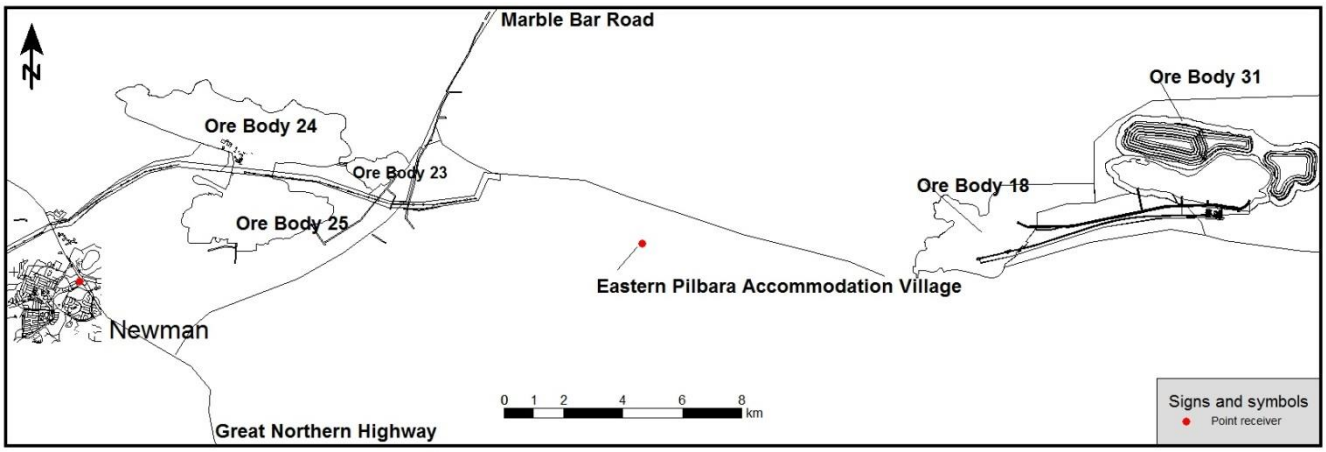


Figure 1-1 Relative locations of nearest receivers to Ore Body 31

The four scenarios which have been modelled and assessed are as follows;

Scenario 1: 15 Mtpa hauled via road from OB31 to OB18 and crushed at OB18.

Scenario 2: 15 Mtpa crushed at OB31 and hauled via road from OB31 to OB18.

Scenario 3: 15 Mtpa transported via overland conveyor from OB31 to OB18 and crushed at OB18.

Scenario 4: 15 Mtpa crushed at OB31 and transported via an overland conveyor to OB18.

The objectives of the noise assessment were to:

- develop a noise model for each of the four development scenarios at OB31;
- quantify the received noise levels at the Eastern Pilbara Accommodation Village and at the Township of Newman for each scenario; and
- assess the noise impacts against the *Environmental Protection (Noise) Regulations 1997*[2].

[2] The Environmental Protection (Noise) Regulations 1997 are not applicable at the Eastern Pilbara Accommodation Village because the village is located on the same lease/premises as the mine site. Therefore, the camp is considered as "residences attached to or forming part of" a mine outlined in *Part A, Schedule 1 of the Environmental Protection (Noise) Regulations 1997* and therefore excluded from the Regulations. The Regulations have been used for comparison only and the considered aspirational noise targets at the Eastern Pilbara Accommodation Village (see section 3.2 for details).

1.1 Scope

The scope of this document is as follows;

1. **Legislation -** An overview of the environmental noise legislation is provided in Section 3 and Appendix A**.**

2. **Noise model** – An environmental noise model was developed for the proposed development of OB31. The model was setup to predict worst-case noise levels for the four possible operating scenarios (see Section 3).

3. **Modelling Results** – The received noise levels were determined for the Eastern Pilbara Accommodation Village and the Township of Newman for the 4 operating scenarios (see Section 6). The modelling results were then assessed against the assigned noise levels defined in the *Environmental Protection (Noise) Regulations 1997*.

2. REFERENCED DODUMENTS

1. *Environmental Protection (Noise) Regulations 1997*.
2. Environmental Protection Authority Guidance No.8 – Environmental Noise May 2007.
3. Australian Standard 2187.2 Explosives – Storage and Use.
4. *Environmental Protection Act 1986*.

3. SUMMARY OF LEGISLATION

The following sections present an overview of environmental noise regulations in Western Australia (section 3.1) and the application of these regulations at the Eastern Pilbara Accommodation Village (section 3.2) and Newman township.

3.1 Environmental Protection (Noise) Regulations 1997

Noise management in Western Australia is implemented through the Environmental Protection (Noise) Regulations 1997 [1] (the Regulations) which operates under the *Environmental Protection Act 1986* (EP Act). The Regulations specify noise levels (assigned levels), which are the maximum acceptable levels that can be received at noise-sensitive, commercial and industrial premises.

Assigned noise levels have been set differently for noise sensitive premises, commercial premises, and industrial premises. For noise sensitive premises, i.e. residences, an "influencing factor" is incorporated into the assigned noise levels. The influencing factor depends on land use zonings within circles of 100 metres (m) and 450 m radius from the noise receiver.

The regulations define three types of assigned noise level:

- L_{Amax} assigned noise level means a noise level which is not to be exceeded at any time;
- L_{A1} assigned noise level which is not to be exceeded for more than 1% of the time; and
- L_{A10} assigned noise level which is not to be exceeded for more than 10% of the time.

The L_{A10} noise limit is the most applicable noise parameter for this study because this is representative of continuous noise emissions from a facility (i.e. OB31 mining operations).

Table 3-1 shows the assigned noise levels for noise sensitive premises. As can be seen from the table, the time of day also affects the assigned levels for noise sensitive premises. As OB31 will operate at all times of day, the most stringent night-time noise level has been used for this assessment.

A detailed overview of these regulations is presented in Appendix A.

3.1.1 Assigned Noise Levels

Table 3-1 presents the L_{A10} assigned noise levels for noise sensitive premises, as defined by the Regulations. The night-time L_{A10} noise level of 35 dB(A) is applicable to this assessment.

Table 3-1 Assigned noise levels

Time of day	Assigned Noise Level, L_{A10} [3]
0700 to 1900 hours Monday to Saturday	45
0900 to 1900 hours Sundays and public holidays	40
1900 to 2200 hours all days	40
2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	**35**

[3] L_{Ax} refers to the A-weighted noise level that is exceeded for x% of the time. See Appendix A for examples.

Clause 7.1 of the regulations also state that '*new noise sources must not cause, or significantly contribute to, a level of noise which exceeds the assigned level*'.

Clause 7.2 defines 'significantly contribute' to be '*a level of noise if the noise emission as determined under subregulation (3) exceeds a value which is 5 dB below the assigned level at the point of reception'*.

As there are other noise sources in the area, particularly around the township of Newman that are not part of the OB31 development, it is assumed that any additional noise may result in an exceedence of the assigned levels. Therefore, the applicable assigned noise levels in Newman due to the OB31 development operating in-isolation (i.e. without other Newman mining operations) are 5 dB less than those shown in Table 3-1. As the development will be a 24/7 operation the most applicable criteria is **30 dB(A),** which has been used for this assessment**.**

3.2 Application of Environmental Noise Regulations at the Eastern Pilbara Accommodation Village

The EP Act and Environmental Protection (Noise) Regulations 1997 criteria are not applicable to the Eastern Pilbara Accommodation Village because the accommodation village is located within the boundary of the mining premises, and the legislative noise limits are intended to protect sensitive receptors beyond the boundary of premises.

However, EPA Guidance for the Assessment of Environmental Factors Environmental Noise, Draft No.8 [2] states that camps for operation staff should be located and designed so as to achieve compliance with the assigned noise levels and acceptable standards.

Therefore, the assigned noise levels listed in Table 2-1 have been used in this noise impact assessment for the Eastern Pilbara Accommodation Village. The night-time noise level has been used because it is the most stringent of the assigned noise levels, and the 'non-significant' contributor penalty is not applicable.

BHP Billiton Iron Ore recognises the importance of maintaining appropriate environmental standards, and will investigate noise control options that will ensure that environmental objectives described in the EPA Guidance are met.

4. BACKGROUND

OB31 is located approximately 40 km east of Newman Township in the Pilbara region of Western Australia (Figure 1-1). OB31 is situated to the east of the existing Ore Body 17/18 (OB17/18) mine within Mineral Lease ML244SA, which is subject to the Iron Ore (Mount Newman) Agreement Act 1964 (Newman Agreement Act). OB31 has not previously been developed and as such is considered a Greenfield development.

BHP Billiton Iron Ore currently operates a number of iron ore mines and associated rail and port infrastructure within the Pilbara region of Western Australia. Current mining operations in proximity to OB31 include;

- Newman Joint Venture hub, located approximately two km west of Newman Township, which consists of Mount Whaleback and Ore bodies 29, 30 and 35;
- OB17/18 Mine, located approximately 30 km east of Newman Township;
- Wheelarra Hill (Jimblebar) Mine, located approximately 40 km east of Newman Township and five to 10 km south of OB31; and
- Orebodies 23, 24 and 25, located approximately eight km northeast of Newman Township.

The closest operations to OB31 are the OB17/18 Mine and Wheelarra Hill (Jimblebar) Mine as shown in Figure 4-1.

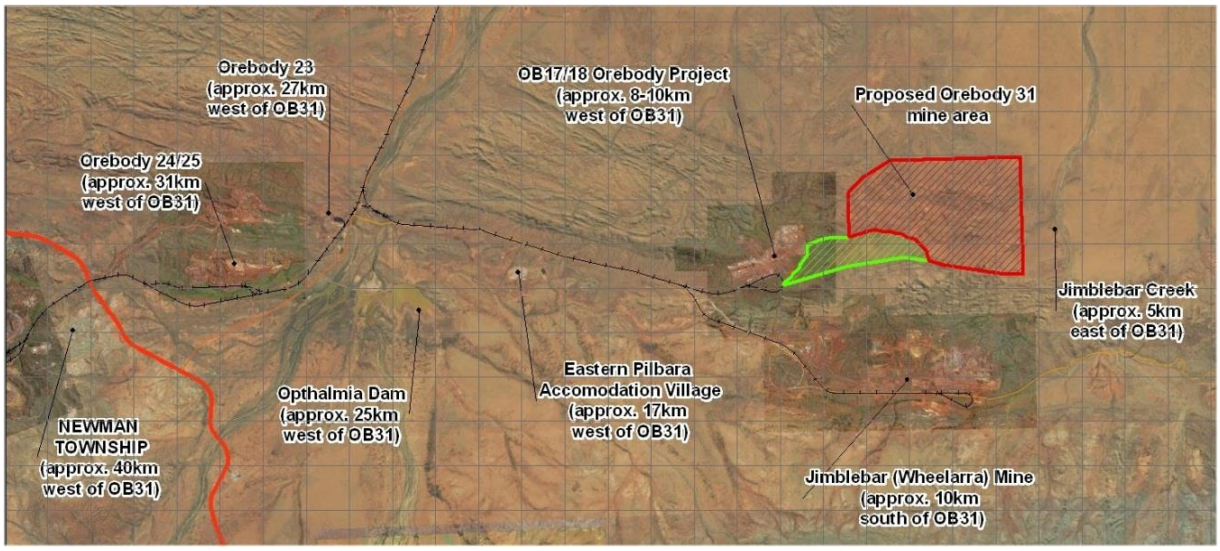


Figure 4-1 Location of Ore Body 31 relative to other operations

The proposed output for OB31 operations is 15 mtpa, which will be processed at OB31 and/or OB18, and transported via rail to the Port Hedland port facility. The OB31 operations are expected to achieve the 15 mtpa peak output capacity by the mining year 2020.

5. MODELLING

A noise model has been developed for the OB31 development in order to determine received levels at the Eastern Pilbara Accommodation Village and the Township of Newman, as well as determine if OB31 could cause or significantly contribute to a noise exceedence in Newman. The following sections present an overview of the model and detailed information on the inputs for the various OB31 development scenarios.

5.1 Noise Modelling Software

An acoustic model has been developed using SoundPlan noise modelling program developed by SoundPlan LLC. SoundPlan software calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. The inputs required are noise source data, ground topographical data, meteorological data and noise sensitive receiver locations.

For more detailed information about the SoundPlan noise modelling software, refer to Appendix B.

5.2 Model Method

The noise model have been developed and configured for the operating scenarios listed below. The model has been used to generate noise contours and predict noise levels at the Eastern Pilbara Accommodation Village and at the Township of Newman.

Scenario 1: 15 Mtpa hauled via road from OB31 to OB18 and crushed at OB18.

Scenario 2: 15 Mtpa crushed at OB31 and hauled via road from OB31 to OB18.

Scenario 3: 15 Mtpa transported via overland conveyor from OB31 to OB18 and crushed at OB18.

Scenario 4: 15 Mtpa crushed at OB31 and transported via an overland conveyor to OB18.

The quantity of transported ore for each scenario is 15 Mtpa. This is the maximum planned output from OB31 and will occur in the years 2020, 2021, 2022 and 2025. Of these four years 2022 was selected as being the worst case, as the mine plan[4] indicates the highest number of operating plant for that year.

5.3 Model Inputs

5.3.1 Weather Conditions

The CONCAWE algorithm has been used to predict the noise levels at the sensitive receivers. Meteorological conditions assigned to the model are in accordance with the Environmental Protection Authority's (EPA's) recommendations for worst-case weather conditions outlined in "Guidance for the Assessment of Environmental Factors, Draft No.8, May 2007" [2] which for night-time are as presented in Table 5-1.

[4] OB31 Ancilliary.xlsm

Table 5-1 Worst-case meteorological conditions applied to the model

Parameter	Value in model
Wind speed	3m/s
Wind direction	worst case toward receiver
Humidity	50%
Temperature	15°C
Pasquil stability class	F

5.3.2 Topography and Ground Types

Topographical information for the noise model was provided by BHP Billiton Iron Ore in shape file format files which were imported into the noise model to create a digital ground map.

Ground absorption for hard and soft surfaces is as specified by the CONCAWE[5] propagation algorithm. CONCAWE is a conservative algorithm which is accepted by the Department of Environment Regulation (DER). The ground absorption used for the OB31 modelling was hard compact gravel (ground factor=0.6).

5.3.3 Noise Receiver Locations

The noise model has been used to predict received noise levels at two noise sensitive locations, listed in Table 5-2.

Table 5-2 Receivers used in the model

Receiver	GPS Coordinates (MGA 94)[6]
Eastern Pilbara Accommodation Village	(51)186371m E, 7416175m S
Township of Newman	(51)167422m E, 7414902m S

5.3.4 Noise Sources

Sound Power Levels (SWLs) of the proposed mobile and stationary equipment was entered into the noise model (see Table 5-3). The SWLs used in the model were noise measurements taken from SVT's database of similar mining equipment, primarily from those measured at other operating BHP Billiton Iron Ore sites.

[5] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry. The outcome was an empirical algorithm which predicts noise levels at receiving locations.

[6] OB31 and Newman fall under different zones according to the MGA94 coordinate system (Newman is in zone 50 whereas OB31 is in zone 51). In order to have a continuous coordinate system all points falling in zone (50) were converted to equivalent zone 51 coordinates for this modelling.

A summary of the equipment types and SWLs used in the model are presented in Table 5-3.

Table 5-3 *Sound power levels used for the plant and mobile equipment (source: SVT)*

Equipment Type[7]	Octave Band Sound power Levels (dB(A))									Overall dB(A)
	31	63	125	250	500	1000	2000	4000	8000	
Mobile Equipment										
Haul Truck	77.3	89.7	106.5	103.5	105.9	106.9	107.6	99.8	92.2	113.5
Shovel	67.7	88.5	100.4	104.5	107.8	107.2	104.9	97.7	87.2	112.8
Front End Loader	64.7	79.2	97.7	95.3	103.3	105.3	104.0	98.7	91.5	109.9
Track Dozer (CAT D10)	71.4	85.4	98.1	104.4	109.5	109.2	105.7	96.3	85.1	114.0
Wheel Dozer (CAT 854)	63.6	83.3	100.6	101.4	109.1	114.6	109.3	104.7	99.7	117.1
Wheel Dozer (CAT 834)	60.5	82.0	99.0	102.9	105.5	109.1	105.8	100.6	93.6	112.9
IT62 Stemming Loader	60.5	82.0	99.0	102.9	105.5	109.1	105.8	100.6	93.6	112.9
Grader (CAT 16)	59.8	76.5	92.2	93.9	102.5	106.7	105.4	100.8	92.4	110.7
Water Cart (785DWC)	64.3	87.7	95.3	101.9	102.4	101.9	99.7	91.4	89.3	108.1
Service Truck (3900GLT)	67.7	77.5	97.8	102.8	107.3	105.6	103.1	99.5	89.3	111.6
Omega 8.5 Forklift	55.6	63.8	74.9	81.4	91.8	91.0	90.2	86.0	78.9	96.5
Low Loader Float (784)	63.6	83.3	100.6	101.4	109.1	114.6	109.3	104.7	99.7	117.1
Atlas Copco PV271	68.1	83.6	108.2	110.4	114.3	111.3	110.7	105.9	96.1	118.7
Atlas Copco ROC-L8	68.1	83.6	108.2	110.4	114.3	111.3	110.7	105.9	96.1	118.7
Fixed Plant										
Primary Crusher	79.2	91.2	103.9	114.4	115.8	113.0	113.2	107.0	99.9	120.6
Overland Conveyor[8]	49.2	65.5	79.6	86.4	89.9	89.4	87.5	79.4	70.2	94.8
Transfer Station	63.6	81.8	90.9	96.4	106.8	107	102.2	95.7	86.7	111.0
Conveyor Drives (630)kw	65.6	81.8	89.9	98.4	106.8	103	100.6	91.2	80.9	109.5
Conveyor Drives (1250)kw	63.6	80.8	91.9	100.4	106.8	106	108.2	91.1	81	112.2

[7] Where the specific equipment item was not in SVT's noise data base the nearest equivalent item was used. Whenever there was uncertainty the SWL from the larger item of plant (i.e. conservative estimates) were used.

[8] The SWL values quoted for conveyors are per metre. As conveyors are line sources, their overall SWL increases with length. Some conveyors are a few km long and therefore their overall SWL in the model is up to 40 dB higher than the values indicated here.

The noise model includes fixed plant and mobile equipment (i.e. haul trucks, heavy surface mobile equipment and ancillary equipment). The number of mobile equipment noise sources entered into the model for each scenario was taken from the current mine plan for the year 2022 provided by BHP Billiton Iron Ore[9]. The mining equipment (listed in Table 5-4) was distributed over the proposed OB31 mining area with trucks graders and water carts extending to OB18. The acoustic centre of the mobile sources were assumed to be 2m above local ground level.

All noise sources were assumed to be running simultaneously in the model, under worst case meteorological conditions, which represents worst case operating condition.

Table 5-4 Summary of equipment numbers for each scenario entered into the model

Equipment Type	Scenarios			
	1	2	3	4
Mobile Equipment				
Haul Truck	18	18	18	18
Shovel	3	3	3	3
Front End Loader)	1	1	1	1
Track Dozer (CAT D10)	5	5	5	5
Wheel Dozer (CAT 854)	2	2	2	2
Wheel Dozer (CAT 834)	2	2	2	2
IT62 Stemming Loader	3	3	3	3
Grader (CAT 16)	2	2	2	2
Water Cart (785DWC)	3	3	3	3
Service Truck (3900GLT)	1	1	1	1
Omega 8.5 Forklift	1	1	1	1
Low Loader Float (784)	1	1	1	1
Atlas Copco PV271	3	3	3	3
Atlas Copco ROC-L8	4	4	4	4
Fixed Plant				
Primary Crusher	0	1	0	1
Overland Conveyor	0	0	1	1
Transfer Station	0	0	2	2
Conveyor Drives (630)kw	0	0	2	2

[9] OB31 Ancilliary.xlsm. The mine plan equipment numbers are summarised for each scenario in Table 4-4.

Equipment Type	Scenarios			
	1	2	3	4
Conveyor Drives (1250)kw	0	0	6	6

5.4 Model Assumptions

The following assumptions were made for this noise modelling;

- Mobile equipment numbers were entered into the model according to mine plan received from BHP Billiton Iron Ore. The worst case (i.e. most equipment) mining year of 2022 was modelled.
- Worst case meteorological conditions were applied to all model scenarios (see section 5.3.1 for details on the metrological conditions applied to the model).
- All noise sources have been placed above original ground level, including mobile equipment sources which would operate within a pit. This represents worst case as the pit face would offer noise shielding.
- Conveyor noise source levels were applied from measurements of similar overland conveyors at other BHP Billiton Iron Ore inland sites.
- It is assumed that overland conveyor would require 6 x 1250kW drives.
- It is assumed a short feed conveyor is located at each end of the overland conveyor. These feed conveyors each include a 630kW drive and a transfer station.
- For scenarios 3 and 4 which include an overland conveyor, it is assumed that there will be no reduction in the number of trucks operating.
- Rail noise was excluded from the model.

The assumptions listed above, and well as the application of worst case weather and operational conditions, ensure that the OB31 noise model is conservative.

6. NOISE MODELLING RESULTS

6.1 Point Receiver Results

Table 6-1 presents the predicted L_{A10} received noise levels at the nearest noise sensitive receivers for each scenario under worst case weather conditions.

Table 6-1 Noise modelling results for night-time under worst case weather conditions

Receivers	Noise Model Results - L_{A10} received noise levels			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Eastern Pilbara Accommodation	15.4	15.5	19.6	19.7
Newman East	6.2	6.3	9.1	9.2

6.2 Comparison against the Environmental Noise Regulations

As can be seen in Table 6-1, the predicted noise levels at both the Eastern Pilbara Accommodation Camp and at the Township of Newman are below the night-time criteria of 30 dB(A) and 35 dB(A) respectively, as described in section 3.1.1.

6.3 Noise Contours

Noise contour maps of the predicted noise impacts are presented in Appendix C.

7. BLASTING NOISE AND VIBRATION ASSESSMENT

Blasting is a common mining activity that results in high noise and vibration levels. The following sections present blasting noise and vibration limits and a summary of the expected impact of blasting at OB31 on the noise sensitive receivers at the Eastern Pilbara Accommodation and Newman.

7.1 Blasting Criteria

7.1.1 Blasting Noise Limits

Blast noise limits as defined in the Environmental Protection (Noise) Regulations 1997 are presented in Table 7-1.

Table 7-1: Blast Noise Limits

Time Period	Noise Limit $L_{linear, peak}$ dB	Condition
Daytime (7 am to 6 pm) except Sundays or public holidays	125	Applies to any blast
Daytime (7 am to 6 pm) except Sundays or public holidays	120	Applies to 9 in any 10 consecutive blasts
Sundays & Public Holidays (7 am to 6 pm)	120	Applies to any blast
Sundays & Public Holidays (7 am to 6 pm)	115	Applies to 9 in any 10 consecutive blasts
6 pm to 7 am on any day	90	Applies to any blast

7.1.2 Blasting Vibration Limits

EPA Guidance Note No.8 states "Predictions of ground vibration levels should be carried out for the nearest adjacent premises for a typical blast of the size proposed, using Appendix J7 of Australian Standard AS 2187.2-2006[10]".

The accepted vibration parameter for blasting is the ground borne particle velocity at the receiver (in mm/s). The vibration levels, as defined for single story residential buildings in Appendix J of AS 2187.2, are listed in Table 7-2.

Table 7-2 Recommended maximum peak particle velocity

Type of Building Structure	Peak Particle Velocity (mm/s)
Houses and low-rise residential buildings and commercial buildings	10

[10] Appendix J of AS 2187.2-2006: Explosives - Storage Transport and Use (Standards Australia, 1993) states "that 'conventional' blasting at 'normal' distances is unlikely to create ground vibrations of a magnitude which causes damage".

7.2 Blasting Assessment

Blasting noise and vibration measurements have not been undertaken during the current assessment. However, based on previous blasting noise measurements[11] and the AS2187 empirical vibration formula[12], noise and vibration impacts from blasting are expected to be limited to within 1km from the blast.

As the nearest noise sensitive receivers to OB31 are greater than 10km away, blasting noise and vibration levels are not expected to impact the receivers at Eastern Pilbara Accommodation and Newman above the limits listed in Table 7-1 and Table 7-2 respectively.

[11] Blasting Noise Assessment (Jimblebar 2009).

[12] AS 2187.2-2006 empirical formula for predicting ground borne vibration levels.

8. CONCLUSIONS

Based on the noise modelling results for the 4 operating scenarios at OB31, the following has been concluded:

- Received noise levels at the Eastern Pilbara Accommodation Village are predicted to be less than 20 dB(A) for all scenarios analysed and therefore comply with the noise regulations [1] (i.e. 'noise target').

- Received noise levels at the Township of Newman are predicted to be below 10 dB(A) and therefore also comply with the noise regulations [1]. The received noise levels predicted in Newman as a result of OB31 operations, are much lower than ambient noise in the town and therefore do not contribute to overall noise levels in Newman.

- At the noise levels predicted, the OB31 operations will not be audible in the Eastern Pilbara Accommodation Village or Newman Township.

- Blasting noise and vibration impacts are expected to be limited to within 1km from the blast. As the OB31 nearest noise sensitive receivers are greater than 10km away, blasting noise and vibration levels are not expected to impact the Eastern Pilbara Accommodation and Newman above the limits outlined by the Environmental Protection (Noise) Regulations 1997 or Australian Standard AS2187.2 for vibration.

APPENDIX A NOISE LEGISLATION

Noise management in Western Australia is implemented through the Environmental Protection (Noise) Regulations 1997 which operate under the *Environmental Protection Act 1986*. The Regulations specify maximum noise levels (assigned levels), which are the highest noise levels that can be received at noise sensitive premises, commercial premises and industrial premises.

Assigned noise levels have been set differently for the different types of premises. For noise sensitive premises, i.e. residences, an 'influencing factor' is incorporated into the assigned noise levels.

The regulations define three types of assigned noise level:

- L_{Amax} assigned noise level means a noise level which is not to be exceeded at any time;
- L_{A1} assigned noise level which is not to be exceeded for more than 1% of the time; and
- L_{A10} assigned noise level which is not to be exceeded for more than 10% of the time.

The L_{A10} noise limit is the most significant for this study since this is representative of continuous noise emissions from the facility. Table A 1 shows the assigned noise levels for noise sensitive premises. As can be seen from the table the time of day also affects the assigned levels for noise sensitive residences.

Table A 1 Assigned noise levels for noise sensitive premises[13]

Type of premises receiving noise	Time of day	Assigned level dB(A)		
		L_{A10}	L_{A1}	L_{Amax}
Locations within 15 m of a building directly associated with a noise sensitive use.	0700 to 1900 hours Monday to Saturday	45+ influencing factor	55+ influencing factor	65+ influencing factor
	0900 to 1900 hours Sundays and public holidays	40+ influencing factor	50+ influencing factor	65+ influencing factor
	1900 to 2200 hours all days	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	35+ influencing factor	45+ influencing factor	55+ influencing factor
Locations further than 15 m from a building directly associated with a noise sensitive use.	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises	All hours	65	80	90

[13] *Environmental Protection (Noise) Regulations 1997*

Appendix A-1 Corrections for Characteristic of Noise

Noise levels at the receiver are subject to penalty corrections if the noise exhibits intrusive or dominant characteristics, i.e. if the noise is impulsive, tonal, or modulating. Table A-2 presents the penalties incurred for noise that exhibits intrusive or dominant characteristics (i.e. if it has tonal, modulating or impulsive characteristics).

Regulation 9 sets out objective tests to assess whether the noise is taken to be free of these characteristics. As there are large distances between OB31 and the noise sensitive receivers, and OB31 operations will not be audible above background ambient noise, no tonality penalty is applicable to the received noise levels.

Table A 2 Assigned penalties for intrusive or dominant noise characteristics[14]

Adjustment where noise emission is not music these adjustments are cumulative to a maximum of 15 dB		
Where tonality is present	**Where modulation is present**	**Where impulsiveness is present**
+5 dB	+5 dB	+10 dB

Appendix A-2 Assigned Noise Levels

The assigned noise levels, as outlined by the Regulations, are presented in Table A-3.

Table A-3 Assigned noise levels

Time of day	Assigned Noise Level in dB(A)
0700 to 1900 hours Monday to Saturday	45
0900 to 1900 hours Sundays and public holidays	40
1900 to 2200 hours all days	40
2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	**35**

Appendix A-3 Application of the Regulations at the Eastern Pilbara Accommodation Village

The Environmental Protection (Noise) Regulations are **not applicable** at the Eastern Pilbara Accommodation Village. As the Eastern Pilbara Accommodation Village forms part of the mining area lease/premises, the Eastern Pilbara Accommodation Village is excluded from the Noise Regulations.

[14] *Environmental Protection (Noise) Regulations 1997*

The Regulations, and more specifically the night-time assigned noise level of 35 dB(A) listed in Table 2-1, have been used in this noise impact assessment at the Eastern Pilbara Accommodation Village for comparison purposes only and defined as noise targets in the assessment.

APPENDIX B NOISE MODELLING

An acoustic model which calculates sound pressure levels at nominated receiver locations and produces noise contours over a defined area of interest around the noise sources has been developed using SoundPLAN 7.0. The software models sound propagation under atmospheric conditions accounting for different types of noise sources using several available algorithms which follow recommendations outlined in applicable standards. Conformance to standards and intensive validation routines has secured SoundPLAN its international recognition, including Australian territories and Western Australian EPA's approval (see EPA Guidance Note 8).

The inputs required for accurate SoundPLAN calculations are as follows: noise source data expressed in sound power levels, ground topographical data, meteorological conditions and receiver locations and characteristics (point or area receivers).

The CONCAWE algorithm for industrial noise simulation has been used to predict the sound levels at the sensitive receivers and its surroundings. Meteorological conditions assigned to the model are in accordance with EPA's recommendations for worst-case weather conditions outlined in *Guidance for the Assessment of Environmental Factors, Draft No.8, May 2007*:

- Day (07:00 - 19:00) wind speed – 4m/s; Pasquil Stability Class "E"; temperature - 20°C; and relative humidity – 50%.
- Night (19:00 - 07:00) wind speed – 3m/s; Pasquil Stability Class "F"; temperature - 15°C; and relative humidity – 50%.

The different meteorological conditions for day and night intervals include the refraction effects of sound waves during propagation in the parts of the atmosphere close to the ground. Refraction occurs as a result of a change in sound speed with elevation, and is affected by temperature inversions and wind speed gradients. Worst-case conditions usually occur during night time, when downward refraction bends the waves towards the ground increasing the noise levels at the receiver.

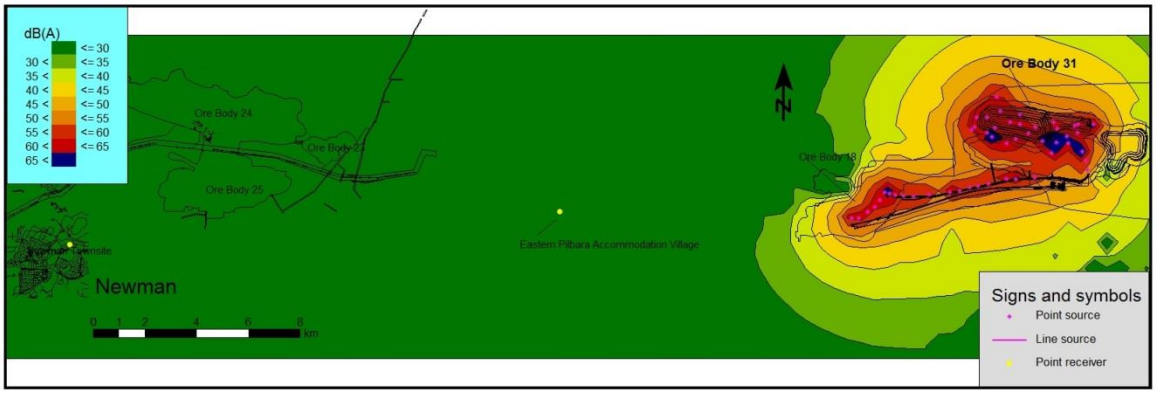
The model has been used to generate noise contours and predict noise levels at the Eastern Pilbara Accommodation Village and at the Township of Newman.

The acoustical model does not include noise emissions from any sources other than the proposed mining activities. Noise emissions from road traffic, animals and domestic sources are excluded from all modelling scenarios.

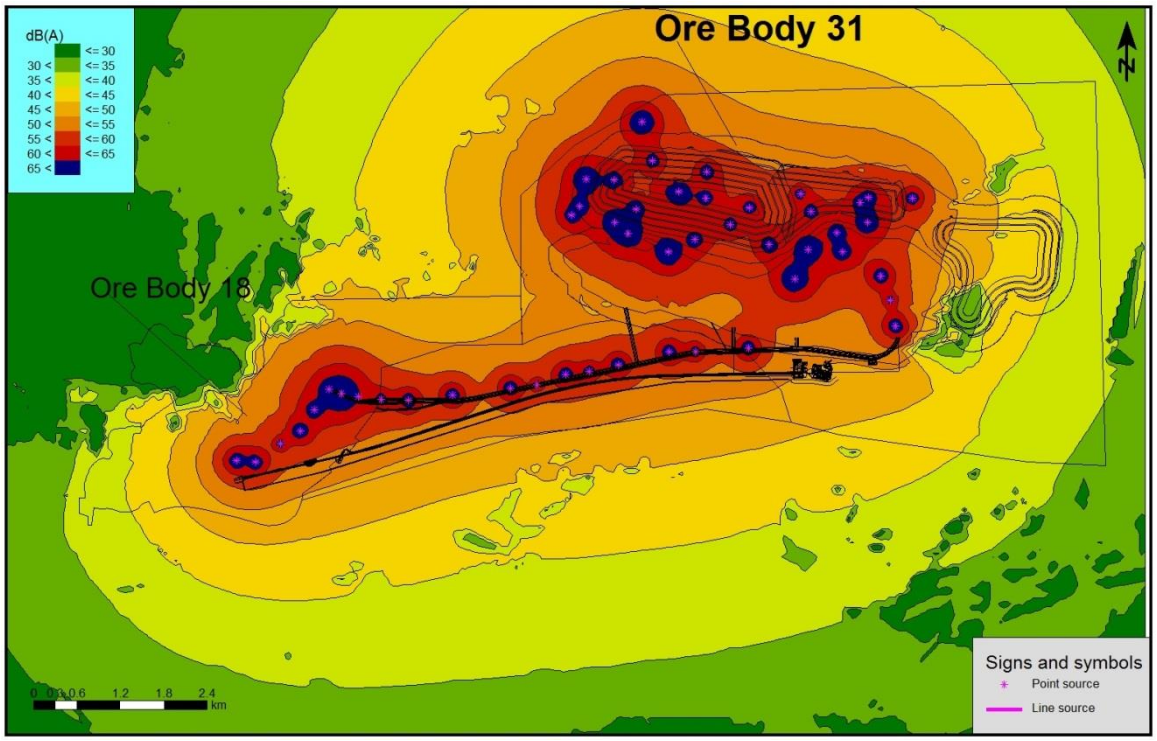
APPENDIX C GRID NOISE MAPS

Appendix C-1 Scenario 1

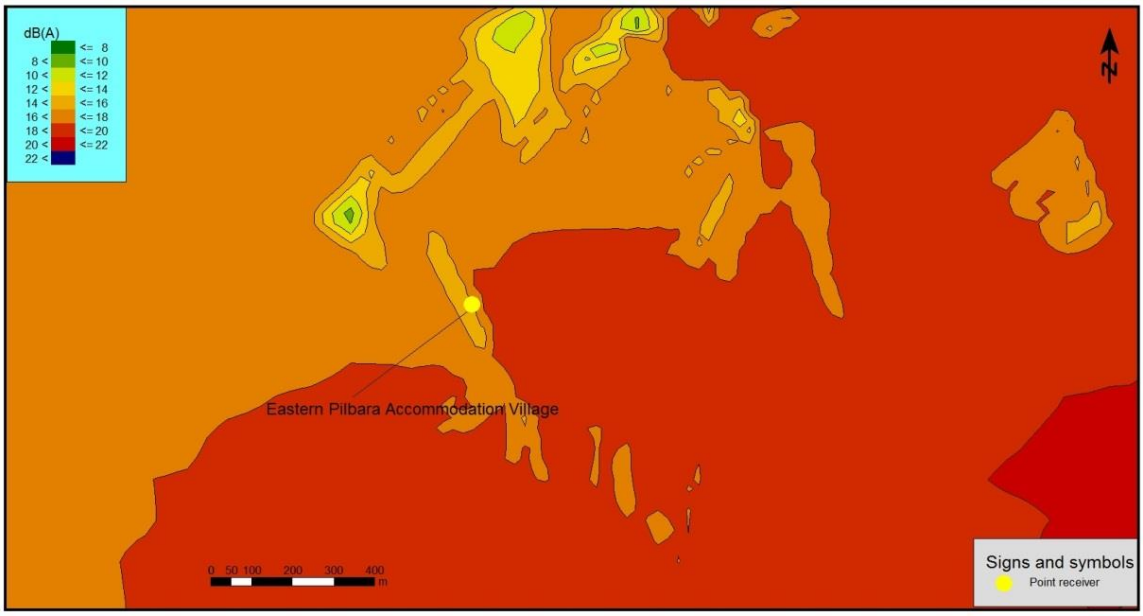
Appendix C-1.1 Scenario 1 – Model Overview



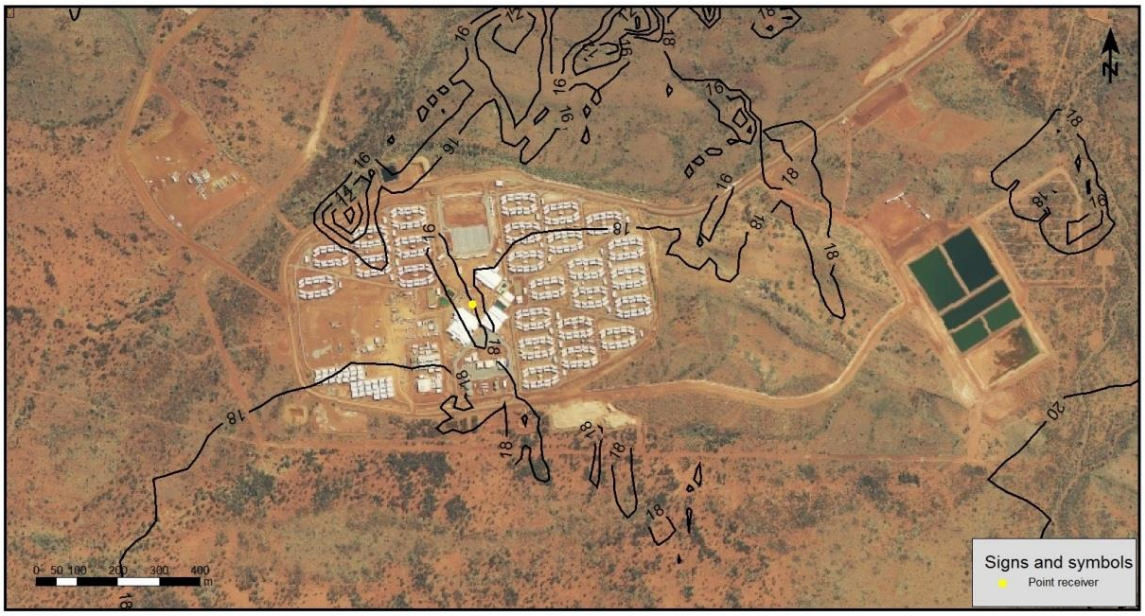
Appendix C-1.2 Scenario 1 – Plant



Appendix C-1.3 Scenario 1 – Eastern Pilbara Accommodation Camp



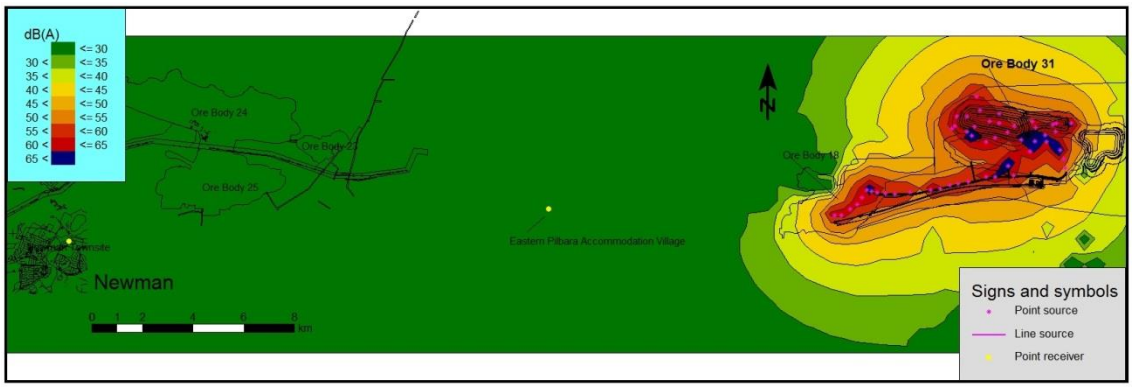
Appendix C-1.4 Scenario 1 – Eastern Pilbara Accommodation Camp - Noise Contours



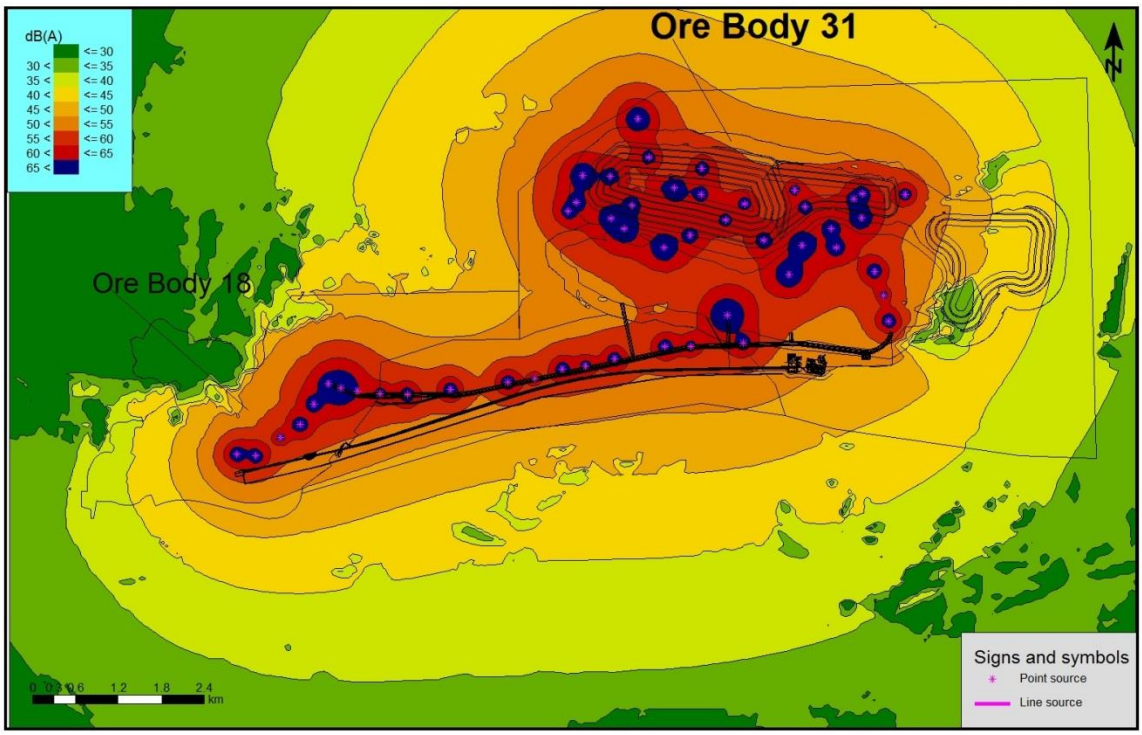
Appendix C-1.5 Scenario 1 – Newman

Appendix C-2 Scenario 2

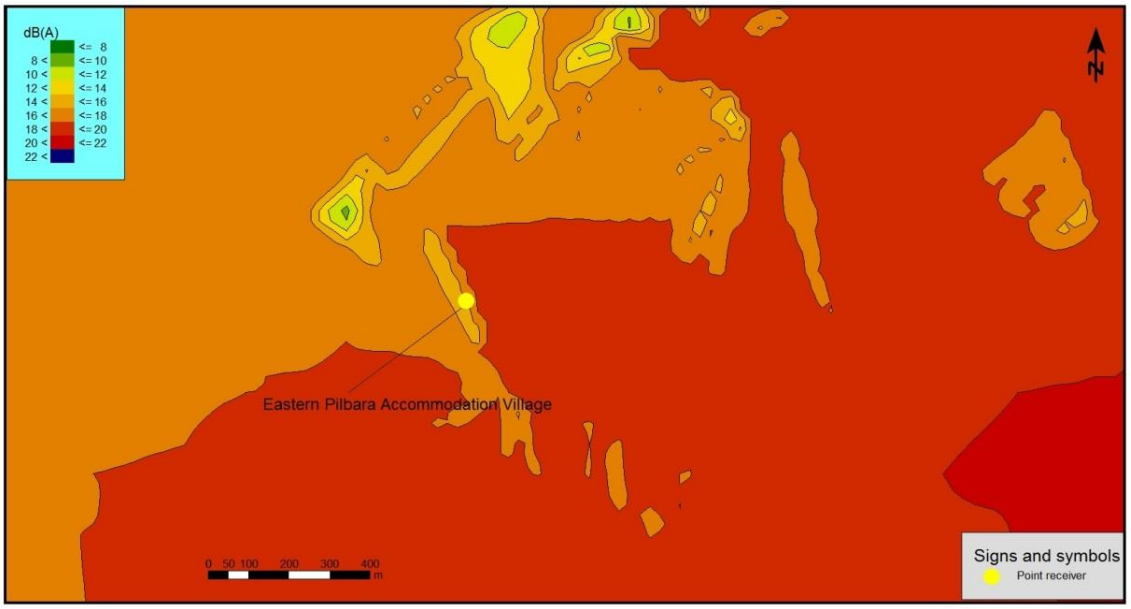
Appendix C-2.1 Scenario 2 – Model Overview



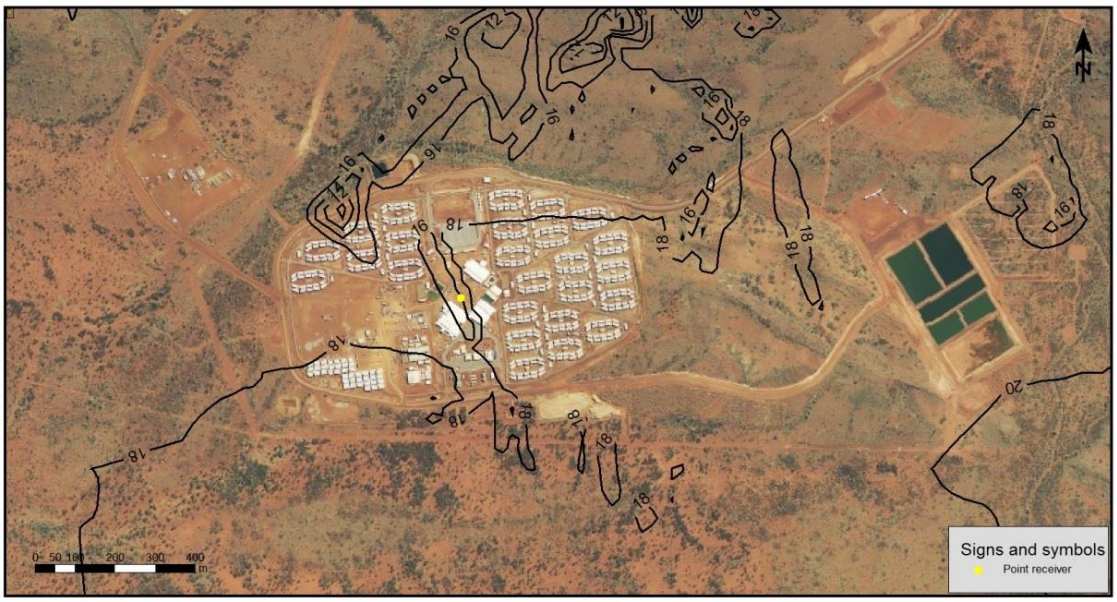
Appendix C-2.2 Scenario 2 - Plant



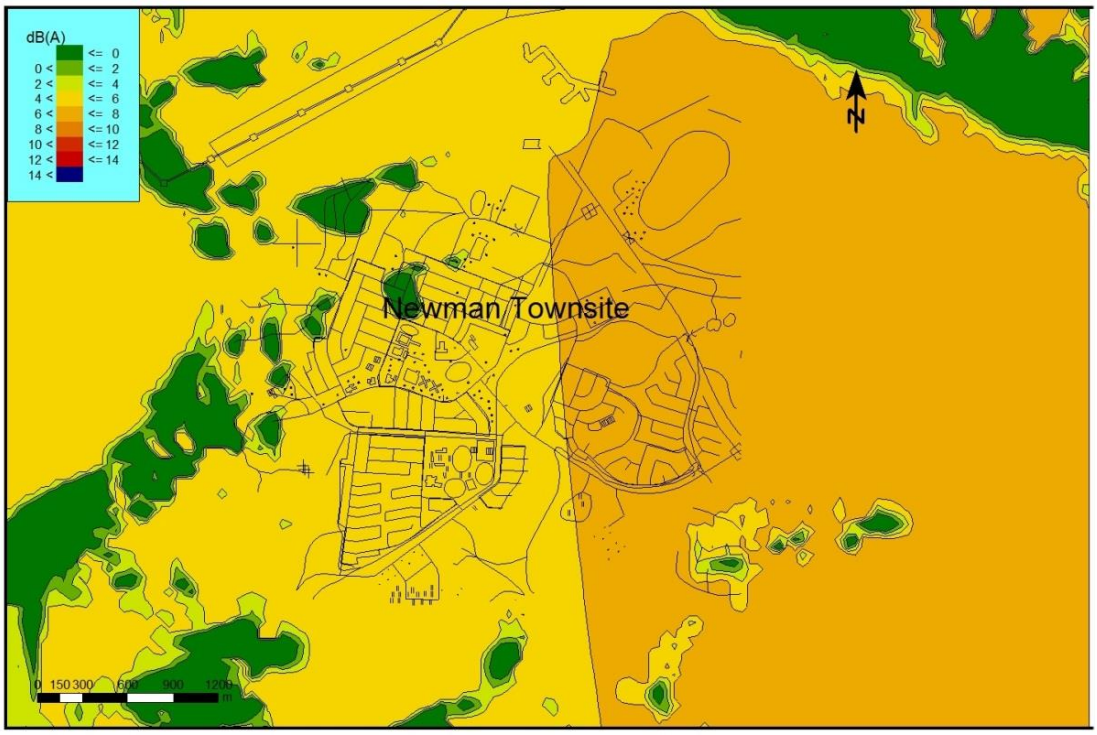
Appendix C-2.3 Scenario 2 - Eastern Pilbara Accommodation Camp



Appendix C-2.4 Scenario 2 - Eastern Pilbara Accommodation Camp - Noise Contours

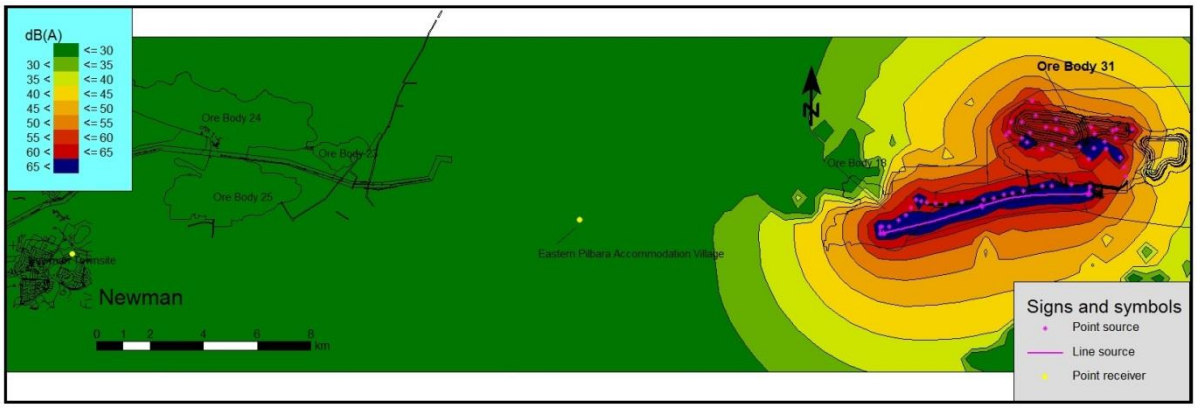


Appendix C-2.5 Scenario 2 - Newman

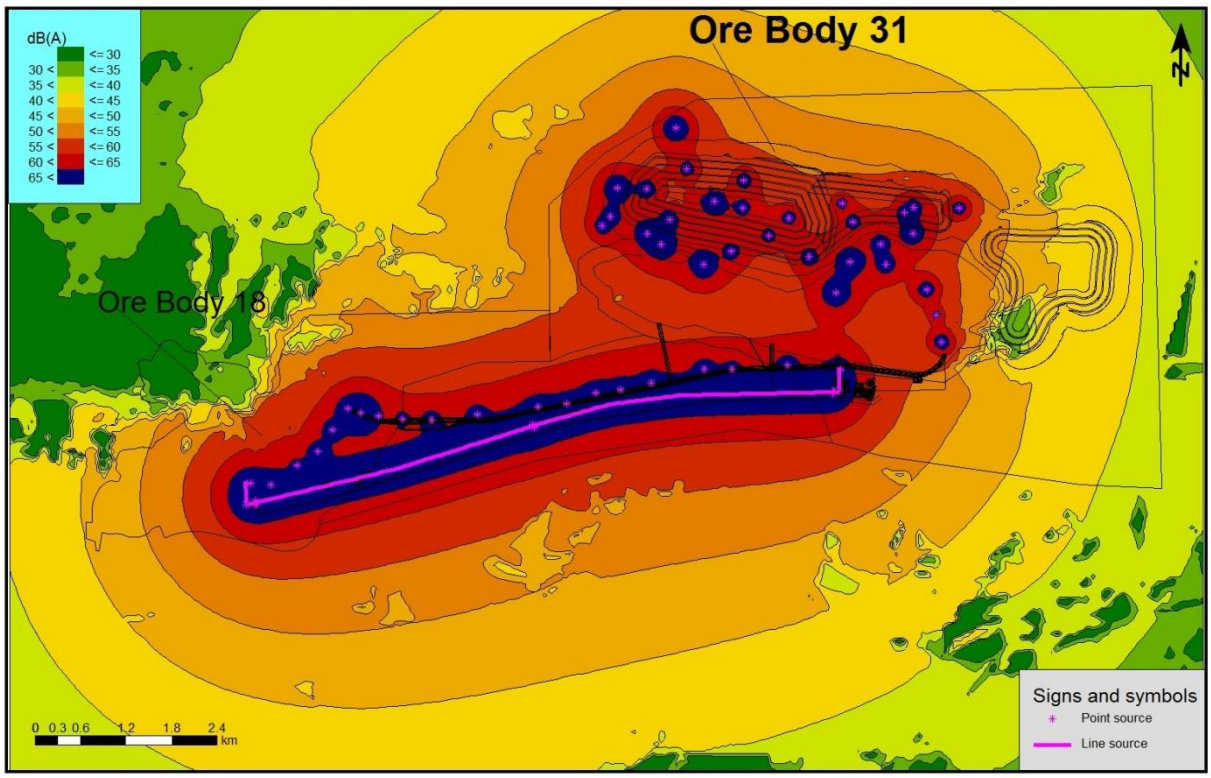


Appendix C-3 Scenario 3

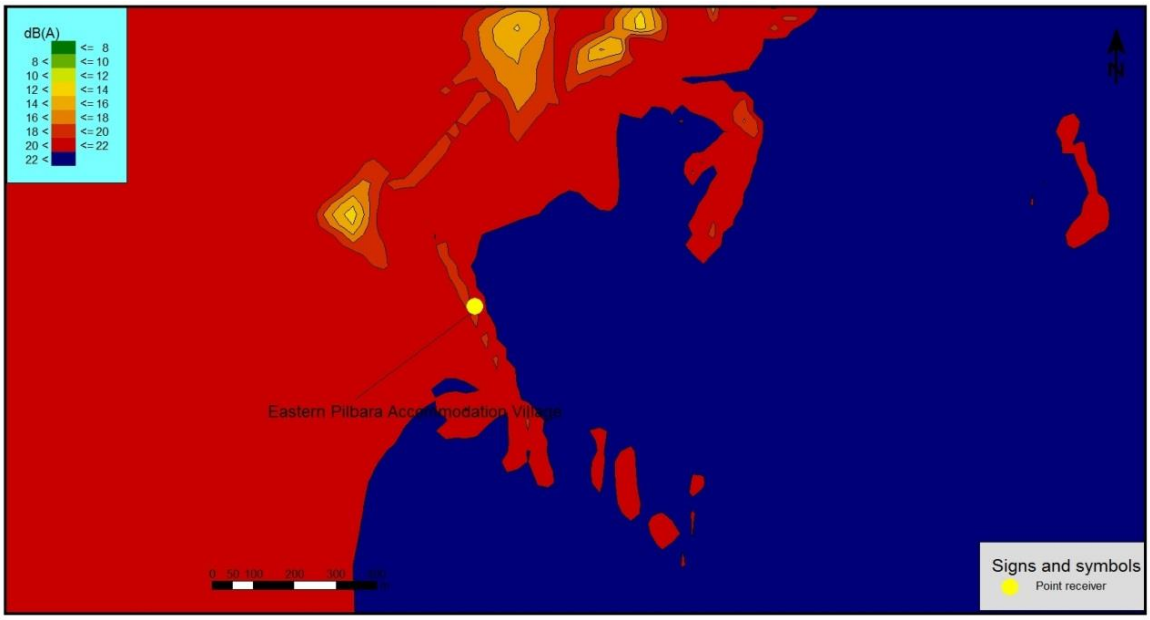
Appendix C-3.1 Scenario 3 – Model Overview



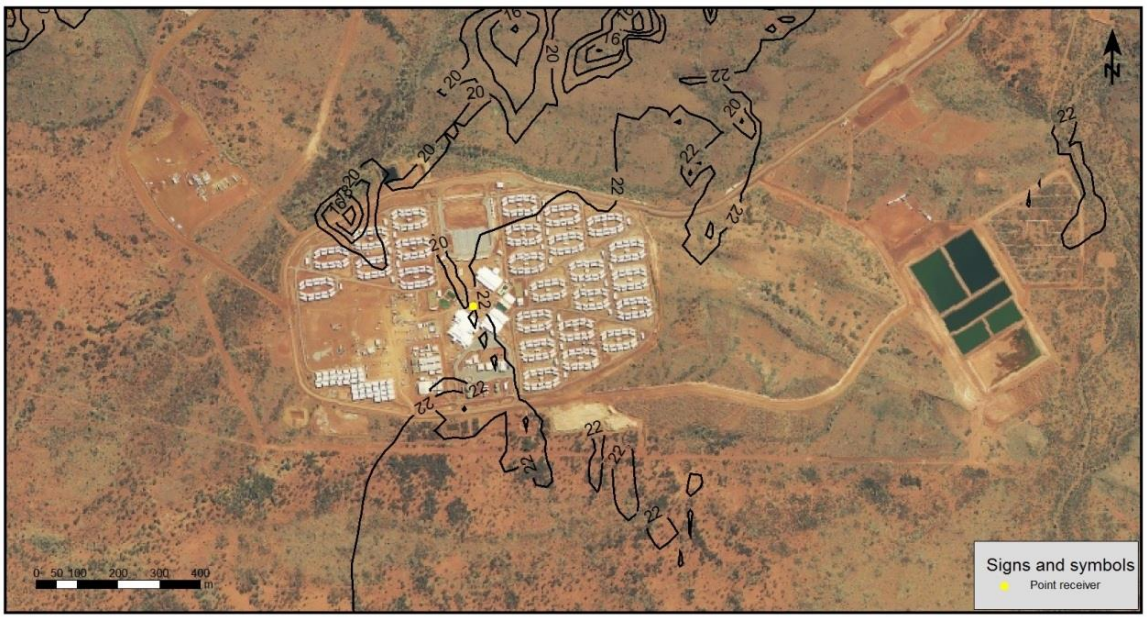
Appendix C-3.2 Scenario 3 - Plant



Appendix C-3.3 Scenario 3 - Eastern Pilbara Accommodation Camp



Appendix C-3.4 Scenario 3 - Eastern Pilbara Accommodation Camp - Noise Contours

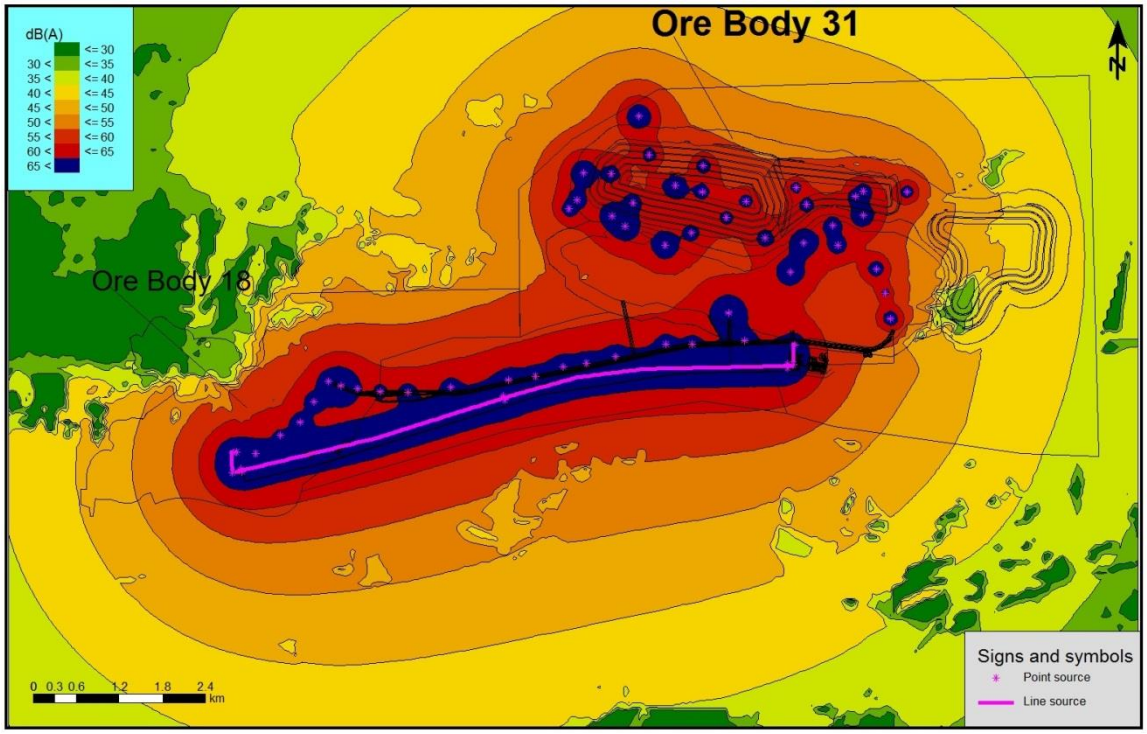


Appendix C-3.5 Scenario 3 - Newman

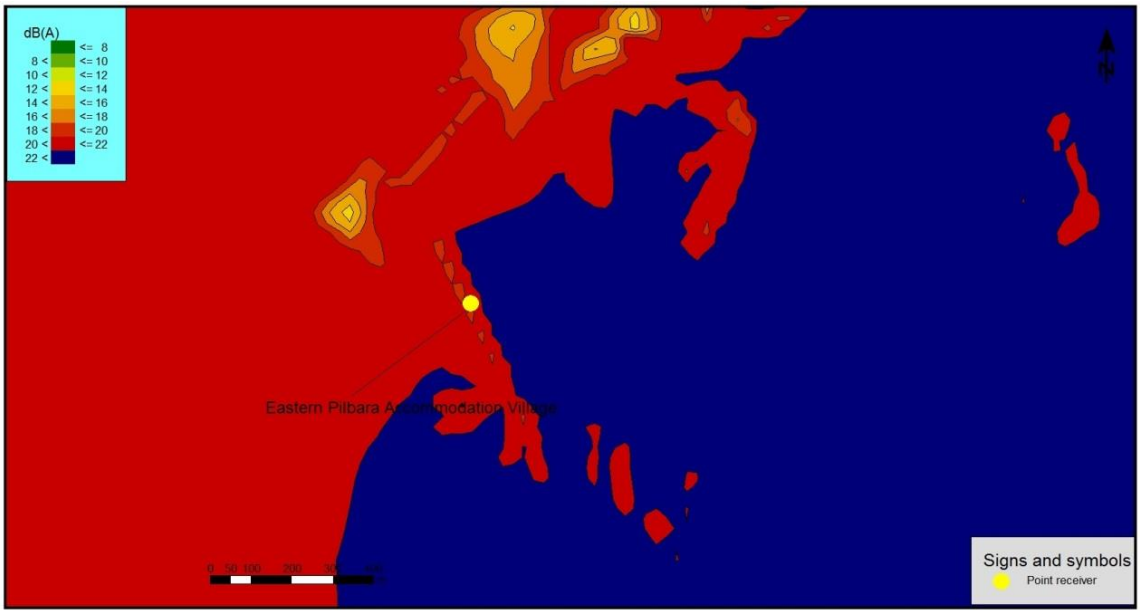
Appendix C-4 Scenario 4

Appendix C-4.1 Scenario 4 – Model Overview

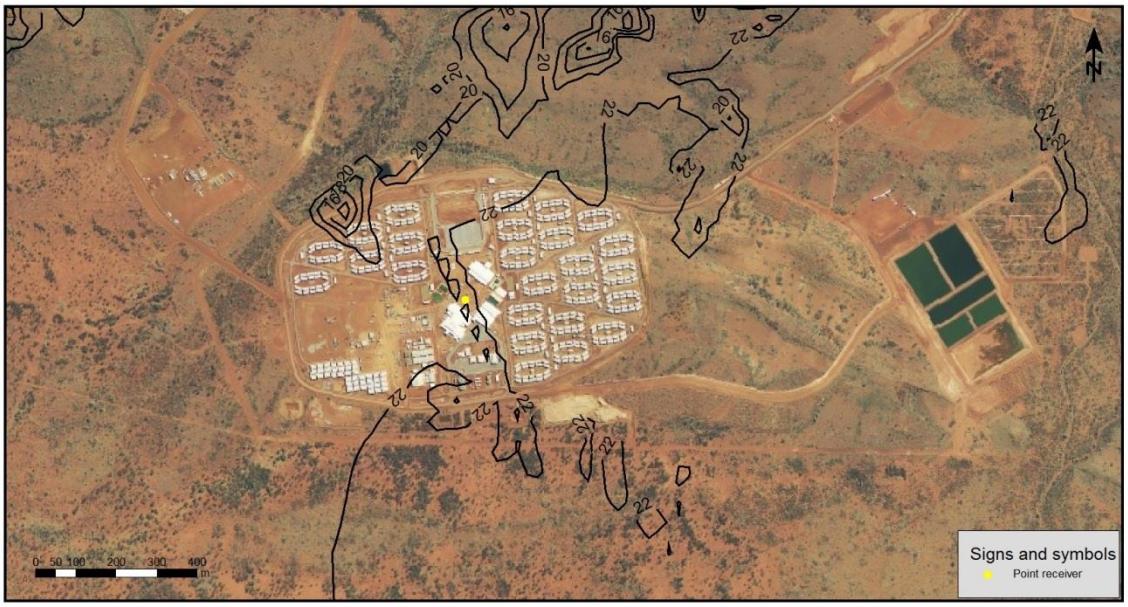
Appendix C-4.2 Scenario 4 - Plant



Appendix C-4.3 Scenario 4 - Eastern Pilbara Accommodation Camp



Appendix C-4.4 Scenario 4 - Eastern Pilbara Accommodation Camp - Noise Contours



Appendix C-4.5 Scenario 4 - Newman

Title:	File Note: Ore Body 31 Environmental Noise Assessment - Scenario 5
Project:	Ore Body 31 Environmental Noise Assessment
Client:	BHP Billiton Iron Ore

SVT Doc No	1370520-6-200	SVT Job No.	1370520

Revision	Description	Prepared	Reviewed	Date
2	Revised following client comment	Phil Lucas		25 July 2014
1	Draft – Issued to client for comment	Luke Adams	Sonya Brunt	1 July 2014
0	Draft – Issued for internal comment	Luke Adams	Phil Lucas Granger Bennett	18 June 2014

Dear Sonya,

RE: ORE BODY 31 ENVIRONMENTAL NOISE ASSESSMENT – SCENARIO 5

1. INTRODUCTION

SVT have been engaged by BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) to undertake an environmental noise impact assessment of the proposed mining operations at Ore Body 31 (OB31).

The noise study will assess the noise impacts at the nearest noise sensitive receivers for various development scenarios for OB31. The nearest sensitive receivers are the Eastern Pilbara Accommodation Village which is located approximately 16 kilometres (km) west of OB31 and the Township of Newman which is located approximately 40 km west of OB31. The locations of these receivers are shown in Figure 1-1.

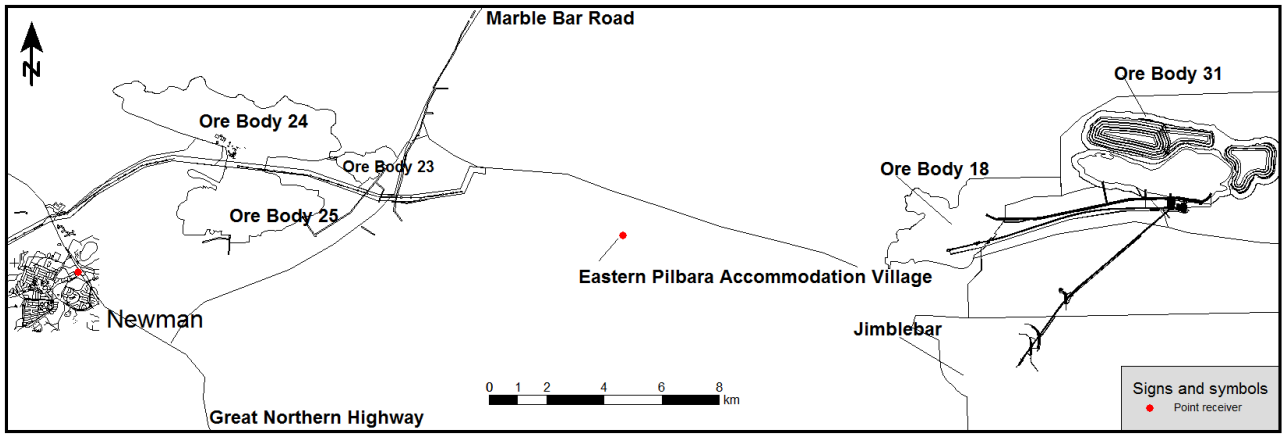


Figure 1-1 Relative locations of nearest receivers to Ore Body 31

1.1 Scope

Five scenarios have been created for the environmental noise assessment of OB31. Scenarios 1-4 are presented in SVT Document 1370520-4-100 "*Environmental Noise Assessment: Ore Body 31*". This briefing note will present the results of Scenario 5 only, which is the development scenario listed below;

Scenario 5:

15Mtpa – crushed and transported via overland conveyor from OB31 to OB18; and

15Mtpa – crushed and transported via overland conveyor from OB31 to Jimblebar.

1.2 Objectives

The objectives of the noise assessment for OB31 development scenario 5 were to:

- develop a noise model for OB31 Scenario 5;
- quantify the received noise levels at the Eastern Pilbara Accommodation Village and at the Township of Newman; and
- assess the noise impacts of OB31 Scenario 5 against the *Environmental Protection (Noise) Regulations 1997*[1].

2. NOISE CRITERIA

The Environmental Protection (Noise) Regulations have been used to assess the noise impacts of OB31 Scenario 5 on the nearest noise sensitive receiver locations at the Eastern Pilbara Accommodation Village and the Township of Newman. Detailed information regarding the Regulations are presented in the full OB31 noise report (see SVT Document 1370520-4-100).

A summary of the assigned noise levels that have been used as the criteria for each noise sensitive receiver in development scenario 5 are presented in Table 2-1.

Table 2-1 Noise criteria used for this assessment (night-time L_{A10})

Receiver	Noise Criteria, L_{A10} in dB(A)
Eastern Pilbara Accommodation Village	35[1]
Newman	30[2]

[1] The Environmental Protection (Noise) Regulations are not applicable at the Eastern Pilbara Accommodation Village because the village is located on the same lease/premises as the mine site. Therefore, the camp is considered as "residences attached to or forming part of" a mine outlined in *Part A, Schedule 1 of the Environmental Protection (Noise) Regulations 1997* and therefore excluded from the Regulations. The Regulations have been used for comparison only and the considered aspirational noise targets at the Eastern Pilbara Accommodation Village (see section 2.2 for details).

[2] The Environmental Protection (Noise) Regulations require that for OB31 operations to be considered a 'non-significant' contributor to noise levels in the Town of Newman, the received noise level must be 5dB less than the assigned noise levels of 35dB(A). Therefore, the applicable noise criteria used for Newman is 30 dB(A).

3. NOISE MODELLING

A noise model has been developed using SoundPlan for the OB31 development in order to determine received levels at the Eastern Pilbara Accommodation Village and the Township of Newman. The following sections provide the inputs that have been entered into the noise model. In order to be conservative, the model has been setup under worst case operational and meteorological conditions.

3.1 Weather Conditions

The CONCAWE algorithm has been used to predict the noise levels at the sensitive receivers. Meteorological conditions assigned to the model are in accordance with the Environmental Protection Authority's (EPA's) recommendations for worst-case weather conditions outlined in "*Guidance for the Assessment of Environmental Factors, Draft No.8, May 2007*" which for night-time are as presented in Table 3-1.

Table 3-1 Worst-case meteorological conditions applied to the model

Parameter	Value in model
Wind speed	3m/s
Wind direction	worst case toward receiver
Humidity	50%
Temperature	15°C
Pasquil stability class	F

3.2 Topography and Ground Types

Topographical information for the noise model was provided by BHP Billiton Iron Ore in shape file format files which were imported into the noise model to create a digital ground map.

Ground absorption for hard and soft surfaces is as specified by the CONCAWE[3] propagation algorithm. CONCAWE is a conservative algorithm which is accepted by the Department of Environment Regulation (DER). The ground absorption used for the OB31 modelling was hard compact gravel (ground factor=0.6).

3.3 Noise Receiver Locations

The noise model has been used to predict received noise levels at two noise sensitive locations, listed in Table 3-2.

[3] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry. The outcome was an empirical algorithm which predicts noise levels at receiving locations.

Table 3-2 Receivers used in the model

Receiver	GPS Coordinates (MGA 94)
Eastern Pilbara Accommodation Village	(51)186371m E, 7416175m S
Township of Newman	(51)167422m E, 7414902m S

3.4 Noise Sources

Sound Power Levels (SWLs) of the proposed equipment were entered into the noise model. The SWLs used in the model were noise measurements taken from SVT's database of similar mining equipment, primarily from measurements of equipment at other operating BHP Billiton Iron Ore sites.

A list of noise sources entered into the model and model assumptions for all scenarios (including scenario 5) are presented in Appendix A and the model assumptions presented in Appendix A-1.

4. NOISE MODELLING RESULTS

4.1 Point Receiver Results

Table 4-1 presents the predicted L_{A10} received noise levels at the nearest noise sensitive receivers for scenario 5 under worst case weather conditions.

Table 4-1 Scenario 5 -Noise modelling results for night-time under worst case weather conditions

Receivers	Noise Model Results - L_{A10} received noise levels
Eastern Pilbara Accommodation	22.1
Newman East	11.8

4.2 Comparison against the Environmental Noise Regulations

As can be seen in Table 4-1 the predicted noise levels at both the Eastern Pilbara Accommodation Camp and at the Township of Newman are below the night time criteria specified in Table 2-1 and therefore compliant with the Environmental Protection (Noise) Regulations.

4.3 Noise Contours

Noise contour maps of the noise results are presented in Figure 4-1 to Figure 4-4.

Figure 4-1 Scenario 5 – Noise Model Overview - Noise Contour Map

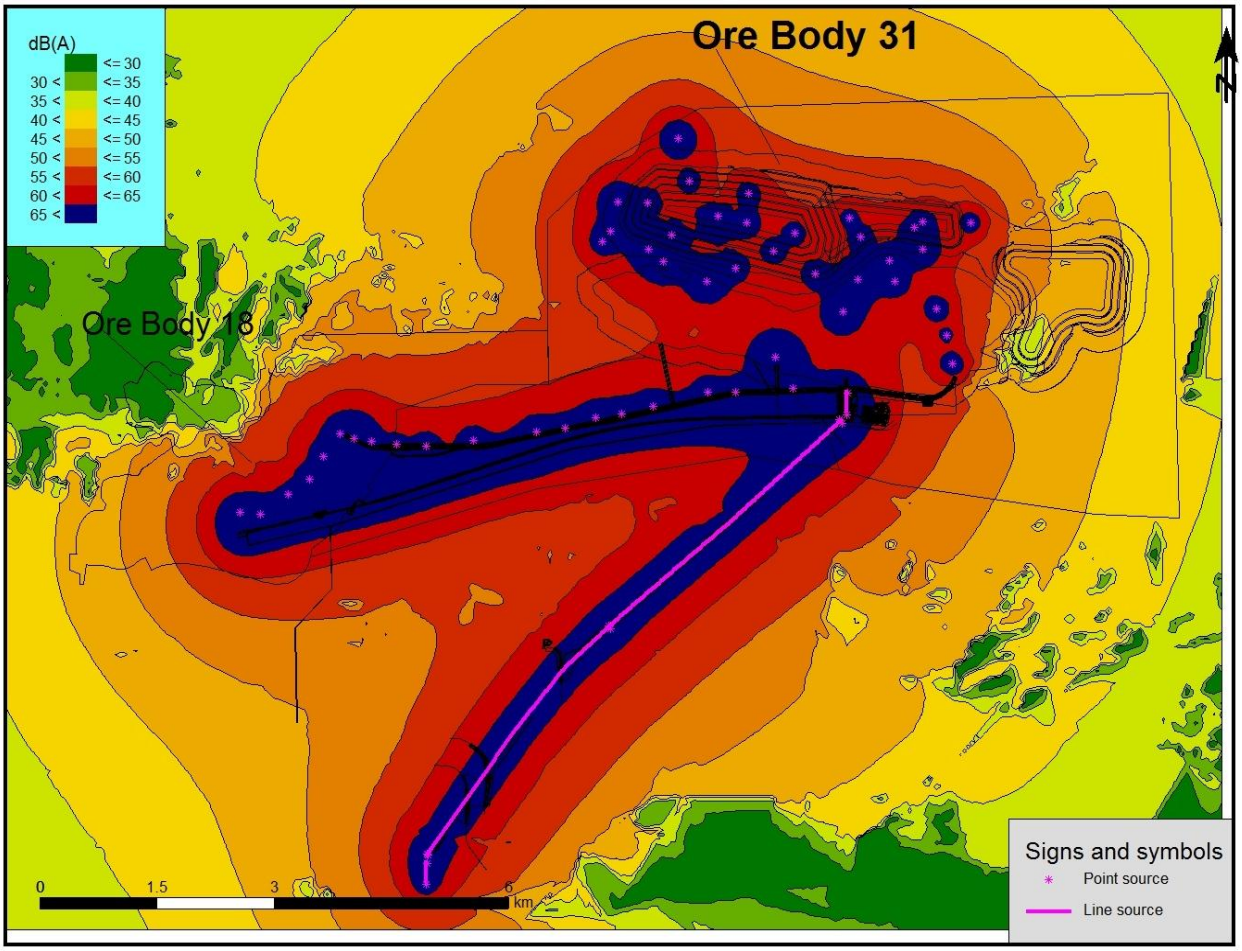


Figure 4-2 Scenario 5 – Noise Contour Map of Plant

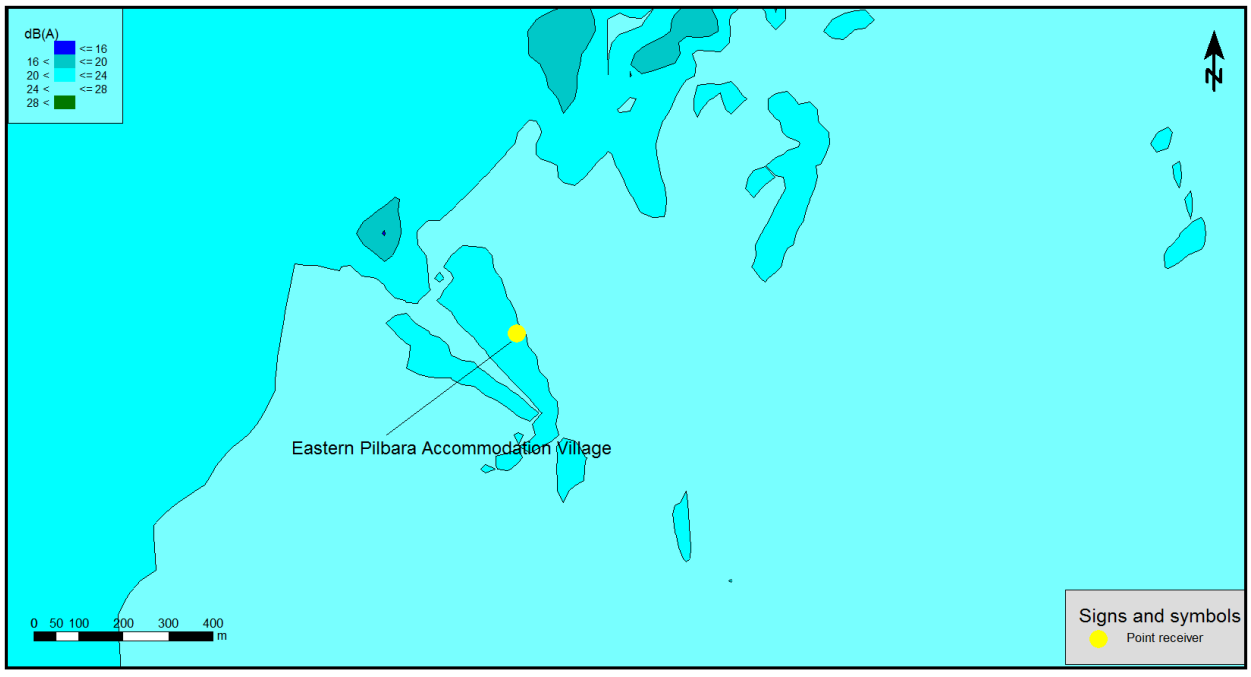


Figure 4-3 Scenario 5 – Noise Contour Map in Eastern Pilbara Accommodation Camp

Figure 4-4 Scenario 5 – Noise Contour Map in Newman Township

5. CONCLUSION

Based on the noise modelling results for the OB31 development scenario 5, the following has been concluded:

- Received noise levels at the Eastern Pilbara Accommodation Village are predicted to be 22.1 dB(A) for scenario 5 and therefore compliant with the noise regulations (i.e. 'noise target').

- Received noise levels at the Township of Newman are predicted to be 11.8 dB(A) and therefore also comply with the noise regulations. The received noise levels predicted in Newman as a result of OB31 operations, are much lower than ambient noise in the town and therefore do not contribute to overall noise levels in Newman.

- At the noise levels predicted, the OB31 operations will not be audible in the Eastern Pilbara Accommodation Village or Newman Township.

APPENDIX A NOISE MODELLING – NOISE SOURCES

A summary of the equipment types and noise source levels (SWLs) used in the model are presented in Table A 1.

Table A 1 Sound power levels used for the plant and mobile equipment (source: SVT)

Equipment Type[4]	Octave Band Sound power Levels (dB(A)									Overall dB(A)
	31	63	125	250	500	1000	2000	4000	8000	
Mobile Equipment										
Haul Truck	77.3	89.7	106.5	103.5	105.9	106.9	107.6	99.8	92.2	113.5
Shovel	67.7	88.5	100.4	104.5	107.8	107.2	104.9	97.7	87.2	112.8
Front End Loader	64.7	79.2	97.7	95.3	103.3	105.3	104.0	98.7	91.5	109.9
Track Dozer (CAT D10)	71.4	85.4	98.1	104.4	109.5	109.2	105.7	96.3	85.1	114.0
Wheel Dozer (CAT 854)	63.6	83.3	100.6	101.4	109.1	114.6	109.3	104.7	99.7	117.1
Wheel Dozer (CAT 834)	60.5	82.0	99.0	102.9	105.5	109.1	105.8	100.6	93.6	112.9
IT62 Stemming Loader	60.5	82.0	99.0	102.9	105.5	109.1	105.8	100.6	93.6	112.9
Grader (CAT 16)	59.8	76.5	92.2	93.9	102.5	106.7	105.4	100.8	92.4	110.7
Water Cart (785DWC)	64.3	87.7	95.3	101.9	102.4	101.9	99.7	91.4	89.3	108.1
Service Truck (3900GLT)	67.7	77.5	97.8	102.8	107.3	105.6	103.1	99.5	89.3	111.6
Omega 8.5 Forklift	55.6	63.8	74.9	81.4	91.8	91.0	90.2	86.0	78.9	96.5
Low Loader Float (784)	63.6	83.3	100.6	101.4	109.1	114.6	109.3	104.7	99.7	117.1
Atlas Copco PV271	68.1	83.6	108.2	110.4	114.3	111.3	110.7	105.9	96.1	118.7
Atlas Copco ROC-L8	68.1	83.6	108.2	110.4	114.3	111.3	110.7	105.9	96.1	118.7
Fixed Plant										
Primary Crusher	79.2	91.2	103.9	114.4	115.8	113.0	113.2	107.0	99.9	120.6
Overland Conveyor[5]	49.2	65.5	79.6	86.4	89.9	89.4	87.5	79.4	70.2	94.8
Transfer Station	63.6	81.8	90.9	96.4	106.8	107	102.2	95.7	86.7	111.0
Conveyor Drives (630)kw	65.6	81.8	89.9	98.4	106.8	103	100.6	91.2	80.9	109.5
Conveyor Drives (1250)kw	63.6	80.8	91.9	100.4	106.8	106	108.2	91.1	81	112.2

[4] Where the specific equipment item was not in SVT's noise data base the nearest equivalent item was used. Whenever there was uncertainty, the larger item of plant (i.e. conservative estimates) were used.

[5] As conveyors are line sources these values are per unit length. Total sound power for this item (approximate length = 8000m) is approximately 40 dB higher than the values indicated here.

The noise model includes fixed plant and mobile equipment. The number of mobile equipment noise sources entered into the model was taken from the current mine plan for the year 2022 provided by BHP Billiton Iron Ore[6]. The mining equipment (listed in Table A 2), was distributed over the proposed OB31 mining area with trucks graders and water carts extending to OB18. The acoustic centre of the mobile sources were assumed to be 2m above local ground level. All noise sources were assumed to be running simultaneously in the model, under worst case meteorological conditions, which represents worst case operating condition.

Table A 2 Summary of equipment numbers for each scenario entered into the model

Equipment Type	Scenarios				
	1	2	3	4	5
Mobile Equipment					
Haul Truck	18	18	18	18	**36**
Shovel	3	3	3	3	**6**
Front End Loader)	1	1	1	1	**1**
Track Dozer (CAT D10)	5	5	5	5	**10**
Wheel Dozer (CAT 854)	2	2	2	2	**4**
Wheel Dozer (CAT 834)	2	2	2	2	**4**
IT62 Stemming Loader	3	3	3	3	**3**
Grader (CAT 16)	2	2	2	2	**2**
Water Cart (785DWC)	3	3	3	3	**3**
Service Truck (3900GLT)	1	1	1	1	**2**
Omega 8.5 Forklift	1	1	1	1	**2**
Low Loader Float (784)	1	1	1	1	**2**
Atlas Copco PV271	3	3	3	3	**6**
Atlas Copco ROC-L8	4	4	4	4	**8**
Fixed Plant					
Primary Crusher	0	1	0	1	**2**
Overland Conveyor	0	0	1	1	**2**
Transfer Station	0	0	2	2	**4**
Conveyor Drives (630)kw	0	0	2	2	**4**
Conveyor Drives (1250)kw	0	0	6	6	**12**

[6] OB31 Ancilliary.xlsm. The mine plan equipment numbers are summarised for each scenario in Table A-2.

Appendix A-1 Model Assumptions

The following assumptions were made for this noise modelling;

- Mobile equipment numbers were entered into the model according to the mine plan received from BHP Billiton Iron Ore. For previous scenarios the worst case (i.e. most equipment) mining year of 2022 was used as a basis for modelling. As scenario 5 involves a doubling of production, a corresponding doubling of mobile equipment numbers was assumed.
- All noise sources have been placed above original ground level, including mobile equipment sources which would operate within a pit. This represents worst case as the pit face would offer noise shielding.
- Conveyor noise source levels were applied from measurements of similar overland conveyors at other BHP Billiton Iron Ore inland sites.
- It is assumed that the overland conveyors would require 6 x 1250kW drives.
- It is assumed a short feed conveyor is located at each end of the overland conveyors. These feed conveyors each include a 630kW drive and a transfer station.
- The addition of overland conveyors will not result in a reduction in the number of mobile equipment operating.
- Rail noise was excluded from the model.

The assumptions listed above, and well as the application of worst case weather and operational conditions, ensure that the OB31 noise model is conservative.