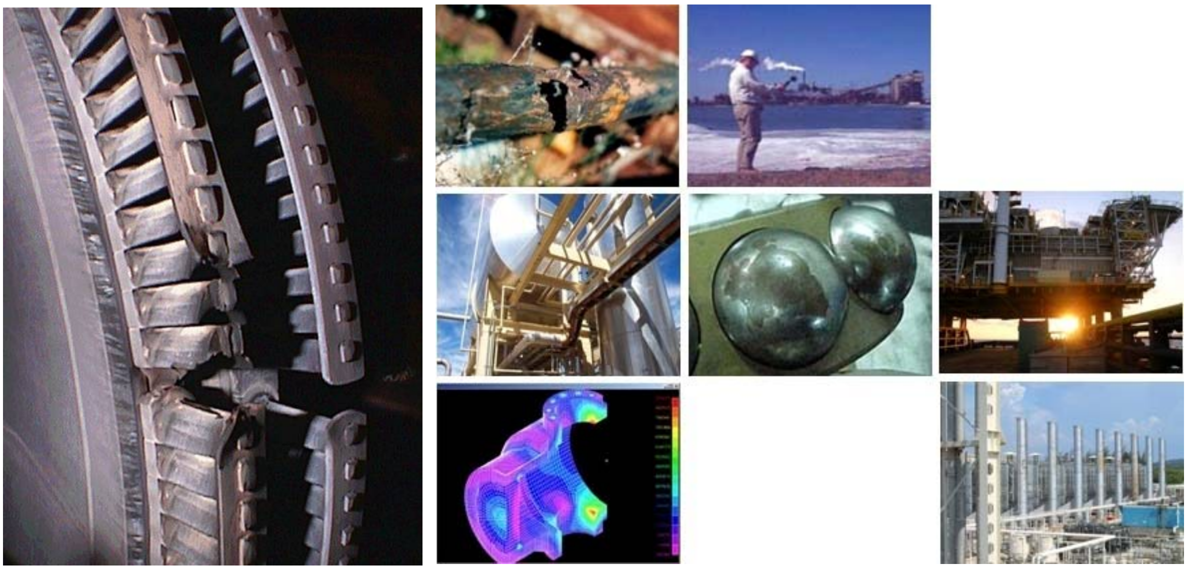
SVT ENGINEERING CONSULTANTS

PORT HEDLAND OUTER HARBOUR DEVELOPMENT NOISE ASSESSMENT REPORT



BHP BILLITON IRON ORE

Rpt11-075031-Rev 4-11 December 2009

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EXECUTIVE SUMMARY

Overview

SVT were commissioned by BHP Billiton Iron Ore to undertake an environmental noise impact assessment of the present and proposed expansion of BHP Billiton Iron Ore's Port Hedland facilities in Western Australia. The objectives of the study are to determine current noise emission levels and to assess:

- the noise impacts of Outer Harbour Development Stage 1, Stage 2, Stage 3 and Stage 4;
- the noise impacts of rail operations; and
- where appropriate, to suggest methods to mitigate excessive noise emissions to achieve compliance with noise limits imposed under the regulations and in accordance with BHP Billiton Iron Ore's noise objectives

Background

Noise surveys of BHP Billiton Iron Ore's Port Hedland operations have been undertaken progressively over the years – commencing prior to the PACE Project (2004). Environmental noise emissions from BHP Billiton Iron Ore's Port Hedland facilities do not currently comply with the assigned noise emission levels of the Environmental Protection (Noise) Regulations 1997. As a result BHP Billiton Iron Ore has developed the following noise objectives:

- Reduce noise to as low as reasonably practicable, acknowledging growth, and where reasonably possible, comply with the requirements of the Environmental Protection (Noise) regulations 1997 (including seeking an exemption if necessary);
- Where it is impracticable to comply with the Environmental Protection Noise Regulations, ensure continuous improvement is facilitated through a Noise Reduction Management Plan; and
- Ensure the new plant and infrastructure being planned for the Port facilities particularly Prescribed Plant as defined by the Environmental Protection Act, (1984) complies with the Environmental Protection (Noise) regulations 1997.

Applicable Regulations

Port Facilities

For Port Facility operations the Environmental Protection (Noise) Regulations 1997 which operate under the *Environmental Protection Act 1986* are applicable. The Regulations specify maximum noise levels (assigned levels), which are the highest noise levels that can be received at noise-sensitive premises, 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 added to the assigned noise levels. Penalties are also applied for noise that has tonal characteristics. Therefore, the maximum permissible noise levels allowed at the noise sensitive premise is the assigned noise level + influencing factor – tonal penalty. The maximum allowable noise levels for the various point receivers at Port Hedland is given in Table 5-5. For the in isolation assessment the received levels will be evaluated against the assigned levels, while for the cumulative assessment (i.e. Outer

Harbour and RGP 5) the maximum allowable levels will be used. The rationale behind this is provided in the body of the report.

Table 1-1: Assigned noise levels and maximum permissible noise levels (including 5dB penalty for tonality) for noise sensitive premises.

Position	Influencing Factor in dB	L_{A10} Assigned noise levels in dB(A)			Penalty	L_{A10} Maximum Allowable noise levels in dB(A)		
		Day	Evening	Night		Day	Evening	Night
1. Brearley St	2	47	42	37	5	42	37	32
2. Hospital	2	47	42	37	5	42	37	32
3. Police Station	17	62	57	52	5	57	52	47
4. Pretty Pool	0	45	40	35	0	45	40	35
5. South Hedland	0	45	40	35	0	45	40	35
6. Wedgefield Industrial Estate	NA	65	65	65	0	65	65	65

Rail Operations

Rail and road noise management in Western Australia is implemented through the state planning policy 5.4 "*Road and Rail Transport Noise and Freight Considerations in Land Use Planning*" (22 Sept 09) which operates under the *Planning and Development Act 2005*. The state planning policy specifies a noise target and a noise limit.

Table E- 1 Planning Policy Noise Criteria

Time of day	Noise Target	Noise Limit
Day (6am – 10pm)	$L_{Aeq(Day)}$ = 55dB(A)	$L_{Aeq(Day)}$ = 60dB(A)
Night (10pm – 6am)	$L_{Aeq(Night)}$ = 50dB(A)	$L_{Aeq(Night)}$ = 55dB(A)

The 5dB difference between the outdoor noise target and the outdoor noise limit represents an acceptable margin for compliance.

The policy recognises that in a number of instances it may not be reasonable and practicable to meet the 'noise target'. Where transport noise is above the target level, measures are expected to be implemented that best balance reasonable and practicable considerations, such as noise cost/benefit, feasibility, community preferences, amenity impacts, safety, security and conflict with other planning and transport policies. In these cases the community should also be consulted to assist in identifying best overall solutions.

Modelling

The following noise source configurations were modelled:

1) **Port Facility**. The port facilities were modelled for the following four situations:

- Outer Harbour Development consists of:

  Stage 1, Stage 2, Stage 3 and Stage 4

2) **Rail Noise**. A rail model has been developed for the Outer Harbour Development. This model includes the Western Spur and Boodarie loop. It also includes current rail operations from the main line rail from Bing Siding to Nelson point and from Bing Siding along the Goldsworthy line to Finucane Island. Rail operations in the yard at Nelson Point and at Finucane Island were also modelled.

Port Facility Compliance and Noise Control

Compliance

BHP Billiton Iron Ore's operations are located adjacent to the Town of Port Hedland and due to historical land use planning there is a minimal buffer between industry and sensitive receptors. None the less BHP Billiton Iron Ore is committed to reducing noise levels, but also understandings that existing land use conflicts make compliance with the Noise Regulations difficult. All noise control recommendations have been based on meeting BHP Billiton Iron Ore's noise objectives.

In the body of the report it has been shown that it is not reasonably practicable for RGP 5 plus the Outer Harbour Development to meet the maximum allowable levels. It has also been shown that without any noise control the Outer Harbour Development is also not compliant with the assigned levels.

Noise Control and ALARP

A detailed examination of engineering noise controls for the proposed Outer Harbour Development will be undertaken during preparation of the Works Approval application. An integrated approach will be taken that will focus on a range of factors such as:

- BHP Billiton Iron Ore's noise objectives;
- Magnitude of predicted noise impacts at the sensitive receptors;
- Ranking of noise source contributions at the sensitive receptors; and
- The principle of As Low as Reasonably Practicable (ALARP) which balances noise attenuation with factors such as:
    - Safety;
    - Cost benefit analysis, considering total life cycle costs
    - Technical performance, reliability and on-going maintenance requirements; and
    - Operation and maintenance.

The prime aim of the integrated approach will be to meet BHP Billiton Iron Ore's noise objectives where reasonably practicable, based on optimization of noise controls across BHP Billiton Iron Ore's Port Hedland operations. The assessment of potential engineering noise control measures will include the installation of:

- Noise barriers;
- Enclosures for conveyor drives and transfer stations; and
- Low noise conveyor idlers.

The final package of engineering noise controls will be confirmed as part of the Works Approval application.

Rail Compliance

According to the results predicted by the noise model for the in isolation case all the receivers were in compliance with the state planning policy 5.4.

TABLE OF CONTENTS

1. INTRODUCTION

SVT were commissioned by BHP Billiton Iron Ore to undertake an environmental noise impact assessment of the present and proposed expansion of BHP Billiton Iron Ore's Port Hedland facilities in Western Australia. The objectives of the study are to determine noise emission levels in order to:

- Assess the noise impacts of the proposed port upgrade for Outer Harbour Development;
- Assess the noise impacts of the rail operations; and
- Where appropriate, to suggest methods to mitigate excessive noise emissions to achieve compliance with noise limits imposed under the Environmental Protection (Noise) Regulations 1997 and in accordance with BHP Billiton Iron Ores noise objectives.

1.1 Applicable Documents

The following lists the applicable documents:

- Noise Reduction Management Plan – Port Hedland Rev 0 01/12/2006; and
- SVT Doc: Rpt 02A 075063 Port Hedland Noise assessment report for RGP 5 rev 0 17 Dec 08

1.2 BHP Billiton Iron Ore's Noise Objectives

BHP Billiton Iron Ore has developed the following noise objectives:

- Reduce Noise to as low as reasonably practicable, acknowledging growth, and where reasonably possible, comply with the requirements of the Environmental Protection (Noise) regulations 1997 (including seeking an exemption if necessary);
- Where it is impracticable to comply with the Environmental Protection Noise Regulations, ensure continuous improvement is facilitated through a Noise Reduction Management Plan; and
- Ensure the new plant and infrastructure being planned for the Port facilities particularly Prescribed Plant as defined by the Environmental Protection Act, (1984) complies with the Environmental Protection (Noise) regulations 1997.

1.3 Major Activities

The major activities undertaken during the course of this study are given below.

- Measurement of equipment noise levels and calculation of associated Sound Power Levels (SWL);
- Modelling of Outer Harbour Development and assuming similar equipment to that already in operation at Port Hedland;
- Evaluation of the Outer Harbour Development with BHP Billiton Iron Ore's noise objectives; and
- Provide noise control solutions that will, where practicable, meet BHP Billiton Iron Ore's noise objectives.

2. BHP BILLITON IRON ORE PORT HEDLAND OPERATIONS

2.1 Introduction

BHP Billiton Iron Ore is one of Australia's largest iron ore producers, operating open pit mining operations in the Pilbara region of Western Australia at Mt Whaleback, Yandi, Jimblebar, Orebody 18, Orebody 23/25, Area C and Yarrie/Nimingarra. Two dedicated heavy haulage rail systems, running from Newman, Area C and Yandi mines and Yarrie/Nimingarra operations, deliver the ore to BHP Billiton Iron Ore's Port Hedland port facilities.

The BHP Billiton Iron Ore Port Hedland port facilities consist of processing, stockpiling and shiploading operations at Finucane Island and Nelson Point, located on the opposite sides of the Port Hedland Inner Harbour.

At the conclusion of the 2007/2008 financial year, BHP Billiton Iron Ore exported approximately 124 million wet tonnes (mwt) of iron ore from its Nelson Point and Finucane Island operations. The Rapid Growth Project 5 (RGP5) expansion has recently been approved and is currently under construction and BHP Billiton Iron Ore is now seeking approval for the Outer Harbour Development.

2.2 Previous Noise Modelling Overview

Noise surveys of BHP Billiton Iron Ore's Port Hedland operations have been undertaken progressively over the years commencing prior to the PACE Project (2004). Environmental noise emissions from BHP Billiton Iron Ore's Port Hedland facilities do not currently comply with the assigned noise emission levels of the Environmental Protection (Noise) Regulations 1997. As a result noise modelling has been undertaken prior to each expansion phase and has provided noise contours and predicted noise levels at a number of sites within Port Hedland, these include:

- Brearley Avenue;
- Hospital;
- Police Station;
- Pretty Pool;
- South Hedland;
- Wedgefield Estate; and
- Green Acres.

The location of these receivers used in the model can be seen in Figure 2-1.

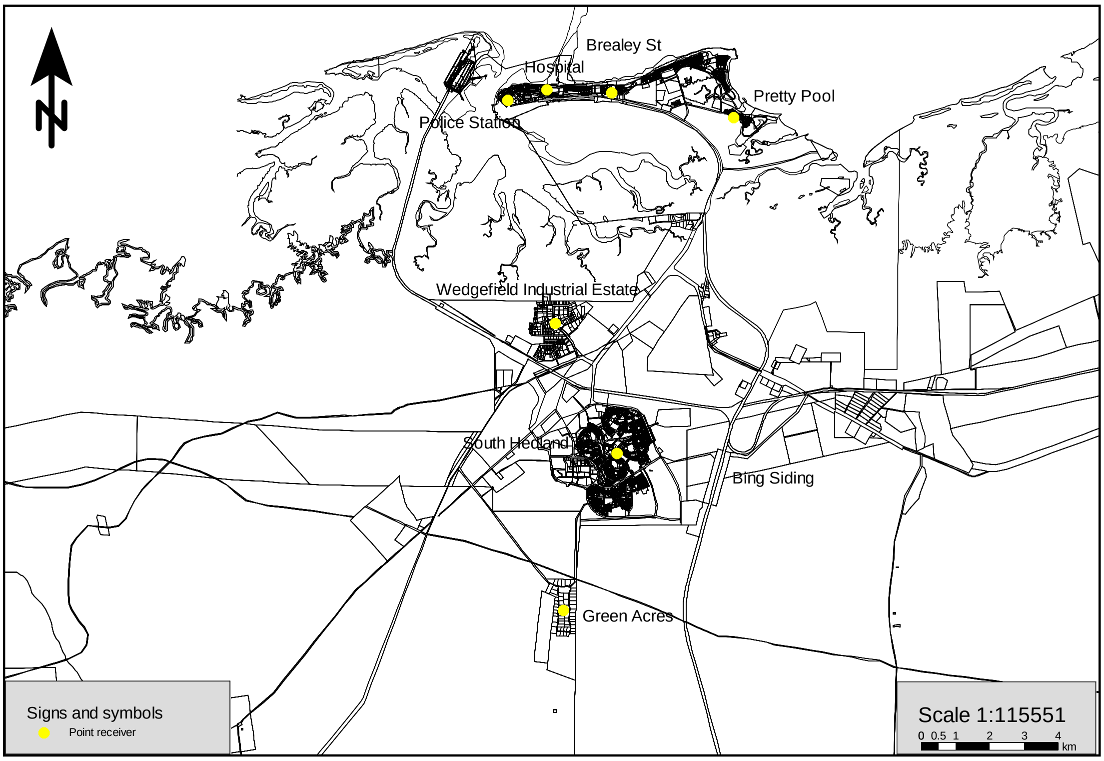

Figure 2-1: Port Hedland Layout and Noise Level Receivers

BHP Billiton Iron Ore has undertaken to continue monitoring the above sites and will continue to use the Hospital as the point of reference to measure noise performance. BHP Billiton Iron Ore considers the Hospital to be the most appropriate reference site location with respect to noise for the following reasons:

- it is located within an area reflective of where the community lives;
- the monitoring location is adjacent to the Hospital itself – a noise sensitive premises;
- it is more directly influenced by BHP Billiton Iron Ore's operations (i.e. away from the Port operations and ocean influences);
- it is slightly elevated compared to the surrounding topography and hence is likely to provide a more conservative assessment point; and
- it is selected by DoH as a reference point for dust monitoring.

3. OUTLINE OF PROPOSED PORT UPGRADE

The Outer Harbour Development has been divided into four Stages, the development will be staged over six years with each Stage increasing the output of the facility by 60 MTpa as shown in Table 3-1.

Table 3-1 Outer Harbour Development Stages

Outer Harbour development	Starting year	Output
Stage 1	2013	60 MTpa
Stage 2	2015	120 MTpa
Stage 3	2017	180 MTpa
Stage 4	2019	240 MTpa

The port development can be spatially categorised into the following three components (see Figure 3-1):

1) Overland, jetty and wharf conveyors;

2) Boodarie stockyards;

3) Rail spur corridor and rail loop.

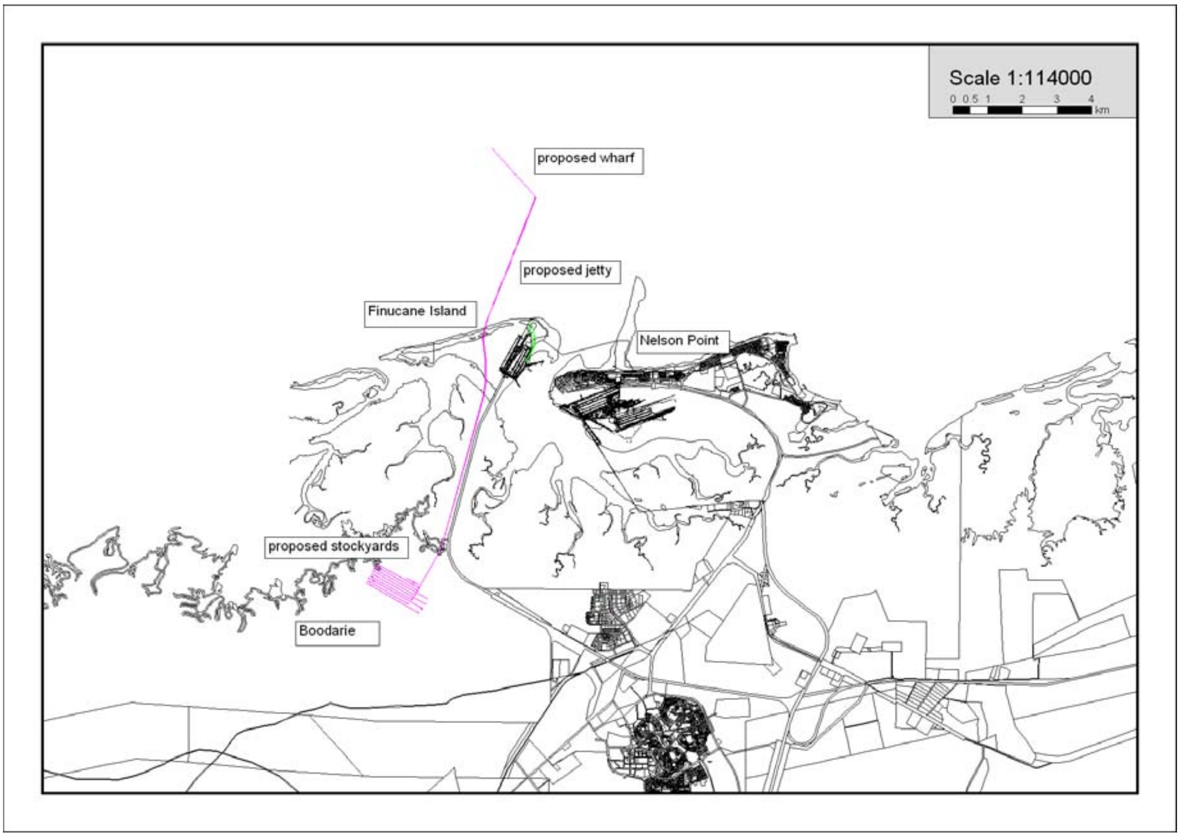

Figure 3-1 Outer Harbour Development layout

3.1 Overland, Jetty and Wharf Conveyor

The Outer Harbour Development has been divided into four Stages. Each Stage has a conveyor system with the capacity of 60 MTpa that will transport ore from the Boodarie site to the new Outer Harbour Development located offshore from Finucane Island. The current layout indicates that the overland conveyor route will follow the existing/ decommissioned HBI conveyor. Once all four Stages are in place there will be a total of four Car Dumpers with four associated conveyors systems transporting a total of 240 MTpa to the offshore wharf. The wharf and shiploading will be located offshore from Finucane Island, where the major noise sources for the Finucane Island (Outer Harbour) and conveyors are considered to be:

- Overland conveyors;
- Overland conveyor drives;
- Transfer conveyors and drives for the conveyors;
- Wharf conveyor; and
- Ship loaders.

3.2 Mainland: Boodarie Stockyards

The Boodarie site will accommodate the rail loop and stockyards and associated materials handling facilities with a maximum capacity of 240 MTpa. Stockyards will be established in four Stages of 60MTpa. Each stockyard consists of the following major noise sources:

- Car dumper;
- In-loading conveyor;
- Screen house;
- Stock yard conveyors and conveyor drives;
- Stackers;
- Reclaimers; and,
- Out-loading conveyor.

3.3 Rail Spur Corridors

A rail spur from the main Newman to Port Hedland rail line to the Boodarie stockyards is proposed. The number of rail movements is predicted to be approximately 5000 per annum for each 60MTpa of nominal throughput. This includes loaded and empty rakes. After processing, the ore is conveyed to one of four stackers in the stockyard area, or directly to the ship loaders.

The ore production and associated rail movements predicted for the development of rail can be seen in Table 3-2. The layout of the rail including the current operations and the Western Spur and Boodarie loop can be seen in Appendix E.

Table 3-2: Tonnage and rakes per day for each Stage

	Total tonnage MTpa	Rakes per day
RGP 5	205	45.4
Stage 1	265	58.7
Stage 2	325	72.0
Stage 3	385	85.3
Stage 4	445	98.5

3.4 Rapid Growth Programs

The Outer Harbour Development will be compared with the RGP 5 configuration in order to determine if the BHP Billiton Iron Ore objective for continuous improvement is met. The applicable RGP 5 configuration is given in Appendix A and B.

4. PORT HEDLAND AND SURROUNDING AREA

4.1 Port Hedland

Within Port Hedland there are industrial, commercial and residential areas. The industrial areas are concentrated at Nelson Point and Finucane Island, the commercial area is located at the town centre of Port Hedland and the residential area is located along the west end of Port Hedland.

The industrial activities in Port Hedland are primarily due to port operations associated with the shipping of iron ore and salt. Other operations include handling and shipping of manganese, copper concentrate, chromate and the port also operates as a live export port for livestock. Of these activities due to scale the BHP Billiton Iron Ore facilities at Nelson Point and Finucane Island dominate noise impacts are the greatest contributors within the town at the west end.

4.2 Wedgefield Industrial area

The industrial area of Wedgefield is some 5.5 km from the BHP Billiton Iron Ore operations at Port Hedland as shown in Figure 4-1. Wedgefield field is zoned as an industrial area.

4.3 South Hedland

South Hedland is a town, consisting of a residential area with a shopping and office area which is zoned as a commercial area. South Hedland is some 9 km away from Port Hedland as shown in Figure 4-1.

Figure 4-1 Port Hedland and surrounding area, image © 2009 Google – Map Data © 2009 DigitalGlobe

5. APPLICABLE REGULATIONS AND ASSIGNED LEVELS

Two separate modelling activities have been undertaken. These activities are port operations and rail operations. Each activity has different applicable regulations.

5.1 Regulation Applicable to Port Facility Operations

5.1.1 Summary of 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 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 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;
- 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 port facility. Table 5-1 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 5-1: Assigned noise levels for noise sensitive premises.[1]

Type of premises receiving noise	Time of day	Assigned Level dB(A)		
		LA 10	LA 1	LA max
Locations within 15m 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 15m 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

Since the port facilities operates 24 hours a day the most stringent noise limit that would apply to noise emissions will occur during the night time hours.

Table 5-2: Assigned penalties for intrusive or dominant noise characteristics.[2]

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

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 modulated. That is, the measured or predicted noise levels are increased by the applicable penalties, and the adjusted noise levels must comply with the assigned noise levels. Regulation 9 sets out objective tests to assess whether the noise is taken to be free of these characteristics.

5.1.2 Assigned Level Evaluation for Port Hedland

As the assessment is for a multitude of different premises, different assigned noise levels will be applicable to different areas of the town. As can be seen from Table 5-1different premises zoning classifications have different assigned levels. So industrial premises have an assigned L_{A10} value of 65dB(A), commercial premises have an assigned L_{A10} value of 60dB(A) while residential premises

[1] Environmental Protection (Noise) Regulations 1997

[2] Environmental Protection (Noise) Regulations 1997

have different assigned levels depending on the day of the week and the time of the day and surrounding land use. The relevant zone to each noise monitoring positions is shown in Table 5-3.

Table 5-3 Zones relevant to each logging position

Residential	Commercial (60dB(A))	Industrial (65dB(A))
Darlot Street Hospital Rural Village Pretty Pool South Hedland Golf Course Cook Point Brearley Avenue	Police Station (Influencing Factor = 17dB for residents at police station) Port Hedland Shopping Centre South Hedland Telstra Building	Wedgefield HBI

The most stringent assigned levels are applicable to residential areas at night time (22:00 to 07:00), on weekends from 09:00 and public holidays. Residential areas will therefore be the focus of the assessment undertaken here.

5.1.3 Influencing Factors

The influencing factor is calculated at the noise sensitive premises and the calculated value is added to the assigned noise levels as shown in Table 5-1. The influencing factor depends on land use zonings within circles of 100 metres and 450 metres radius from the noise receiver. The value is dependent on:

- the proportion of industrial land use zonings;
- the proportion of commercial zonings; and
- the presence of major roads within the circles.

Due to the large number of noise sensitive premises an influencing factor has not been calculated for each premises, but rather an influencing factor has been calculated for specific areas as shown in Figure 5-1 and Table 5-4, which is considered representative of the area. As can be seen from the figure, and as expected the influencing factor and therefore the assigned noise level varies within the town area.

Table 5-4 Influencing Factor for various locations in Port Hedland

Residential Area	Influencing Factor
Police Station	17dB
Hospital	2dB
Darlot St	2 to 3dB
Brearley Avenue	1 to 2 dB
Pretty Pool	0
Cook Point	0
Rural Village	0
South Hedland Golf Course	0

Figure 5-1 Influencing factors that can be applied to different areas of Port Hedland, image © 2009 Google – Map Data © 2009 DigitalGlobe

5.1.4 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. Since the port facilities operates 24 hours a day the most stringent noise limit that would apply to noise emissions will occur during the night time hours.

Table 5-2 presents the penalties incurred for noise that exhibits intrusive or dominant characteristics (i.e. if it has tonal, modulating or impulsive characteristics).

The Outer Harbour Development will be considered in isolation and cumulatively with RGP 5 (i.e. the cumulative assessment will include all noise sources from RGP 5 and the Outer Harbour Development). For the in isolation case it is not expected that there will be any tonal signal present in the receiver noise due to the distance of the Outer Harbour Development from Port Hedland. As a result a penalty for tonality will not be applied.

However for the cumulative case tonality was assessed for the Port Hedland area using 1/3rd octave measurements taken over 30 minute periods at various locations within the town of Port Hedland. It was found that tonal signals were present in areas extending from McKay street to the corner of McGregor and Lukis streets. A 5dB penalty therefore applies to this area and will be applied to the cumulative case. Beyond the McGregor and Lukis streets intersection no tonal characteristics could be attributed to the BHP Billiton Iron Ore facility was found within the noise measurements. The 5dB penalty should therefore not be applied to these areas.

5.2 Assigned Level Evaluation for Wedgefield

Wedgefield is classified as an industrial area with no known premises that can be classed as sensitive[3] premises as per the regulations. This implies that Wedgefield has an assigned LA10 value of 65dB (A).

[3] Sensitive premises are defined as premises occupied solely or mainly for residential or accommodation purposes; rural premises; caravan parks and camping grounds; Hospitals with less than 150 beds; rehabilitation centres, care institutions;

5.2.1 Influencing Factors

As Wedgefield is an industrial area there are no influencing factors that are applicable.

5.2.2 Corrections for Characteristic of Noise

As Wedgefield is approximately 5.5km from Port Hedland it is expected that there will be no tonality in the received noise from the Port facility due to absorption in the atmosphere. No penalty will therefore be applicable to Wedgfield.

5.2.3 Assigned Noise Levels

The assigned levels for Wedgefield will therefore be the same as per the regulations for industrial areas.

5.3 Assigned Level Evaluation for South Hedland

South Hedland can be classified as predominately residential. For the purposes of this report and for evaluation purposes the commercial area of South Hedland will not be considered since the most restrictive assigned noise levels for the town is due to noise sensitive premises. Therefore, South Hedland will be subject to assigned levels as per the regulation for noise sensitive premises.

5.3.1 Influencing Factors

Since there are large areas of South Hedland which are zoned residential, the influencing factor has been assumed to be 0. The limits as per the regulation for noise sensitive areas will be used as a worst case scenario for all areas in South Hedland.

5.3.2 Corrections for Characteristic of Noise

As South Hedland is approximately 9km from Port Hedland it is expected that there will be no tonality in the received noise from the Port facility due to absorption in the atmosphere. No penalty will therefore be applicable to South Hedland.

5.3.3 Assigned Noise Levels

The assigned levels for South Hedland will therefore remain as per the regulations.

5.4 Assigned and Maximum Allowable Noise Levels for Port Hedland, South Hedland and Wedgefield

The maximum allowable[4] noise level represents the maximum noise level allowed to be received at a premises to ensure compliance with the assigned noise levels of the Environmental Protection

educational institutions; premises used for public worship; hotels; premises for aged and child care; prisons and detention centres.

[4] An example of maximum allowable level is as follows: The assigned level for night time residential areas is 35dB(A). An influencing factor is added if the resident is within 100m of a commercial area or 450m of an industrial area. For the Hospital the influencing factor has been calculated to be 2dB. The adjusted regulatory limit is therefore 35dB(A) + 2dB which is 37dB(A). If a measurement is taken at the Hospital and it is found to 37dB(A) with a tonal signal from the BHPBIO facility present in the noise then a 5dB penalty will be applied. The effective noise limit will be 37dB(A) -5dB which is 32dB(A). According to the regulation BHPBIO will therefore not be compliant. As site measurements have indicated that a tonal signal from the facility is present up to the corner of McGregor and Lukis streets the assigned level has been adjusted

(Noise) Regulations 1997. The maximum allowable noise level takes characteristic noise into account. The maximum allowable noise levels for the various point receivers are given in Table 5-5.

Table 5-5: Assigned noise levels for noise sensitive premises including 5dB penalty for tonality.

Position	Influencing Factor in dB	L_{A10} Assigned noise levels in dB(A) (applied for the in Isolation case)			Penalty	L_{A10} Maximum Allowable noise levels in dB(A) (applied for the cumulative case)		
		Day	Evening	Night		Day	Evening	Night
Brearley St	2	47	42	37	5	42	37	32
Hospital	2	47	42	37	5	42	37	32
Police Station	17	62	57	52	5	57	52	47
Pretty Pool	0	45	40	35	0	45	40	35
South Hedland	0	45	40	35	0	45	40	35
Wedgefield Industrial Estate	NA	65	65	65	0	65	65	65
Rural Village	0	45	40	35	0	45	40	35

5.5 Regulation Applicable for Rail Operations

Rail and road noise in Western Australia is managed through the State Planning Policy 5.4 "*Road and Rail Transport Noise and Freight Considerations in Land Use Planning"* (SPP 5.4 gazetted September 2009) which was developed under the *Planning and Development Act 2005* in consultation with the Department of Environment and Conservation (DEC), Main Roads WA (MRWA), Public Transport Authority (PTA) and the Western Australia Local Government Association (WALGA).

The policy is only triggered by certain activities. If the expansion falls outside of the listed activities then the policy is not triggered. The following activities trigger the policy:

- New passenger and freight rail infrastructure projects;
- Major redevelopments of railways; and
- Minor redevelopments that are likely to adversely affect a noise-sensitive land use.

The policy defines a major redevelopment of a railway as follows:

- A proposed substantial realignment, either inside or outside the existing corridor, or
- A rail duplication; or
- Works that significantly increase capacity.

For the purposes of this policy, a minor redevelopment of a railway means minor works such as crossovers, sidings, turnouts, yards, loops, and refuges, relief lines, straightening of curves, re-sleepering or the installation of track signalling devices.

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by 5dB to compensate for the 5dB penalty. This new level is called the maximum allowable level and not the assigned level.

The outdoor noise assessment criteria is given in Table 5-6 and the criteria are applicable to the emission of road and rail transport noise as received at a noise-sensitive land use. These noise levels apply at noise-sensitive receivers, at 1m from the most exposed, habitable façade of the building, at each floor level, and within at least one outdoor living area on each residential lot. When predicting transport noise levels under this policy a +2.5dB façade correction is to be applied for both road and rail as explained in section 3.1 (page 5) of the "*Implementation Guidelines*" for State Planning Policy 5.4 "*Road and Rail Transport Noise and Freight Considerations in Land Use Planning*".

Table 5-6 **Outdoor noise criteria**

Time of day	Noise Target	Noise Limit
Day (6am – 10pm)	$L_{Aeq(Day)}$ = 55dB(A)	$L_{Aeq(Day)}$ = 60dB(A)
Night (10pm – 6am)	$L_{Aeq(Night)}$ = 50dB(A)	$L_{Aeq(Night)}$ = 55dB(A)

The 5dB difference between the outdoor noise target and the outdoor noise limit, as prescribed in Table 5-6, represents an acceptable margin for compliance. In most situations in which either the noise-sensitive land use or the major road or railway already exists, it should be practicable to achieve outdoor noise levels within this acceptable margin. In relation to Greenfield sites, however, there is an expectation that the design of the proposal will be consistent with the target ultimately being achieved.

6. METHODOLOGY

A review of the noise assessments[5] of the current infrastructure up to and including RGP 5 has been made in order to assess the work that has and is planned to be done on the Port Hedland port facility. Noise loggers were also deployed in March 2008 at various locations around Port Hedland for at least 14 days in order to get an indication of representative noise levels for the area under the RGP3 configuration. The representative noise levels are estimated using statistical values LA10 and LA90 which indicate the noise level exceeded for 10 % and 90 % of the recorded time.

Noise emission from the BHP Billiton Port Hedland facilities can be considered as consisting of two components, which will be assessed separately, they are as follows:

1) Port Facility; and

2) Rail Transport.

6.1 Methodology for Port Facility

A noise model was developed for RGP 3 which was the configuration at the time site verification was undertaken. The RGP 4 model was verified using site measurements taken at the end of August 2008 and February 2008 (see SVT Doc Rpt 05A 075063 Attended noise measurements Rev 0 May 09). Once the RGP 4 model had been verified, RGP 5 configurations were added to the model using similar noise sources from RGP 3 for all the new equipment that is to be installed. Similarly the Outer Harbour Development configurations (i.e. Stages 1 – 4) were added to the model.

Noise contours have been produced for the area surrounding the port facility, and noise levels have been predicted at various locations in Port Hedland, Wedgefield, Pretty Pool and South Hedland. The noise contours and noise level predictions have been developed for the case where all plant equipment is operating to provide a conservative assessment.

The output of the model was used to determine the noise control measures for various equipment items at the Port Hedland port facility.

6.2 Methodology for Rail Operations

A rail model was developed by sub-dividing the rail into different sections. Each rail section was allocated a rail speed and associated locomotive and car noise. The allocated rail noise levels were then used to calculate the received noise levels at the different receivers for one single rake. Once the noise levels were calculated for a single rake they were then used to calculate the received noise levels for the different applicable rail tonnages.

[5] Documents 60W-06-0107-TRP-1854262-draft January 07, 60W-06-0071-TRP-185321-4 -Sep-06, and 60W-06-0071-TRP-185321-3 -, Sep-06, provided by VIPAC Engineers and Scientists.

7. BACKGROUND NOISE MEASUREMENTS

Noise monitors were deployed in March 08 at eleven locations (see Table 7-1 and Figure 7-1) that were representative of noise sensitive locations in the area around the Port Hedland port operation facilities. The noise monitoring equipment was set to continuously record L_{A1}, L_{A10} and L_{A90} noise levels at 15 minute intervals, where:

- L_{A1} is the noise level exceeded for 1 % of the time;
- L_{A10} is the noise level exceeded for 10 % of the time; and
- L_{A90} is the noise level exceeded for 90 % of the time.

The logging was undertaken over two periods from 21 February to 5 March 2008 and from the 6 to the 20th March 2008 as shown in Table 7-1. During this time the temperature for the first logging period varied between 26 ^{0}C and 36^{0}C with a dominate NNE wind with a maximum wind speed of 37 km/h. During the second logging period the temperature varied between 25 ^{0}C and 36^{0}C with a dominate NNE and E wind with a maximum wind speed of 35 km/h

Table 7-1 Noise Logging Locations

Location	Position	Date
149 Anderson St, Port Hedland	S20^{0}18.633' E118^{0}36.324'	21/2/08 to 5/3/08
41A Styles Rd, Pretty Pool	S20^{0}19.022' E118^{0}38.463'	6/3/08 to 20/3/08
HBI Plant	S20^{0}23.046' E118^{0}32.278'	6/3/08 to 20/3/08
Golf Course	S20^{0}23.972' E118^{0}34.408'	21/2/08 to 5/3/08
Cooke Point Caravan Park	S 200 18.660' E 118 38.314'	6/3/08 to 20/3/08
Unit 1 Darlot Street, Port Hedland	S20^{0}18.629' E118^{0}35.031'	21/2/08 to 5/3/08
Rural Village (Acres)	S20^{0}27.233' E118^{0}35.706'	20/2/08 to 6/3/08
Telstra Building, South Hedland	S 200 24.476 E 1180 35.742	21/2/08 to 5/3/08
Hospital Engineering Building	S20^{0}18.650' E118^{0}35.422'	21/2/08 to 5/3/08
Police Station	S20^{0}18.756' E118^{0}34.610'	21/2/08 to 5/3/08
BGC Yard, Wedgefield	S20^{0}21.887' E118^{0}35.500'	21/2/08 to 5/3/08

Appendix D provides the results of the ambient noise monitoring recorded at each location. A summary table is provided which gives the average L_{A10} and L_{A90} values collected over the monitoring period during daytime hours, evening hours and night time hours, and for all periods combined. The standard deviations in the measurement results are also provided. The data has also been analysed to determine the L_{90} of the L_{A90} noise levels for the various time periods. This data provides a good indication of the lowest ambient noise levels. Charts showing the monitored noise data are also presented.

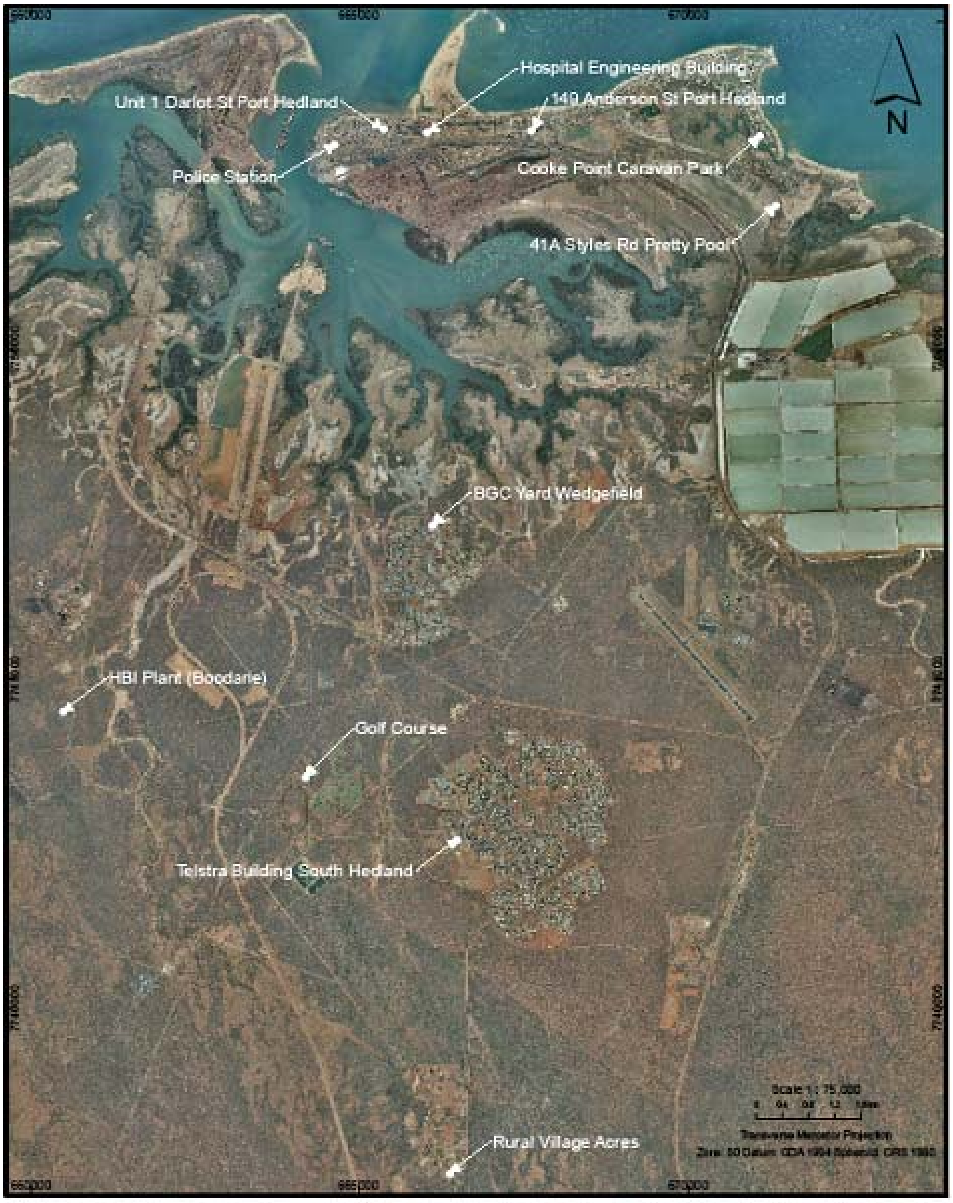


Figure 7-1 Noise Logging Positions in the Port Hedland area

7.1 Measured Background Noise Levels

The measured noise logging data statistics for the 11 noise logging positions is presented in Table 7-2 and the following paragraphs.

Table 7-2 Summary of Noise Logging Data showing the L_{A10}, L_{A90} and L_{A90} of L_{A90}

Location	Period	Average L_{A10} dB(A)	Standard Deviation of the L_{A10} dB	Average L_{A90} dB(A)	Standard Deviation of the L_{A90} dB	L_{90} of L_{A90} dB(A)
Hospital Engineering Building	Day (07:00 to 19:00 hrs)	56.9	3.3	50.1	3.4	46.0
	Evening (19:00 to 22:00 hrs)	53.2	2.6	47.9	2.3	45.5
	Night (22:00 to 07:00 hrs)	54.6	3.5	51.9	3.6	46.5
	All data	55.3	3.5	50.4	3.6	46.0
Police Station	Day (07:00 to 19:00 hrs)	55.9	3.5	48.3	3.1	44.5
	Evening (19:00 to 22:00 hrs)	52.2	3.3	45.6	3.0	42.5
	Night (22:00 to 07:00 hrs)	51.1	4.1	47.2	3.6	41.9
	All data	53.3	4.3	47.3	3.4	43.0
149 Anderson St, Port Hedland	Day (07:00 to 19:00 hrs)	53.9	4.9	44.6	4.2	38.5
	Evening (19:00 to 22:00 hrs)	50.6	6.2	43.2	4.9	35.7
	Night (22:00 to 07:00 hrs)	49.1	5.8	44.8	5.0	37.0
	All data	51.4	5.9	44.4	4.7	37.0
41A Styles Rd, Pretty Pool	Day (07:00 to 19:00 hrs)	54.5	4.2	44.1	4.9	37.5
	Evening (19:00 to 22:00 hrs)	51.1	4.4	42.8	4.2	37.5
	Night (22:00 to 07:00 hrs)	48.0	5.2	42.8	5.0	36.0
	All data	51.3	5.5	43.4	4.9	37.0
Cooke Point Caravan Park	Day (07:00 to 19:00 hrs)	46.8	7.1	39.1	6.8	29.5
	Evening (19:00 to 22:00 hrs)	46.6	6.6	39.0	5.5	32.0

Location	Period	Average L_{A10} dB(A)	Standard Deviation of the L_{A10} dB	Average L_{A90} dB(A)	Standard Deviation of the L_{A90} dB	L_{90} of L_{A90} dB(A)
	Night (22:00 to 07:00 hrs)	41.9	5.6	37.2	5.2	30.0
	All data	45.0	6.9	38.4	6.0	30.0
Telstra Building, South Hedland	Day (07:00 to 19:00 hrs)	54.1	2.9	49.3	2.3	46.0
	Evening (19:00 to 22:00 hrs)	51.4	2.7	47.4	2.2	44.5
	Night (22:00 to 07:00 hrs)	50.1	2.5	47.9	2.9	44.0
	All data	52.0	3.3	48.4	2.7	44.7
HBI BGC Yard, Wedgefield	Day (07:00 to 19:00 hrs)	49.0	4.5	40.9	4.5	35.0
	Evening (19:00 to 22:00 hrs)	45.2	5.6	37.9	3.8	33.0
	Night (22:00 to 07:00 hrs)	43.4	3.8	39.1	3.6	34.5
	All data	46.1	5.1	39.6	4.3	34.5
HBI Plant	Day (07:00 to 19:00 hrs)	49.4	8.3	42.8	7.4	33.5
	Evening (19:00 to 22:00 hrs)	47.2	7.0	41.9	6.4	34.5
	Night (22:00 to 07:00 hrs)	44.4	8.7	41.5	8.7	32.5
	All data	47.0	8.5	42.1	7.8	33.0
Rural Village (Acres)	Day (07:00 to 19:00 hrs)	44.2	7.4	34.0	4.8	29.0
	Evening (19:00 to 22:00 hrs)	44.7	7.5	35.1	3.8	31.0
	Night (22:00 to 07:00 hrs)	36.8	4.2	31.8	2.9	29.0
	All data	41.4	7.4	33.4	4.2	29.0

8. NOISE MODELLING – OVERVIEW

8.1 Noise Model Software

An acoustic model has been developed using the SoundPlan noise modelling program developed by SoundPlan LLC. The 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 receiver locations.

The model has been used to generate noise contours and predict noise levels at noise sensitive locations for the area around Port Hedland, South Hedland and Wedgefield.

8.2 Input Data

8.2.1 Source Sound Power Levels

Depending on the configuration the Port Hedland noise model consists of approximately 270 noise sources, which makes it a very detailed model. The sound power levels used in the model are derived from sound power levels calculated from on-site noise measurements. The on-site measurements consisted of nearfield noise measurements and in some cases far field noise measurements. In most cases the sound power levels were verified using two separate measurements. As a result there is a high level of confidence in the sound power levels entered into the model.

8.2.2 Topography and Ground Types

Topographical information for the noise model was provided in .dxf format files, which were imported into the noise model directly. Ground absorption for hard and soft surfaces is as specified by the CONCAWE[6] propagation algorithms. The ground absorption for the sea surface has been set to zero (perfectly reflecting), representing a realistic worst-case condition at the frequencies of interest. Soft ground has been used for land. Stockpiles in the form of berms have been included in the model. CONCAWE is a conservative algorithm, which has been shown to over predict, it is also accepted by the DEC.

8.2.3 Receiving Locations

The noise model has been used to predict noise levels at the seven locations at which baseline noise levels have been previously established. Those locations are as indicated in Table 8-1.

[6] 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 8-1 Co-ordinates of receiving locations

Receiver	Location	GPS co-ordinates (GDA-95)
R1	Brearley St , Port Hedland	7753338 N, 667699 E
R2	Hospital 7753, Port Hedland	7753424 N, 665799 E
R4	Police Station, Port Hedland	7753117 N, 664652 E
R5	Pretty Pool, Port Hedland	7752609 N, 671261 E
R6	South Hedland	7742771 N, 667852 E
R7	Wedgefield Industrial Estate	7746567 N, 666048 E

8.2.4 Meteorology

Certain meteorological conditions can increase noise levels at a receiving location by a process known as refraction. When refraction occurs, sound waves that would normally propagate directly outwards from a source can be bent downwards causing an increase in noise levels. Such refraction occurs during temperature inversions and where there is a wind gradient.

The SoundPlan noise model has a range of different algorithms which it can use to calculate noise levels for user defined meteorological conditions. The CONCAWE algorithm for industrial noise simulation has been used in the SoundPlan model to predict the sound levels at each of the point receiver locations and the 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; Pasquill Stability Class "E"; temperature - 20°C; and relative humidity – 50%.
- Night (19:00 – 07:00) wind speed – 3m/s; Pasquill Stability Class "F"; temperature – 15°C; and relative humidity – 50%.

The meteorological condition for night-time includes the refraction effects of sound waves during propagation in the parts of the atmosphere close to the ground. 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 night time meteorological conditions were used in the model as this represents the worst case conditions.

8.3 Noise model configurations

The following was modelled:

1) **Port Facility**. The port facilities were modelled for the following four situations:

- Outer Harbour Development divided into the following:
    1. Stage 1 : 60 MTpa
    2. Stage 2 : 120 MTpa
    3. Stage 3 : 180 MTpa

4. Stage 4 : 240 MTpa

2) **Rail Noise**. Rail noise was modelled for the rail from Bing Siding to Nelson Point and Finucane Island for the current rail operations and also for the proposed Western Spur and Boodarie rail loops for the Outer Harbour Development.

9. NOISE MODELLING – PORT FACILITY

9.1 Noise Modelling Results for RGP 5

The RGP 5 configuration used in the model is shown in Appendix A : (Nelson Point) and Appendix B : (Finucane Island). The worst case predicted noise levels at the point receivers for RGP 5 are given in Table 9-1. Figure 9-1 shows the noise contours for RGP 5.

Table 9-1 Point Receiver predictions for RGP 5 with Noise control

Receiver Locations	RGP 5 with noise control LA10 noise levels dB(A)
Brearley St	49.9
Rural Village	23.6
Hospital	58.2
Police Station	61.6
Pretty Pool	33.7
South Hedland	26.7
Wedgefield	35.5

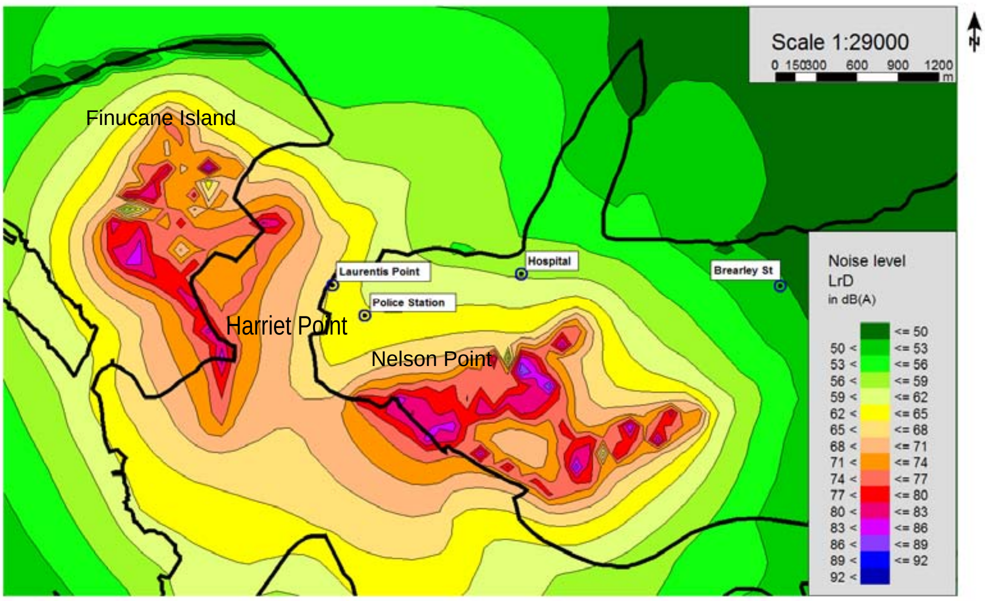


Figure 9-1 Noise contours of the Port Hedland area for RGP 5

9.2 Noise Modelling Results for Outer Harbour Development

The Outer Harbour Development configuration used in the model is shown in Figure 3-1. For this configuration it has been assumed that there is no noise control in place.

9.2.1 Outer Harbour Development Stage 1 in Isolation

The worst case predicted noise levels at the point receivers are given in Table 9-2. When the predicted Outer Harbour Development levels are considered in isolation, it can be seen that for the Outer Harbour Development Stage 1 received noise levels exceed the regulation at Hospital. Figure 9-2 shows the noise contours for Outer Harbour Development Stage 1.

Table 9-2 Point Receiver predictions for Outer Harbour Development Stage 1 in Isolation

Receiver Locations	Outer Harbour Development LA10 noise levels in Isolation dB(A)	LA10 assigned noise levels dB(A)
	Stage 1	
Brearley St	36.9	37
Hospital	43.0	37
Police Station	46.0	47
Pretty Pool	27.9	35
South Hedland	23.7	35
Wedgefield Industrial Estate	30.3	65

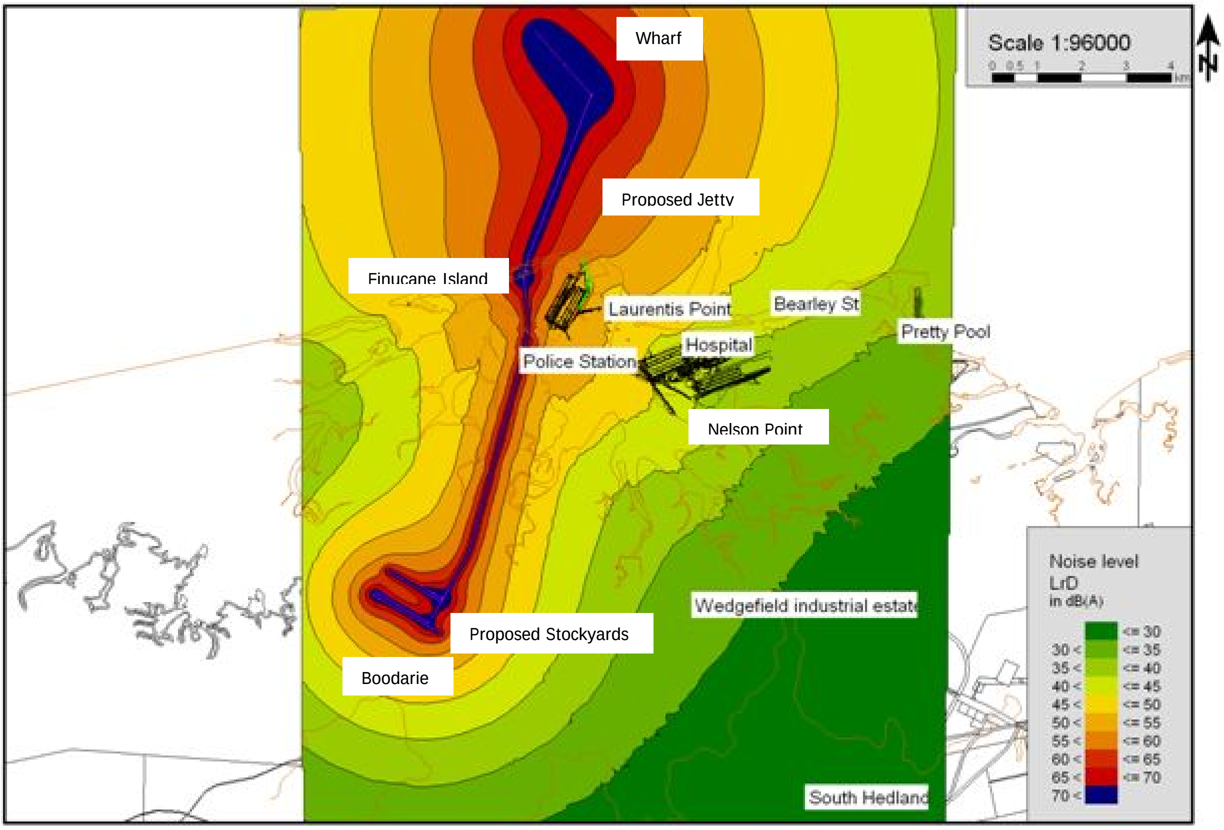


Figure 9-2 Noise contours of the Port Hedland area for Outer Harbour Development Stage 1

9.2.2 Cumulative Outer Harbour Development Stage 1 operating in conjunction with RGP 5

The cumulative noise levels for the Outer Harbour Development operating in conjunction with RGP 5 (current approved facility configuration) are shown in Table 9-3.

As can be seen from the table the received levels for all the receivers are higher than the predicted RGP 5 levels.

Table 9-3: Point Receiver predictions for Outer Harbour Development Stage 1 with RGP 5

Receiver Locations	Combined level, Outer Harbour Development with RGP 5 dB(A)	RGP 5 dB(A)
	Stage 1	
Brearley St	50.1	49.9
Hospital	58.3	58.2
Police Station	61.7	61.6
Pretty Pool	34.7	33.7
South Hedland	28.5	26.7
Wedgefield Industrial Estate	36.6	35.5

9.2.3 Point Calculations Outer Harbour Development Stage 2 to Stage 4 in Isolation

The worst case for noise levels at the point receivers for Stages 2 to 4 are given in Table 9-4. As can be seen from the table and as expected the received levels increase with each Stage. As can be seen from the table the received levels at Brearley St, the Hospital and the Police Station are above the received levels.

Table 9-4 Point Receiver predictions for Outer Harbour Development Stage 2 to Stage 4 in Isolation

Receiver Locations	Outer Harbour Development LA10 noise levels in Isolation dB(A)			LA10 assigned noise levels dB(A)
	Stage 2	Stage 3	Stage 4	
Brearley St	39.9	41.6	42.9	37
Hospital	46.0	47.8	49.1	37
Police Station	49.0	50.8	52.3	47
Pretty Pool	30.9	32.6	33.9	35
South Hedland	26.3	27.9	29.3	35
Wedgefield Industrial Estate	32.9	34.5	35.9	35

Figure 9-3 shows the noise contours for Outer Harbour Development Stage 4 in isolation.

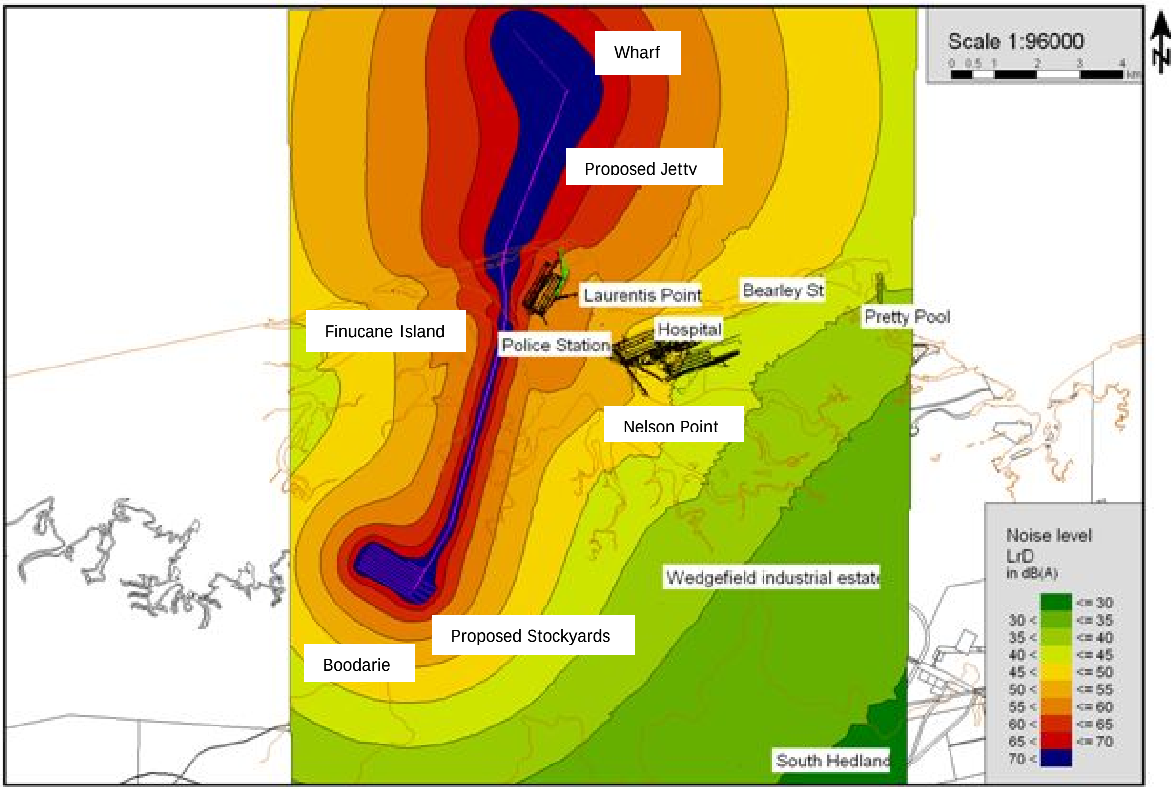


Figure 9-3 Noise contours of the Port Hedland area for Outer Harbour Development Stage 4

9.2.4 Cumulative Outer Harbour Development Stage 2 to Stage 4 operating in conjunction with RGP 5

Table 9-4 shows the increase in noise levels for the cumulative impacts (i.e. operation of the Outer Harbour Development operating in conjunction with RGP 5) for each successive Stage.

Table 9-5 Point Receiver predictions for Outer Harbour Development Stage 2 with RGP 5

Receiver Locations	RGP 5 dB(A)	Combined level, Outer Harbour Development with RGP 5 dB(A)		
		Stage 2	Stage 3	Stage 4
Brearley St	49.9	50.3	50.5	50.7
Hospital	58.2	58.5	58.6	58.7
Police Station	61.6	61.8	61.9	62.1
Pretty Pool	33.7	35.5	36.2	36.8
South Hedland	26.7	29.5	30.4	31.2
Wedgefield Industrial Estate	35.5	37.4	38.0	38.7

9.3 Summary of Results (Outer Harbour Development Stages 1 to 4)

Table 9-6 shows the difference between the assigned level and the Outer Harbour Development in isolation. As can be seen from the table the in isolation case exceeds the assigned levels at Brearley St, the Hospital, and the Police Station.

Table 9-6 Summary of results showing the assigned levels and Outer Harbour Development received level for Stages 1 to 4 in Isolation

Receiver Positions	LA10 noise levels in dB(A)				
	Assigned level	Outer Harbour Development in Isolation			
		Stage 1	Stage 2	Stage 3	Stage 4
Brearley St	37	36.9	39.9	41.6	42.9
Hospital	37	43.0	46.0	47.8	49.1
Police Station	52	46.0	49.0	50.8	52.3
Pretty Pool	35	27.9	30.9	32.6	33.9
South Hedland	35	23.7	26.3	27.9	29.3
Wedgefield Industrial Estate	65	30.3	32.9	34.5	35.9

Table 9-7 Summary of the difference between the assigned levels and Outer Harbour received levels for Stages 1 to 4 in Isolation in dB(A)

Receiver Positions	Difference in dB(A)				
	Assigned level	Outer Harbour Development in Isolation			
		Stage 1	Stage 2	Stage 3	Stage 4
Brearley St	37	-0.1	2.9	4.6	5.9
Hospital	37	6.0	9.0	10.8	12.1
Police Station	52	-6.0	-3.0	-1.2	0.3
Pretty Pool	35	-7.1	-4.1	-2.4	-1.1
South Hedland	35	-11.3	-8.7	-7.1	-5.7
Wedgefield Industrial Estate	65	-34.7	-32.1	-30.5	-29.1

Table 9-8 shows a summary of the predicted noise levels at the nominated receivers for the cumulative case.

Table 9-9 shows the difference between RGP 5 and the Outer Harbour Development Stages 1 to 4 with RGP 5 operating.

Table 9-8 Summary of results showing the assigned levels and the cumulative case (i.e RGP 5 and Outer Harbour Development received level for Stages 1 to 4)

Receiver Positions	LA10 noise levels in dB(A)				
	RGP 5	Outer Harbour Development with RGP 5 operating			
		Stage 1	Stage 2	Stage 3	Stage 4
Brearley St	49.9	50.1	50.3	50.5	50.7
Hospital	58.2	58.3	58.5	58.6	58.7
Police Station	61.6	61.7	61.8	61.9	62.1
Pretty Pool	33.7	34.7	35.5	36.2	36.8
South Hedland	26.7	28.5	29.5	30.4	31.2
Wedgefield Industrial Estate	35.5	36.6	37.4	38.0	38.7

Table 9-9: Summary of the difference between RGP 5 and Outer Harbour Stages 1 to 4 with RGP 5 operating

Receiver Positions	Difference in dB(A)				
	RGP 5	RGP 5 and Outer Harbour Development			
		Stage 1	Stage 2	Stage 3	Stage 4
Brearley St	49.9	12.9	12.9	12.9	12.9
Hospital	58.2	21.1	21.1	21.1	21.1
Police Station	61.6	9.6	9.6	9.6	9.6
Pretty Pool	33.7	-1.3	-1.3	-1.3	-1.3
South Hedland	26.7	-8.3	-8.3	-8.3	-8.3
Wedgefield Industrial Estate	35.5	-29.5	-29.5	-29.5	-29.5

9.4 Comparison of results at the Hospital

Figure 9-4 shows how the overall noise level at the Hospital changes with time. The changes are associated with the different Outer Harbour Development configurations and expected tonnage per year. The levels indicate worst case scenario (no additional noise reduction measures in place).

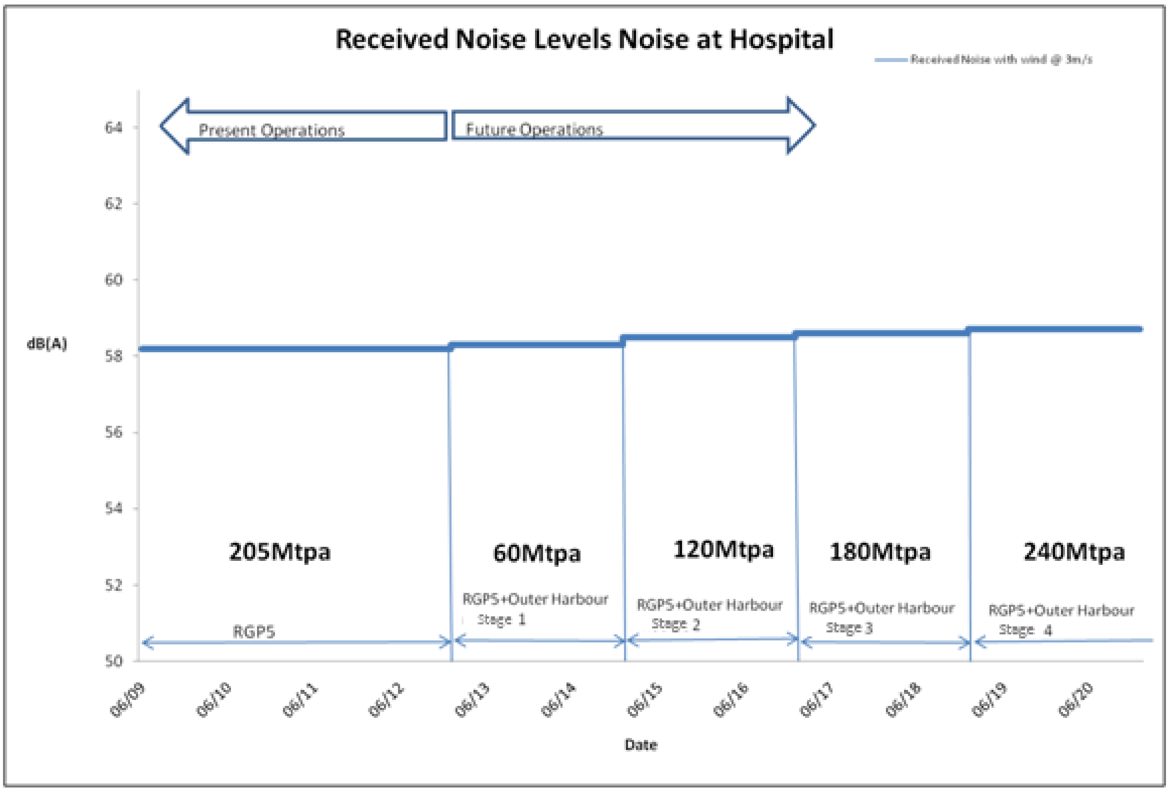


Figure 9-4 Hospital overall predicted noise levels for the different configurations.

10. ANALYSIS OF RESULTS, NOISE CONTROL AND ALARP

10.1 Methodology

The primary purpose of environmental noise control is to propose noise control measures that will reduce noise levels at the sensitive receivers so that they will be compliant with the assigned noise levels. Unfortunately this is not always feasible, as it may not always be possible to practicably implement noise control measures to the extent required to reduce noise at the receivers to a level which they are compliant with the assigned noise levels.

With the above in mind the methodology followed in this report is based on BHP Billiton Iron Ore's noise objectives which are as follows:

- Reduce noise to as low as reasonably practicable, acknowledging growth, and where reasonably possible, comply with the requirements of the Environmental Protection (Noise) regulations 1997 (including seeking an exemption if necessary);
- Where it is impracticable to comply with the Environmental Protection Noise Regulations, ensure continuous improvement is facilitated through a Noise Reduction Management Plan; and
- Ensure the new plant and infrastructure being planned for the Port facilities particularly Prescribed Plant as defined by the Environmental Protection Act, (1984) complies with the Environmental Protection (Noise) regulations 1997.

10.2 Cumulative Impact Compliance

To estimate the feasibility of achieving compliance the cumulative noise impact at the Hospital will be taken as a representative case. The rationale behind using the Hospital is that it has traditionally been used as the benchmark for noise sensitive receivers identified in BHP Billiton Iron Ore's Noise Reduction Management Plan (2009).

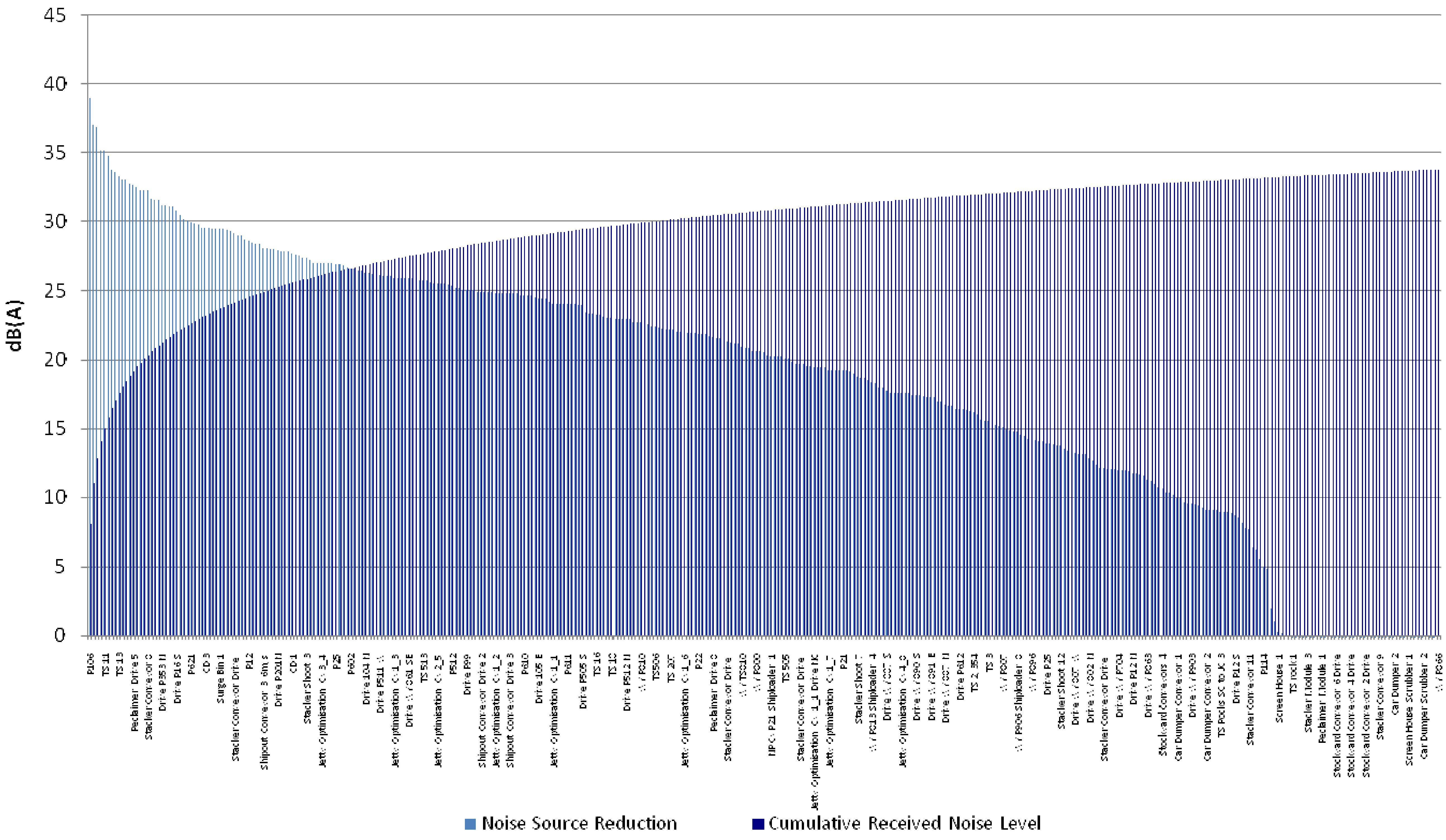


Figure 10-1 Pareto chart showing the noise contributions at the Hospital and the cumulative increase in the noise level at the Hospital with each noise source.

The Outer Harbour Stage 4 and RGP 5 has approximately 374 noise sources that contribute to the overall noise at the Hospital.[7] Figure 10-1 shows the required noise reduction for each noise sources in order to achieve compliance with the most stringent assigned level (i.e. 32dB (A) at night time). The figure also shows the growth in accumulated noise as each noise source is added to the overall noise level at the Hospital.

As can be seen from the figure each noise source from the facility needs to be reduced, with the highest noise sources requiring up to a 40dB reduction, and with the less significant noise contributors requiring a noise reduction between 30 and 1dB. This level of noise reduction will achieve a noise level of 32 dB (A) at the Hospital it will also be a huge undertaking, and is not considered reasonably practicable.

10.3 In Isolation Compliance

Table 10-1 shows the predicted noise levels at each receiver for each Stage of the Outer Harbour Development in isolation. The regulatory exceedances are shown highlighted in red. As can be seen from the table the levels are exceeded at Brearley Street, the Hospital, and the Police Station for Stage 2 to 4 and only Brearley St for Stage 1.

Considering the difference between the regulations and the levels predicted for the Outer Harbour Development in isolation case, the next Stage in the analysis will look at the practicability of achieving the regulation for the Outer Harbour Development in isolation only.

Table 10-1 Predicted results for Outer Harbour Development in Isolation and the Regulatory Limit for that Receiver

	Brearley St	Hospital	Police Station	Pretty Pool	South Hedland	Wedgefield
Stage 1	40.6	45.7	46.9	32.5	26.0	31.6
Stage 2	42.1	47.6	49.5	33.8	27.7	33.7
Stage 3	44.4	49.7	51.4	36.2	29.8	35.6
Stage 4	45.2	50.6	52.7	36.8	30.7	36.7
Regulations	37.0	37.0	47.0	35.0	35.0	65.0

10.4 Noise Control Philosophy

The next sections consider the recommended noise control for the in-isolation case and the cumulative case. In recommending the noise control the following has been taken into consideration:

1) **Noise Source Contribution Ranking**. Usually noise control starts with determining which noise sources are contributing significantly to the noise level at the different receivers. This is important as can be seen from Figure 10-1 where the first noise source contribution at the

[7] As can be seen from the figure in order to meet the assigned level at the Hospital 80% of the reduction in noise is achieved by reducing the noise emissions from the first noise source.

Hospital for Outer Harbour Development results in 80% of the noise at the Hospital. Therefore, in order to effectively reduce the noise at this receiver it is necessary to first address the primary noise sources at the receiver before addressing the less significant noise source contributors. Without addressing the primary noise source the overall noise level will not be significantly reduced.

2) **Baseline Noise Level.** The top noise source at a receiver that has the least practical attenuation will set the baseline for the minimum achievable noise level at that receiver. From this noise level a sliding scale of diminishing returns results. An example of this effect is conveyor P14 which has a stacker running along its length (see Figure 10-2). As the conveyor has a stacker running along its length the noise control options are limited to low noise idlers which can offer a noise reduction of approximately 5 dB. This will reduce the received noise level at the Hospital to approximately 44.2 dB (A). Which implies that if all the other noise sources are removed the lowest possible noise level at the Hospital will be 44.2 dB (A).

Figure 10-2 Picture of a stacker and reclaimer with their associated conveyor belt system

3) **Prioritisation of Noise Control for Multiple Receivers and Sources.** The Port Hedland model consists of over 246 noise sources and 7 noise sensitive receivers. The sensitive receivers are distributed both near and far from the facility. Each receiver has a different set of top noise contributors. In some cases the top noise source contributions are similar for some receivers, but not for all. In the cases where there is commonality between the top noise sources the ranking of the noise source is different between the receivers. In order to evaluate this complex situation the analysis of multiple noise sources and receivers will require a holistic approach. This is achieved in this analysis by determining the correlation between noise sources and the ranking of the noise source contribution at the different receivers. This has resulted in a weighting factor being applied to each noise source that will help prioritise noise control measures.

4) **Achieving ALARP**. In order to determine what is practical, factors such as cost, noise reduction at receiver, maintenance and safety will have to be taken into consideration. Ultimately these factors require interdisciplinary input.

10.5 Noise Control and ALARP

A detailed examination of engineering noise controls for the proposed Outer Harbour Development will be undertaken during preparation of the Works Approval application. An integrated approach will be taken that will focus on a range of factors such as:

- BHP Billiton Iron Ore's noise objectives;
- Magnitude of predicted noise impacts at the sensitive receptors;
- Ranking of noise source contributions at the sensitive receptors; and
- The principle of ALARP which balances noise attenuation with factors such as:
    - Safety;
    - Cost benefit analysis, considering total life cycle costs
    - Technical performance, reliability and on-going maintenance requirements; and
    - Operation and maintenance.

The prime aim of the integrated approach will be to meet BHP Billiton Iron Ore's noise objectives where reasonably practicable, based on optimization of noise controls across BHP Billiton Iron Ore's Port Hedland operations. The assessment of potential engineering noise control measures will include the installation of:

- Noise barriers;
- Enclosures for conveyor drives and transfer stations; and
- Low noise conveyor idlers.

The final package of engineering noise controls will be confirmed as part of the Works Approval application.

Table 10-5: Predicted results for the cumulative case (i.e. Outer Harbour operating in conjunction with RGP 5) with Noise control

RPG5+Outer Harbour	Brearley St dB(A)	Hospital dB(A)	Police Station dB(A)	Pretty Pool dB(A)	South Hedland dB(A)	Wedgefield dB(A)
Stage 1	49.8	57.6	61.1	33.7	26.8	35.6
Stage 2	49.8	57.6	61.1	33.7	26.9	35.7
Stage 3	49.8	57.6	61.1	33.8	27.2	35.9
Stage 4	49.8	57.6	61.1	33.8	27.4	36.1
RGP 5	49.9	58.2	61.6	33.7	26.7	35.5

11. RAIL MODELLING

A rail model has been developed for the Outer Harbour Development. This model includes the Western Spur and Boodarie loop. It also includes current rail operations for the main line rail from Bing Siding to Nelson point and from Bing Siding along the Goldsworthy line to Finucane Island. Rail operations in the yard at Nelson Point and at Finucane Island were also modelled. The noise model for rail operations has incorporated the following assumptions:

- The frequency of rail movements is independent of date and time;
- The meteorological conditions are for still air[8] at 15°C and 50% humidity;
- Train speed is maximum of 50 km/h for the rail and 20 km/h through the facility yards;
- Each full rake is loaded to capacity with 12373 T ore, and drawn by two locomotives;
- The number of empty ore car movements equals the number of fully loaded ore car movements;
- The model also includes rail squeal noise as the train negotiates the bends in the rail and shunting noises in the car dumper yards. The noise levels used in the model are based on the site measurements of each rail curve, radius of curvature was used to determine rail squeal for bends along the Western Spur and Boodarie Loop; and
- The sound levels of the trains in the model are based on measurements taken by SVT at BHP Billiton Iron Ore's Port Hedland facility along the rail in February and April 2009.

The model was calibrated based on verification measurements taken by SVT and using weather conditions as recorded by the Bureau of Meteorology in Port Hedland. The model has been shown to be accurate to 3dB. The layout of the model can be seen in Appendix F.

The layout of the Western Spur and Boodarie Loop can be seen as modelled in Appendix E.

11.1 Methodology

11.1.1 Measured Noise Levels

The sound power level of BHP Billiton Iron Ore locomotives and ore cars used in the model are based on measurements taken by SVT at BHP Billiton Iron Ore's Port Hedland facility. Sound power level summaries are presented in Table 11-1. The position number "P" is the location the measurement was taken and can be seen in Appendix F.

[8] The Draft Statement of Planning and Policy: Road and Rail Transport 2005 does not specify meteorological conditions and after model verification still air was a more accurate representation than 3m/s

Table 11-1Single Ore Car Sound Power Level

	Octave Band Sound Power Levels dB (lin)									
Position	31.5	63	125	250	500	1000	2000	4000	8000	Overall dB(A)
Loaded P3	88.1	98.2	95.6	95.9	88.2	81.4	85.9	82.3	75.0	94.8
Loaded P4	88.8	92.9	89.6	89.1	87.1	79.3	85.0	84.0	82.5	88.4
Unloaded P4	94.9	101.1	100.2	101.1	93.8	97.0	94.9	89.5	85.6	98.3
Unloaded P5	92.8	98.6	94.2	93.4	83.4	83.0	85.3	80.9	71.7	94.9
Unloaded P6	96.5	100.5	101.3	102.0	94.1	88.0	90.8	82.7	73.9	97.9
Loaded P8	92.4	99.3	106.6	96.4	92.8	89.7	88.5	87.2	84.3	99.6
Ore Car Loaded Straight	80.8	85.2	86.6	93.3	77.9	67.9	76.6	68.7	58.5	84.6
Squeal Loaded P6	79.1	88.3	98.2	96.9	95.0	86.5	90.3	90.1	87.1	92.0
Loaded P7	98.8	106.8	105.6	100.9	97.6	91.4	92.9	97.9	90.4	102.7
P1	84.9	96.3	92.8	85.5	84.6	81.8	89.8	96.5	93.9	93.6
P2	86.2	100.5	87.8	80.9	78.0	76.0	83.3	87.3	79.8	95.1

Table 11-2: Locomotive Sound Power Level

	Octave Band Sound Power Levels dB (lin)									
Position	31.5	63	125	250	500	1000	2000	4000	8000	Overall dB(A)
P3	92.0	119.3	100.4	101.6	91.7	90.0	87.8	83.1	82.2	107.2
P4 Unloaded	95.9	109.5	106.5	98.1	93.6	92.1	93.6	92.9	89.4	104.5
P5	94.7	105.5	98.1	93.5	89.6	87.7	86.8	80.4	73.4	102.1
P5 Unloaded	95.7	92.5	92.8	93.5	84.6	83.7	86.8	83.7	74.3	93.0
P6	94.4	106.4	108.3	98.7	95.1	92.3	92.4	92.2	90.0	102.7
P6 Unloaded	97.0	109.4	101.4	103.0	92.4	90.4	90.9	82.4	74.8	104.9
P8	89.0	98.0	105.9	96.7	91.3	87.4	86.7	86.8	83.1	99.3
Straight Loaded	95.4	106.1	106.0	93.2	86.3	83.6	84.3	82.3	74.9	102.1
P4	92.5	107.6	99.3	92.9	92.3	95.0	91.2	87.0	85.8	100.4

Table 11-3: Yard Sound Power Levels

	Octave Band Sound Power Levels dB (lin)									
Position	31.5	63	125	250	500	1000	2000	4000	8000	Overall dB(A)
Shunting Loaded	87.5	90.0	92.9	88.5	90.9	94.8	95.6	90.0	80.2	91.0
Rail Road 100	94.8	111.4	95.5	95.2	93.4	97.9	107.5	108.2	107.4	104.7
Shunting Unloaded	111.5	109.3	106.0	101.7	100.6	99.3	98.5	92.3	83.5	105.4
Yard Squeal	91.9	107.1	95.2	97.0	101.9	99.5	108.9	104.9	105.4	107.5

11.1.2 Rail Model Overview

The section of track was divided according to speed, radius of curvature of the track and loading of the ore cars. The model of the rail was then defined, as per Table 11-1 and Table 11-3. The NORD 2000 assessment method was used for the model calculations, based on Nordic Rail Traffic Noise Prediction Method (1984); the calculation is very intensive and uses the L_{Aeq} and L_{max} of the trains and considers the terrain and sound reflections.
For each receiver position:

- The pass-by duration and source-receiver range throughout one pass-by were determined;
- The L_{Aeq} for one train per hour was estimated, using the NORD 2000 standard propagation equations. This level was then averaged for a single pass-by event;
- The equivalent noise level was then corrected for the number of train pass-by events expected per 24 hour period to determine the $L_{Aeq,day}$ and $L_{Aeq,night}$ [9]; and

To evaluate the $L_{Aeq,day}$ and $L_{Aeq,night}$ the same frequency of train movements has been assumed for the day and night periods, hence the $L_{Aeq,day}$ and $L_{Aeq,night}$ is the same. The ore tonnage at each car dumper was changed for each different RGP model increasing the rail movements along each track according to tonnage. The tonnage for each car dumper (CD) can be seen in Table 11-4.

Table 11-4: Total ore production and number of rakes per day for Outer Harbour Development and RGP 5

	Total tonnage	Rakes per day
RGP 5	205	45
Stage 1	265	59
Stage 2	325	72
Stage 3	385	85
Stage 4	445	98

[9] The average frequency of day time rail movements can be expected to be equal to the average frequency of night time rail movements, and therefore the the $L_{Aeq,day}$ and the $L_{Aeq,night}$ are equal to the $L_{Aeq,24}$

11.2 Results

The predicted L_{Aeq} noise levels were calculated for worst case meteorological conditions (as outlined in 8.2.4 Meteorology). The predicted received levels at each sensitive receiver are shown in Table 11-5 for the Western Spur Railway in isolation and in Table 11-6 for the whole Port Hedland track including the western Spur.

Table 11-5 Predicted noise levels at the different sensitive receiver in Port Hedland, as a result of the Western Spur Rail in Isolation

Receiver	RGP5 Stage 1 265 MTpa (LAeq dB)	RGP5 Stage 2 325 MTpa (LAeq dB)	RGP5 Stage 3 385 MTpa (LAeq dB)	RGP5 Stage 4 445 MTpa (LAeq dB)
Brearley St	28.7	29.6	30.3	30.9
Green Acres	32.3	33.2	33.9	34.5
Hospital	30.3	31.2	31.9	32.5
Police Station	32.7	33.6	34.3	34.9
Pretty Pool	26.8	27.7	28.4	29.0
South Hedland	35.9	36.8	37.5	38.1
Wedgefield industrial estate	40.8	41.7	42.4	43.0

Table 11-6 Predicted noise levels at the different sensitive receiver in Port Hedland, as a result of the total railway in Port Hedland including the Western Spur

Receiver	RGP 5 205 MTpa (LAeq dB)	RGP5 Stage 1 265 MTpa (LAeq dB)	RGP5 Stage 2 325 MTpa (LAeq dB)	RGP5 Stage 3 385 MTpa (LAeq dB)	RGP5 Stage 4 445 MTpa (LAeq dB)
Brearley St	60.9	60.9	62.0	62.9	63.6
Green Acres	33.8	36.1	37.1	37.9	38.6
Hospital	57.8	57.8	58.9	59.8	60.5
Police Station	56.8	56.8	57.9	58.8	59.5
Pretty Pool	43.9	44.0	45.1	45.9	46.7
South Hedland	38.9	40.6	41.7	42.5	43.2
Wedgefield industrial estate	43.4	45.3	46.3	47.1	47.8

11.3 Noise Contour Plot

Results of the Noise contour plot for the Western Spur Rail modelled can be seen in Figure 11-1. The contours are for worst-case meteorological conditions given in Section 8.24 (i.e. for night-time sound propagation). The contours are shown in 5 dB intervals ranging from 30 dB (A) to 75 dB (A). Grid map resolution used for the calculation is 200m.

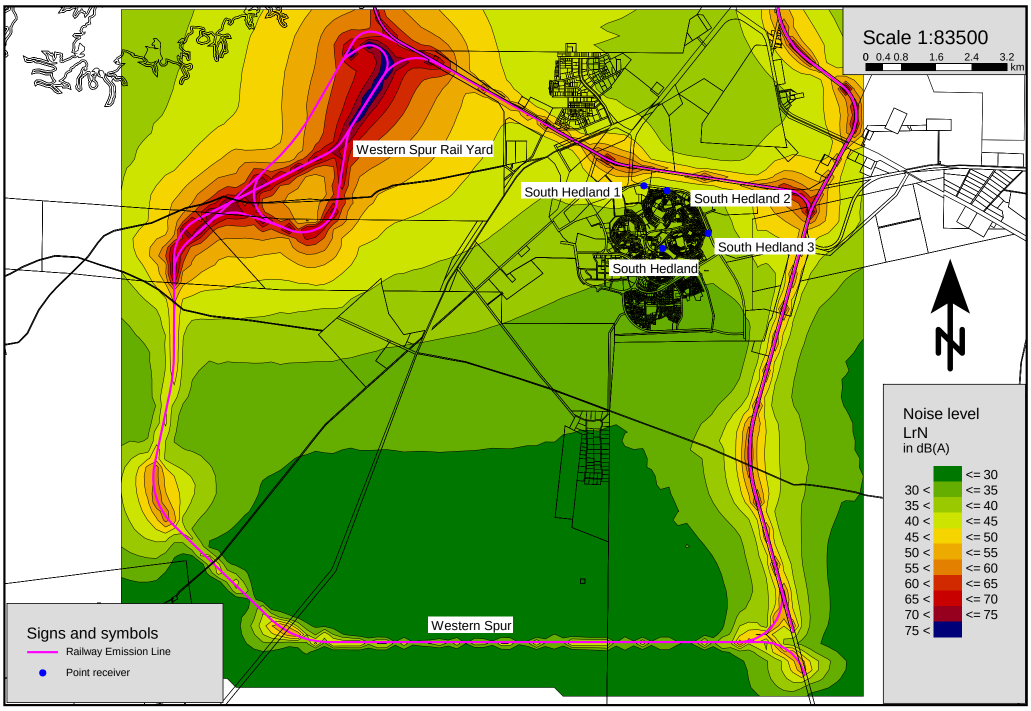
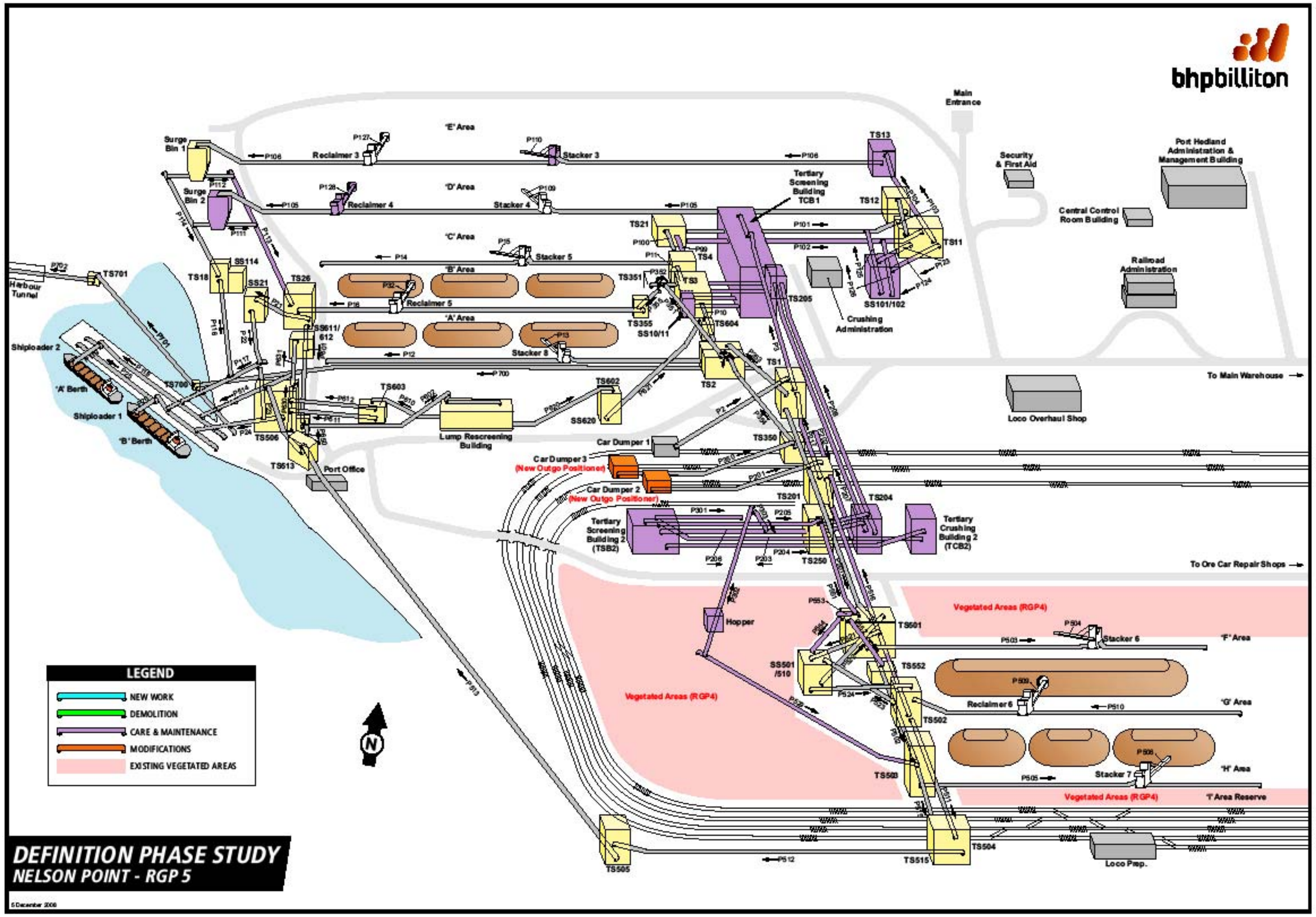


Figure 11-1: Western Spur Noise Contour Plot, for worst case meteorological conditions

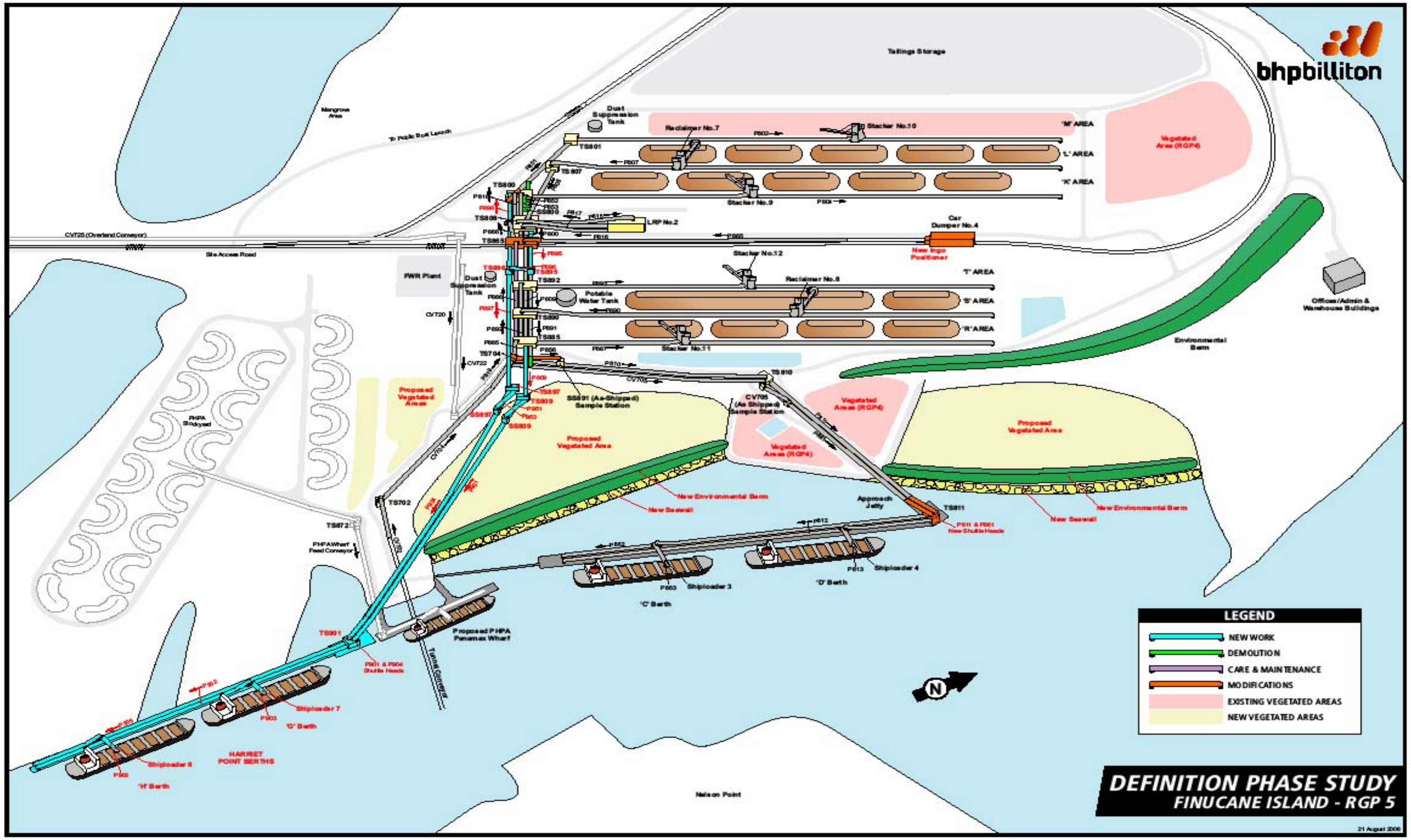
11.4 Assessment of Compliance

The number of rakes estimated for each configuration is based the present operational scenario of 140 MTpa which equates to approximately 31 rakes per day. As can be seen from Table 11-5 the predicted levels are below the noise target criteria for night time operations.

APPENDIX A : RGP 5 CONFIGURATION NELSON POINT



APPENDIX B : RGP 5 CONFIGURATION: FINUCANE ISLAND



APPENDIX C : SOURCE SWL

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
Conveyors											
NP CVP2	Port Hedland Nelson Point	93.6	97.4	95.3	93.5	89.3	84.0	83.5	78.1	71.3	101.7
NP CVP12	Port Hedland Nelson Point	90.0	94.5	93.2	91.4	88.9	84.8	81.5	73.8	66.3	99.3
NP CVP21	Port Hedland Nelson Point	94.9	95.7	93.1	90.6	89.8	84.5	81.7	74.8	69.1	100.6
NP CVP11	Port Hedland Nelson Point	96.2	102.1	96.2	95.9	93.2	88.9	87.4	81.9	75.1	105.0
NP CVP22	Port Hedland Nelson Point	93.5	97.4	94.4	91.5	88.2	83.5	83.1	72.4	67.0	101.2
NP CVP23	Port Hedland Nelson Point	91.7	96.3	95.2	92.7	90.8	86.0	84.3	76.9	70.3	101.1
NP CVP24	Port Hedland Nelson Point	89.0	93.6	94.0	89.9	86.9	81.8	80.6	71.7	65.0	98.7
NP CVP99	Port Hedland Nelson Point	94.6	97.9	92.8	91.3	89.9	85.9	82.5	75.3	71.1	101.4
NP CVP100	Port Hedland Nelson Point	95.1	103.3	93.6	92.4	90.4	86.2	82.3	76.1	71.1	104.9
NP CVP101	Port Hedland Nelson Point	84.6	87.1	87.0	85.4	83.8	81.6	78.0	71.8	68.2	93.3
NP CVP102	Port Hedland Nelson Point	96.3	93.9	90.4	87.4	87.5	85.5	81.2	73.4	67.1	99.7
NP CVP104	Port Hedland Nelson Point	101.3	94.2	87.6	90.7	85.7	82.0	78.5	72.4	66.9	102.7
NP CVP106	Port Hedland Nelson Point	95.1	91.5	88.6	86.0	87.5	83.2	79.4	71.9	67.6	98.2
NP CVP 14	Port Hedland Nelson Point	91.2	90.9	92.0	92.3	92.6	88.1	84.4	75.7	69.4	99.3
NP CVP16	Port Hedland Nelson Point	95.3	98.8	95.9	94.9	93.8	87.6	82.8	75.0	71.5	103.3
NP CVP112	Port Hedland Nelson Point	92.3	95.0	88.2	83.7	82.7	78.4	76.7	70.8	63.4	97.8
NP CVP113	Port Hedland Nelson Point	92.3	92.8	90.4	89.6	92.1	89.1	85.0	78.9	72.7	99.3
NP CVP203	Port Hedland Nelson Point	91.4	96.7	92.1	88.9	86.7	83.0	78.9	73.8	70.3	99.6
NP CVP204	Port Hedland Nelson Point	92.6	95.5	98.9	88.4	86.1	81.1	78.7	72.8	69.5	101.6
NP CVP206	Port Hedland Nelson Point	93.8	95.1	98.7	90.4	88.0	84.3	81.9	76.8	70.8	101.8
NP CVP207	Port Hedland Nelson Point	92.9	99.6	94.2	92.8	90.1	86.3	82.5	76.6	72.1	102.4
NP CVP208	Port Hedland Nelson Point	89.4	94.2	89.5	87.1	85.3	81.4	77.3	70.0	64.3	97.3
NP CVP350	Port Hedland Nelson Point	92.6	98.5	94.8	90.4	88.9	84.6	79.9	73.9	69.1	101.5
NP CVP353	Port Hedland Nelson Point	96.6	99.6	97.4	93.6	91.9	88.1	85.7	77.9	71.8	103.8
NP CVP354	Port Hedland Nelson Point	91.6	96.3	93.3	90.4	88.1	84.4	81.6	75.3	69.5	100.0
NP CVP505	Port Hedland Nelson Point	85.6	89.3	91.4	92.0	90.5	85.5	79.7	70.7	65.8	97.6

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
NP CVP510	Port Hedland Nelson Point	86.3	88.0	89.3	91.1	90.2	84.6	79.8	71.2	66.8	96.7
NP CVP511	Port Hedland Nelson Point	91.7	95.7	93.5	93.1	92.7	88.2	84.0	75.8	71.3	100.9
NP CVP512	Port Hedland Nelson Point	97.8	96.0	93.0	92.7	90.7	86.3	82.4	73.8	69.8	101.9
NP CVP513	Port Hedland Nelson Point	90.2	94.2	94.8	95.6	94.2	89.6	84.9	77.5	72.8	101.5
NP CVP701	Port Hedland Nelson Point	94.8	95.8	92.4	90.6	88.3	84.3	81.1	74.2	67.7	100.4
NP CVP702	Port Hedland Nelson Point	98.5	100.9	96.8	92.9	89.6	88.7	86.5	82.7	79.3	104.6
WY CVP705	Port Hedland Finucane Island	88.6	91.3	89.3	87.7	84.9	81.8	79.3	75.3	68.4	96.1
WY CVP800	Port Hedland Finucane Island	92.8	101.0	96.1	94.2	92.2	87.0	85.4	78.7	71.6	103.7
WY CVP801	Port Hedland Finucane Island	92.7	98.4	95.2	93.5	92.3	87.2	86.7	82.4	75.0	102.3
WY CVP802	Port Hedland Finucane Island	92.8	95.6	94.3	91.6	90.7	85.0	83.1	76.6	68.1	100.6
WY CVP804	Port Hedland Finucane Island	95.1	96.2	93.9	92.2	90.1	86.9	84.4	75.0	65.5	101.2
WY CVP807	Port Hedland Finucane Island	87.3	93.2	90.9	89.1	89.9	82.7	81.1	73.8	65.9	97.8
WY CVP809	Port Hedland Finucane Island	96.4	100.2	94.5	92.1	90.1	86.1	84.9	78.3	71.7	103.2
WY CVP810	Port Hedland Finucane Island	90.6	93.3	90.6	89.5	86.1	81.3	79.9	79.5	68.4	97.8
WY CVP811	Port Hedland Finucane Island	90.4	91.9	89.7	87.7	85.9	81.6	77.4	69.7	63.7	96.8
WY CVP812	Port Hedland Finucane Island	100.8	102.3	101.1	101.2	99.9	97.1	95.1	86.6	76.8	108.7
WY CVP815	Port Hedland Finucane Island	101.7	99.9	96.8	94.2	93.4	88.5	88.0	85.1	79.4	105.5
WY CVP816	Port Hedland Finucane Island	101.2	102.8	98.4	96.9	95.9	94.4	93.3	87.6	83.4	107.3
WY CVP861	Port Hedland Finucane Island	89.3	89.7	86.0	86.0	85.7	79.7	85.7	83.3	71.6	95.6
WY CVP862	Port Hedland Finucane Island	88.8	93.5	91.4	88.0	83.0	80.7	78.8	74.0	70.1	97.4

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
WY CVP865	Port Hedland Finucane Island	87.2	91.8	89.3	88.2	88.2	81.5	79.4	73.1	66.0	96.5
WY CVP890	Port Hedland Finucane Island	91.9	88.1	86.4	83.4	80.1	74.8	72.6	64.5	59.3	94.8
WY CVP891	Port Hedland Finucane Island	93.7	96.1	92.5	90.7	88.7	83.1	80.7	74.5	68.8	100.2
Drives											9.5
Drive NP CV2P N	Port Hedland Nelson Point	103.9	107.2	107.2	106.1	107.3	101.9	102.6	90.7	82.3	114.1
Drive NP CV2P S	Port Hedland Nelson Point	104.2	107.7	105.8	107.3	110.6	103.9	99.5	90.3	82.0	115.1
Drive NP CVP12 N	Port Hedland Nelson Point	99.5	104.0	104.9	107.5	114.1	110.0	109.8	92.1	84.1	117.6
Drive NP CVP12 S	Port Hedland Nelson Point	101.5	107.0	108.4	109.5	110.2	106.9	107.1	90.2	82.1	116.3
Drive NP CVP21 W	Port Hedland Nelson Point	103.2	107.7	108.2	106.1	106.6	104.3	99.7	96.2	93.1	114.4
Drive NP CVP22 S	Port Hedland Nelson Point	100.0	105.2	107.4	106.8	105.2	111.6	110.6	96.6	95.5	116.5
Drive NP CVP23 N	Port Hedland Nelson Point	98.9	105.6	105.5	107.3	112.7	110.0	107.4	101.1	92.1	116.9
Drive NP CVP24 E	Port Hedland Nelson Point	98.2	101.6	109.0	102.7	102.2	100.4	98.4	92.3	90.8	111.9
Drive NP CVP99 N	Port Hedland Nelson Point	96.9	102.8	100.8	100.7	100.8	103.6	98.9	89.0	83.3	109.6
Drive NP CVP100 S	Port Hedland Nelson Point	96.7	101.7	102.1	102.8	103.9	109.1	100.9	97.3	94.0	112.6
Drive NP CVP101 N	Port Hedland Nelson Point	93.0	98.2	100.3	111.5	105.5	101.5	97.4	88.5	82.4	113.4
Drive NP CVP102 E	Port Hedland Nelson Point	104.2	102.0	101.0	105.1	99.4	101.1	95.9	93.5	85.7	110.6
Drive NP CVP104 N	Port Hedland Nelson Point	104.3	102.4	100.6	99.4	102.0	101.2	92.8	88.9	80.1	109.9
Drive NP CVP106 E	Port Hedland Nelson Point	111.5	114.4	109.8	112.2	111.7	106.1	104.7	97.3	92.7	119.6
Drive NP CVP106 W	Port Hedland Nelson Point	114.2	115.9	111.8	111.5	109.1	104.9	105.7	98.5	95.4	120.4
Drive NP CVP14 N	Port Hedland Nelson Point	99.9	101.6	104.7	105.2	105.0	107.8	103.5	89.3	80.7	113.1
Drive NP CVP14 S	Port Hedland Nelson Point	101.1	101.2	105.0	105.7	105.1	105.2	100.5	89.0	79.5	112.4
Drive NP CVP16 N	Port Hedland Nelson Point	104.2	107.7	110.4	107.3	115.2	111.0	111.0	102.4	94.7	119.3
Drive NP CVP16 S	Port Hedland Nelson Point	103.8	108.9	110.6	108.3	117.5	112.7	114.8	104.1	94.1	121.3
Drive NP CVP112 E	Port Hedland Nelson Point	98.2	97.3	92.5	93.5	97.5	96.6	102.0	94.4	86.1	106.5
Drive NP CVP113 W	Port Hedland Nelson Point	106.9	108.0	112.9	111.7	113.5	113.4	110.9	99.9	97.6	120.1
Drive NP CVP203 N1	Port Hedland Nelson Point	110.2	110.4	108.1	109.1	106.0	106.6	105.6	97.9	91.0	116.9

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
Drive NP CVP203 N2	Port Hedland Nelson Point	109.8	111.4	108.9	109.4	106.1	108.0	105.2	96.2	90.0	117.3
Drive NP CVP203 S	Port Hedland Nelson Point	107.8	110.5	109.0	109.4	105.2	106.1	103.5	99.1	87.9	116.5
Drive NP CVP204 E	Port Hedland Nelson Point	99.7	104.7	105.5	111.4	104.3	103.5	98.3	94.3	85.7	114.3
Drive NP CVP204 W	Port Hedland Nelson Point	100.3	105.7	106.2	109.2	107.6	103.9	103.8	96.7	89.1	114.5
Drive NP CVP205 E	Port Hedland Nelson Point	106.7	110.0	106.5	106.1	106.0	105.2	100.0	96.5	91.9	115.1
Drive NP CVP206 E	Port Hedland Nelson Point	104.7	109.2	107.7	105.6	106.9	104.7	101.5	96.3	90.4	114.9
Drive NP CVP207 E	Port Hedland Nelson Point	98.9	104.4	107.5	106.4	112.3	106.0	104.9	97.0	89.4	115.8
Drive NP CVP208 W	Port Hedland Nelson Point	96.2	100.8	104.8	105.5	111.9	109.7	100.1	92.9	87.3	115.4
Drive NP CVP350 S	Port Hedland Nelson Point	96.1	104.2	104.2	96.4	99.0	98.9	88.1	80.1	73.4	108.9
Drive NP CVP353 N	Port Hedland Nelson Point	102.8	106.8	109.4	107.6	108.3	111.2	111.3	104.3	93.2	117.6
Drive NP CVP354 W	Port Hedland Nelson Point	99.7	104.8	104.6	103.8	106.0	108.8	99.4	91.9	88.7	113.4
Drive NP CVP504 N	Port Hedland Nelson Point	104.7	109.0	110.3	107.8	112.6	114.9	107.8	98.9	91.3	119.2
Drive NP CVP504 S	Port Hedland Nelson Point	103.4	108.5	108.3	106.8	108.4	113.7	104.8	96.5	89.8	117.4
Drive NP CVP510 N	Port Hedland Nelson Point	104.4	108.5	110.4	106.8	110.9	111.6	106.6	97.7	89.5	117.6
Drive NP CVP510 S	Port Hedland Nelson Point	104.6	108.8	107.8	105.1	108.9	106.7	99.8	92.4	85.8	115.2
Drive NP CVP511 W	Port Hedland Nelson Point	105.2	107.2	109.0	106.7	113.2	115.3	110.1	99.2	91.9	119.4
Drive NP CVP512 N	Port Hedland Nelson Point	104.0	105.2	108.2	106.1	109.9	112.8	108.1	99.4	91.5	117.2
Drive NP CVP513 W	Port Hedland Nelson Point	101.0	101.7	104.5	102.7	104.0	107.7	97.7	91.4	86.5	112.2
Drive NP CVP701 E	Port Hedland Nelson Point	104.6	109.8	108.7	106.0	108.8	111.8	109.3	101.7	93.5	117.6
Drive NP CVP701 W	Port Hedland Finucane Island	102.2	108.0	106.1	105.2	108.2	112.8	104.9	95.9	90.2	116.5
Drive WY CVP705 E	Port Hedland Finucane Island	111.0	114.5	105.9	107.1	109.6	114.8	102.9	95.3	87.2	119.6
Drive WY CVP800 E	Port Hedland Finucane Island	105.4	109.9	105.9	106.2	110.4	106.4	103.2	94.3	86.7	115.9
Drive WY CVP801 W	Port Hedland Finucane Island	101.8	109.6	105.9	104.4	105.0	105.6	99.5	92.7	84.0	114.0
Drive WY CVP802 N	Port Hedland Finucane Island	103.7	102.1	104.0	105.6	107.7	111.7	103.9	95.6	82.7	115.3

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
Drive WY CVP802 S	Port Hedland Finucane Island	104.6	101.8	104.6	105.6	111.7	110.5	103.6	96.1	82.6	116.0
Drive WY CVP804 W	Port Hedland Finucane Island	100.8	105.3	104.8	101.8	104.2	105.6	101.9	89.0	79.0	112.3
Drive WY CVP804 E	Port Hedland Finucane Island	99.8	106.3	105.0	103.3	109.1	105.9	97.9	89.3	79.7	113.7
Drive WY CVP807 W	Port Hedland Finucane Island	102.6	106.0	104.9	105.2	116.5	110.5	101.0	91.4	83.5	118.4
Drive WY CVP807 E	Port Hedland Finucane Island	102.0	105.2	104.8	104.9	108.1	107.5	100.5	90.1	82.1	113.9
Drive WY CVP809 S	Port Hedland Finucane Island	112.0	109.6	105.5	105.9	111.4	108.2	107.1	93.8	87.7	117.7
Drive WY CVP810 E	Port Hedland Finucane Island	106.0	108.0	105.6	107.2	111.5	109.4	104.4	94.0	88.1	116.5
Drive WY CVP811 N	Port Hedland Finucane Island	105.0	105.0	105.8	111.1	109.1	109.2	101.4	92.7	87.0	116.1
Drive WY CVP812 N	Port Hedland Finucane Island	107.9	111.8	113.8	111.8	117.9	121.2	112.8	102.7	92.5	124.4
Drive WY CVP815 W	Port Hedland Finucane Island	103.2	108.6	105.9	104.6	103.9	104.8	97.8	91.6	84.1	113.5
Drive WY CVP816 E	Port Hedland Finucane Island	106.9	109.6	108.5	107.0	107.4	109.0	104.3	93.2	84.7	116.3
Drive WY CVP861 SE	Port Hedland Finucane Island	113.2	114.9	111.0	113.3	116.4	108.3	105.7	99.9	93.2	121.5
Drive WY CVP862 W	Port Hedland Finucane Island	104.1	106.4	106.7	107.3	113.9	114.4	104.0	95.2	86.6	118.6
Drive WY CVP865 E	Port Hedland Finucane Island	110.7	116.3	111.2	111.8	112.2	111.6	101.0	95.6	85.9	120.6
Drive WY CVP865 W	Port Hedland Finucane Island	110.8	119.0	113.3	110.6	108.9	111.1	99.4	93.3	83.8	121.6
Drive WY CVP891 E	Port Hedland Finucane Island	104.6	104.4	103.4	103.3	109.9	109.9	105.0	92.0	85.4	115.1
Other											
Conveyor NP Reclaimer 5	Port Hedland	88.9	94.5	95.1	95.5	94.5	88.0	83.0	76.0	69.7	101.5
Conveyor NP Stacker 5	Port Hedland	89.0	93.3	94.1	92.2	93.3	93.1	89.3	81.4	75.9	100.9
Drive Bucket NP Reclaimer 5	Port Hedland	99.4	101.4	106.2	106.8	104.7	109.1	101.7	95.9	86.0	113.8

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
Drive Conveyor NP Reclaimer	Port Hedland	104.1	106.1	110.9	111.4	109.4	113.8	106.4	100.5	90.6	118.5
Shoot NP Reclaimer 5	Port Hedland	101.0	98.0	100.5	101.2	101.4	102.8	98.1	95.1	87.3	109.4
Drive NP Stacker 5	Port Hedland	98.7	104.1	107.2	105.5	104.7	103.8	102.5	92.7	85.7	112.9
Shoot NP Stacker 5	Port Hedland	97.3	105.0	108.6	105.1	105.4	101.1	96.5	89.2	81.6	112.9
WY CD 4	Port Hedland	122.9	123.1	118.2	113.9	107.5	104.3	100.8	97.6	88.0	127.0
WY LRP Suttle Level	Port Hedland	119.6	117.9	111.9	108.8	103.5	101.5	99.9	95.9	89.5	122.6
WY LRP Feeder	Port Hedland	113.5	124.6	119.4	115.9	108.5	105.1	102.8	99.7	89.2	126.5
WY LRP Screening	Port Hedland	124.7	124.8	122.0	120.0	113.5	112.6	109.6	107.7	105.8	129.6
WY LRP Bins	Port Hedland	127.5	126.4	122.7	120.4	118.9	118.7	116.4	111.6	104.9	131.8
Transfer Station 4 Shoot1	Port Hedland	100.2	105.1	104.1	101.9	107.9	104.8	98.4	91.7	84.8	112.7
Transfer Station 4 Drive1	Port Hedland	97.2	101.8	102.6	102.6	106.9	103.1	98.4	92.3	86.8	111.3
Transfer Station (1,1)	Port Hedland	100.2	105.1	104.1	101.9	107.9	104.8	98.4	91.7	84.8	112.7
Transfer Station (1,2)	Port Hedland	103.2	108.1	107.1	105.0	110.9	107.8	101.4	94.7	87.8	115.7
Transfer Station (2,1)	Port Hedland	100.2	105.1	104.1	101.9	107.9	104.8	98.4	91.7	84.8	112.7
Transfer Station (2,2)	Port Hedland	103.2	108.1	107.1	105.0	110.9	107.8	101.4	94.7	87.8	115.7
Transfer Station (2,4)	Port Hedland	106.2	111.1	110.1	108.0	113.9	110.9	104.4	97.7	90.8	118.7
Transfer Station (3,1)	Port Hedland	100.2	105.1	104.1	101.9	107.9	104.8	98.4	91.7	84.8	112.7
Transfer Station (3,3)	Port Hedland	105.0	109.9	108.9	106.7	112.7	109.6	103.2	96.5	89.6	117.4
Transfer Station (4,4)	Port Hedland	106.2	111.1	110.1	108.0	113.9	110.9	104.4	97.7	90.8	118.7
Lump Re - Shuttle	Port Hedland	91.6	90.0	83.9	80.9	75.5	73.5	71.9	68.0	61.6	94.6
Lump Re - Bins	Port Hedland	81.7	92.8	87.7	84.1	76.7	73.3	71.1	67.9	57.4	94.8
Lump Re -Feeder	Port Hedland	87.1	90.3	84.9	81.5	74.8	71.9	70.0	66.5	58.3	93.2
Lump Re - Screen	Port Hedland	85.4	90.2	83.7	79.7	76.8	73.4	69.1	66.8	58.7	92.6
Lump Re - Shuttle Point	Port Hedland	117.7	116.1	110.0	107.0	101.6	99.6	98.0	94.1	87.7	120.7
Lump Re - Bins Point	Port Hedland	110.1	121.2	116.0	112.5	105.1	101.7	99.4	96.3	85.8	123.1
Lump Re -Feeder Point	Port Hedland	116.5	119.7	114.3	110.9	104.1	101.3	99.3	95.8	87.6	122.6
Lump Re - Screen Point	Port Hedland	114.8	119.5	113.0	109.0	106.2	102.8	98.5	96.1	88.1	121.9
Lump Rescreening Building	Port Hedland	121.6	125.5	119.9	116.3	110.6	107.5	104.9	101.7	93.4	128.2
TCB 1	Port Hedland	124.6	128.5	122.9	119.3	113.6	110.5	107.9	104.7	96.4	131.2
Car Dumper	Port Hedland	116.7	112.6	110.1	105.1	104.9	101.5	97	91.8	86.6	119.2
Car Dumper Scrubber stack vent	Port Hedland	112	110.3	105.3	100.2	98.1	92	85	81.4	78.6	115
Car Dumper to Stock Yard Conveyor	Port Hedland	87.4	91	91.2	91.7	90	85.6	82.8	76.2	67.1	97.9
Car Dumper to Stock Yard Conveyor Drive	Port Hedland	100.8	109	111.2	109.5	106.9	113.4	103	96.5	88.9	117.8

Element name	Comment	31Hz dB(Z)	63Hz dB(Z)	125Hz dB(Z)	250Hz dB(Z)	500Hz dB(Z)	1kHz dB(Z)	2kHz dB(Z)	4kHz dB(Z)	8kHz dB(Z)	O/A dB(Z)
Screen House	Port Hedland	128	116.8	113.8	110.4	108.5	107	107.2	107.3	105	128.7
Screen House Scrubber stack vent	Port Hedland	112	110.3	105.3	100.2	98.1	92	85	81.4	78.6	115
Stockyard conveyors	Port Hedland	84.1	93	93.7	90.4	89.4	82.9	79.6	75.2	67.5	98.4
Stockyard Conveyor Drive	Port Hedland	100.8	109	111.2	109.5	106.9	113.4	103	96.5	88.9	117.8
Overland conveyor	Port Hedland	91.6	94.7	98.7	98	96.1	92.4	89.3	81.4	73.2	104
Overland Conveyor Drive	Port Hedland	109.4	114	118.8	116.6	123.3	122.4	116.3	105.6	98	127.7
Stacker	Port Hedland	107.2	112.1	113.5	112.8	113.5	113.7	106.6	99	92.5	120.6
Reclaimer	Port Hedland	105.1	113	113.1	111.1	111	110	102.7	97	90.6	119.1
TS Rocks	Port Hedland	101.6	105.6	107.7	110.1	114.1	116.3	115.8	112.9	109.2	121.9
Optimisation - Wharf Conveyor Drive	Port Hedland	103.4	108	112.8	110.6	117.3	116.4	110.3	99.6	92	121.7
Optimisation - Jetty Conveyor 6m/s	Port Hedland	85.6	88.7	92.7	92	90.1	86.4	83.3	75.4	67.2	98

APPENDIX D : NOISE MONITORING CHART

Appendix D-1 : Hospital

The results show a typical daily cycle of noise levels with higher levels experienced during daytime hours. The L_{A90} was found to be on average 50.4 dB(A) with the highest value at night where the L_{A90} was found to be 51.9 dB(A). The high L_{A90} noise level observed could be either due to a localized noise source or due to the consistent emissions from the BHP Billiton Iron Ore facility which is a 24/7 operation.

An interesting observation is that the background noise measurements at the Hospital are a lot less than the predicted noise levels from the model. This can be attributed to the fact that the model is making predictions for the worst case meteorological condition and that the model is making a prediction based on the assumption that all plant equipment is working simultaneously. The last assumption is rarely (if ever) the case for Port Operations as there is always equipment undergoing maintenance and different configurations are being used depending on operational equipments. It is therefore a worst case prediction.

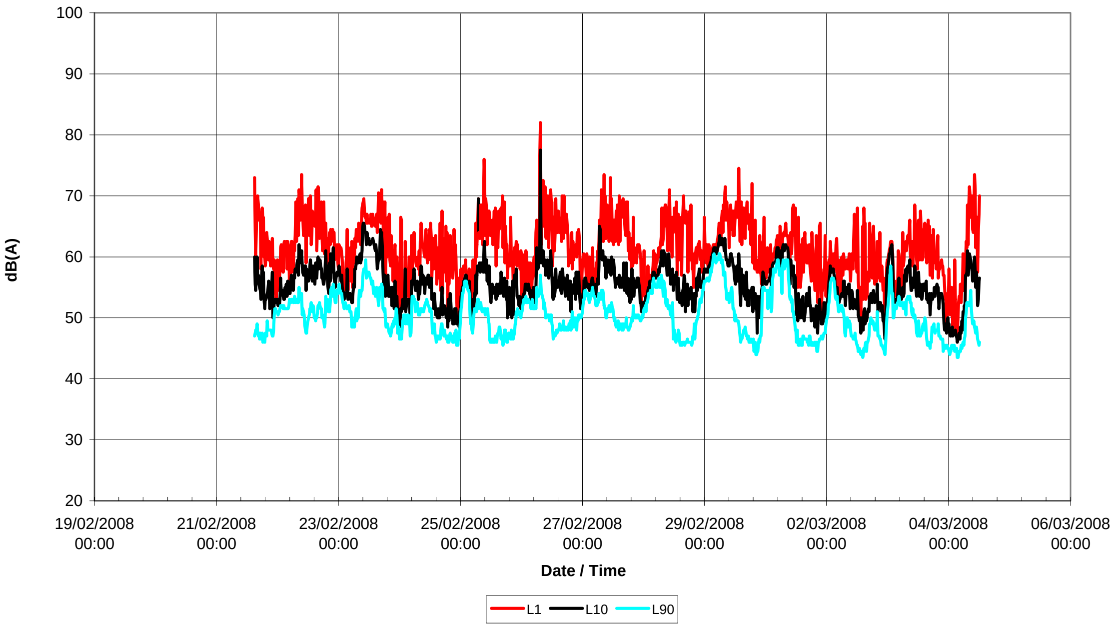


Figure 11-2 Hospital noise monitoring results for week 1 and week 2

Appendix D-2 : Police Station

The results show a typical daily cycle of noise levels with higher levels experienced during daytime hours. For significant periods during the monitoring, L_{A90} noise levels were consistent at approximately 47.3 dB(A), possibly indicating the presence of a localized noise source. The 85 dB(A) peak shown in Figure 11-3 is probably attributed to some localized noise source that was in close proximity of the noise logger for a short duration of time.

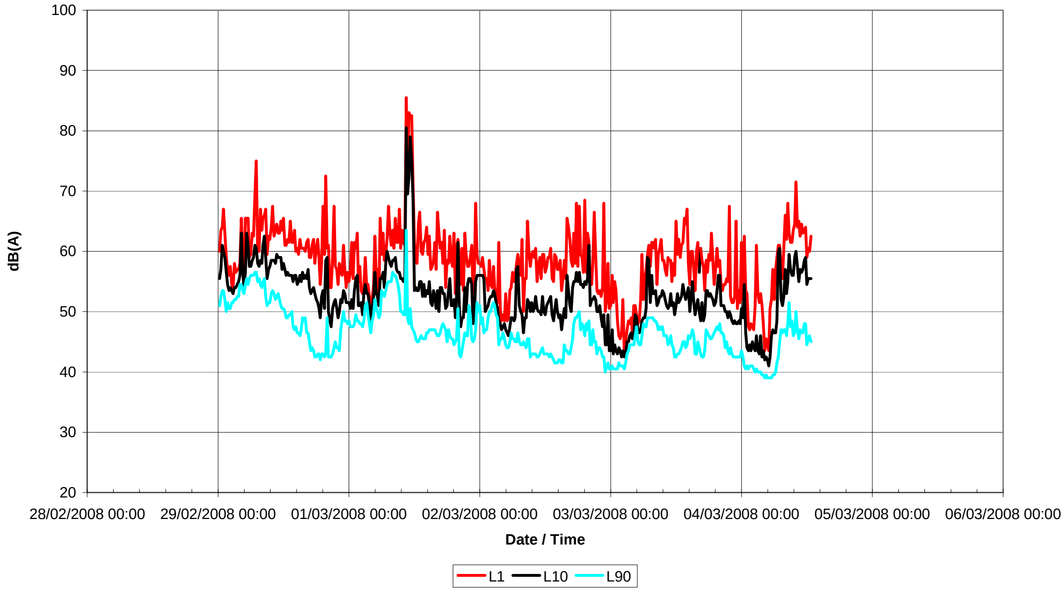


Figure 11-3 Police Station noise monitoring results for week 1 and week 2

Appendix D-3 : 149 Anderson Street Port Hedland

The results show a typical daily cycle of noise levels with higher levels (i.e. L_{A10}) experienced during daytime hours. The L_{A90} were found to be on average 44.4 dB(A) with the highest value at night where the L_{A90} was found to be 44.8 dB(A).

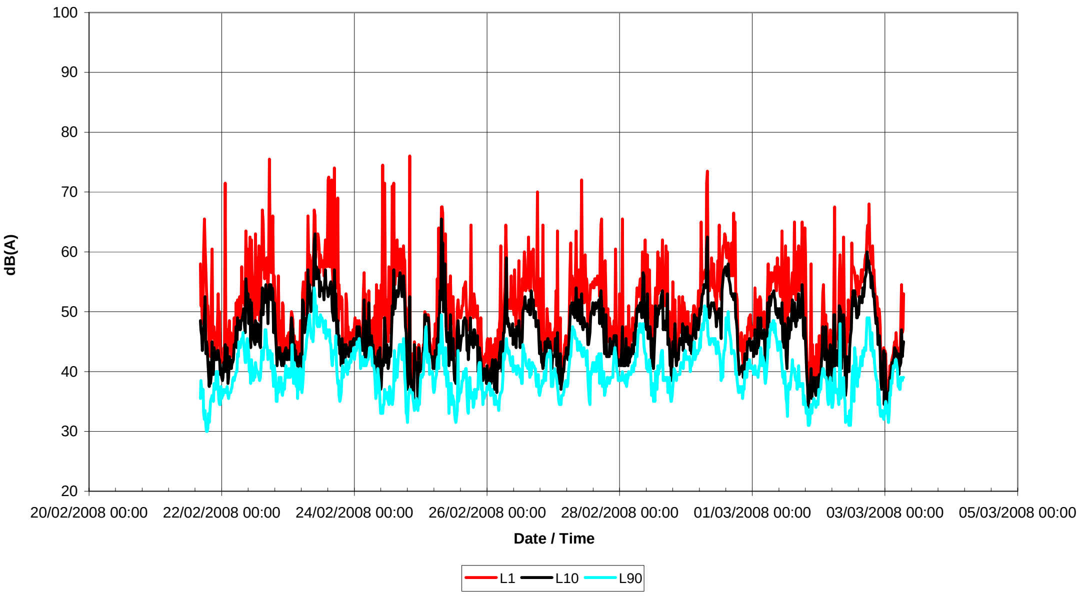


Figure 11-4 149 Anderson St noise monitoring results for week 1 and week 2

Appendix D-4 : Pretty Pool

The results show a typical daily cycle of noise levels with higher levels (i.e. L_{A10}) experienced during daytime hours. The L_{A90} was found to be on average 43.4 dB(A).

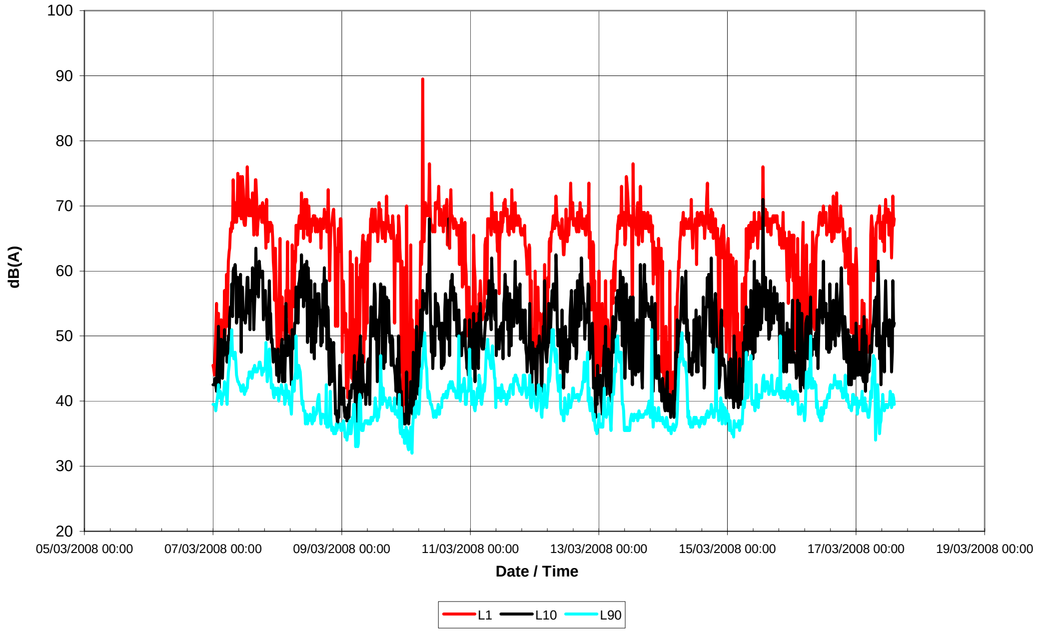


Figure 11-5 Pretty Pool noise monitoring results for week 1 and week 2

Appendix D-5 : Cooke Point

The results show a typical daily cycle of noise levels with higher levels (i.e. L_{A10}) experienced during daytime hours. The L_{A90} was found to be on average 38.4 dB(A) with the highest average value being during daytime hours where the average L_{A90} was calculated as 39.1 dB(A).

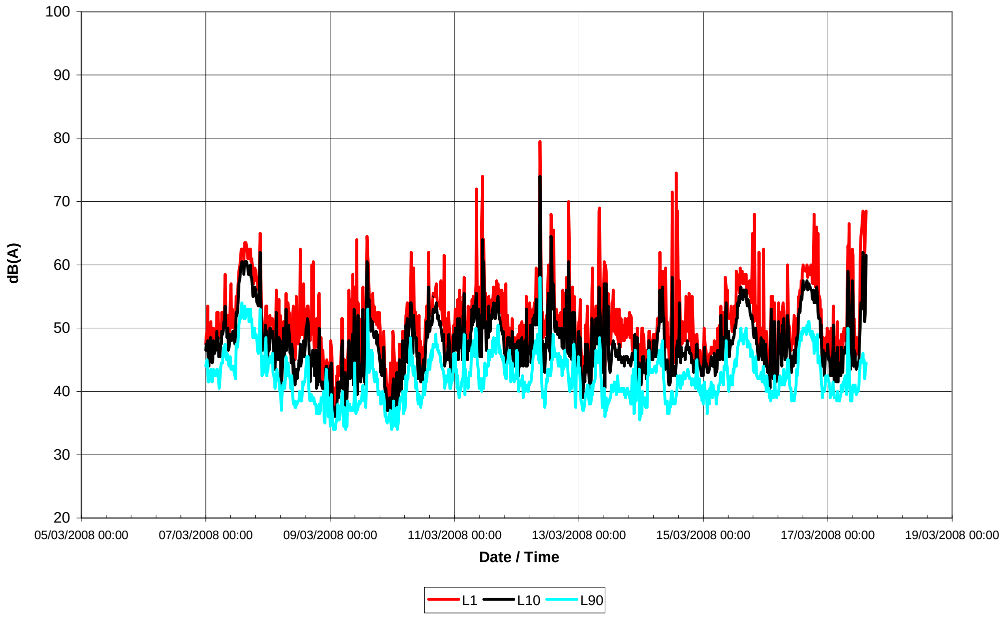


Figure 11-6 Cooke Point noise monitoring results for week 1 and week 2

Appendix D-6 : South Hedland

The results show a typical daily cycle of noise levels with higher levels (i.e. L_{A10}) experienced during daytime hours. The L_{A90} was found to be on average 48.4 dB(A) with the highest average value being during daytime hours where the L_{A90} was found to be 49.3 dB(A).

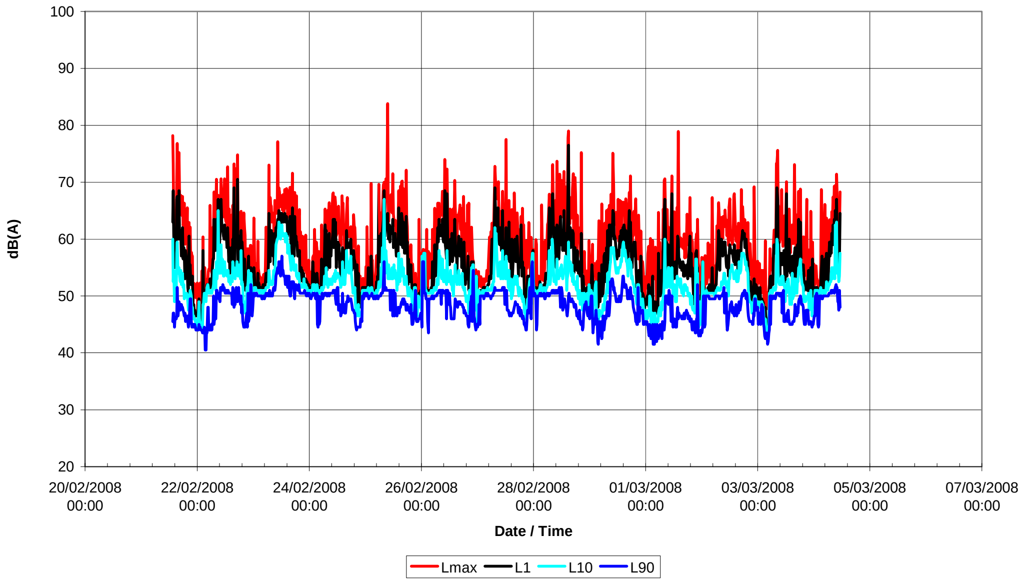


Figure 11-7 South Hedland noise monitoring results for week 1 and week 2

Appendix D-7 : Wedgefield

The results show a typical daily cycle of noise levels with higher levels (i.e. L_{A10}) experienced during daytime hours. The L_{A90} was found to be on average 39.6 dB(A) with the highest value during daytime where the L_{A90} was found to be 40.9 dB(A). As Wedgefield is an industrial area the data seems to indicate that most of the industrial activities take place during daytime hours..

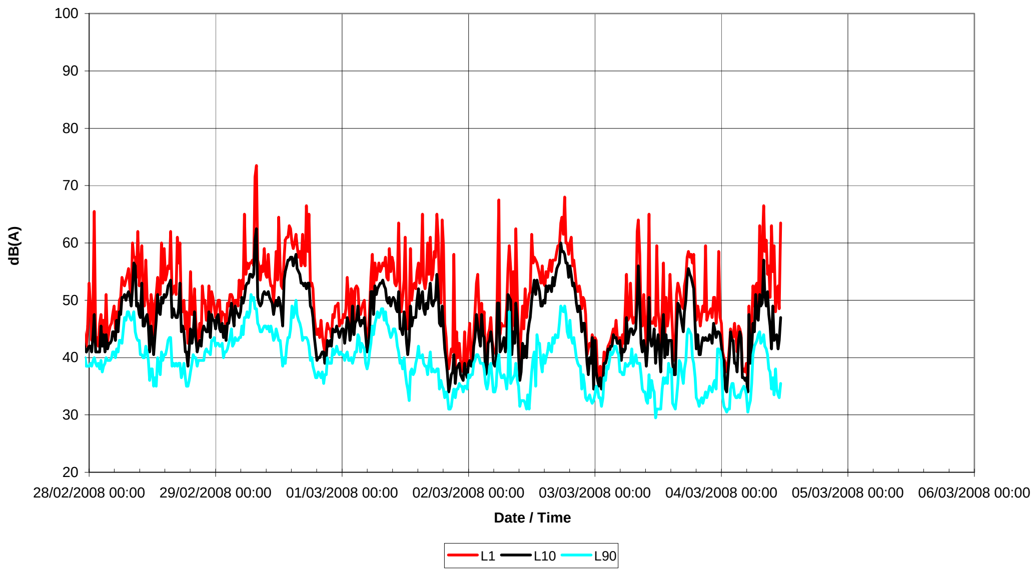


Figure 11-8 Wedgfield noise monitoring results for week 1 and week 2

Appendix D-8 : HBI Plant

The results show a typical daily cycle of noise levels with higher levels (i.e. L_{A10}) experienced during daytime hours. The L_{A90} was found to be on average 42.1 dB(A) with the highest value during daytime where the L_{A90} was found to be 42.8 dB(A).

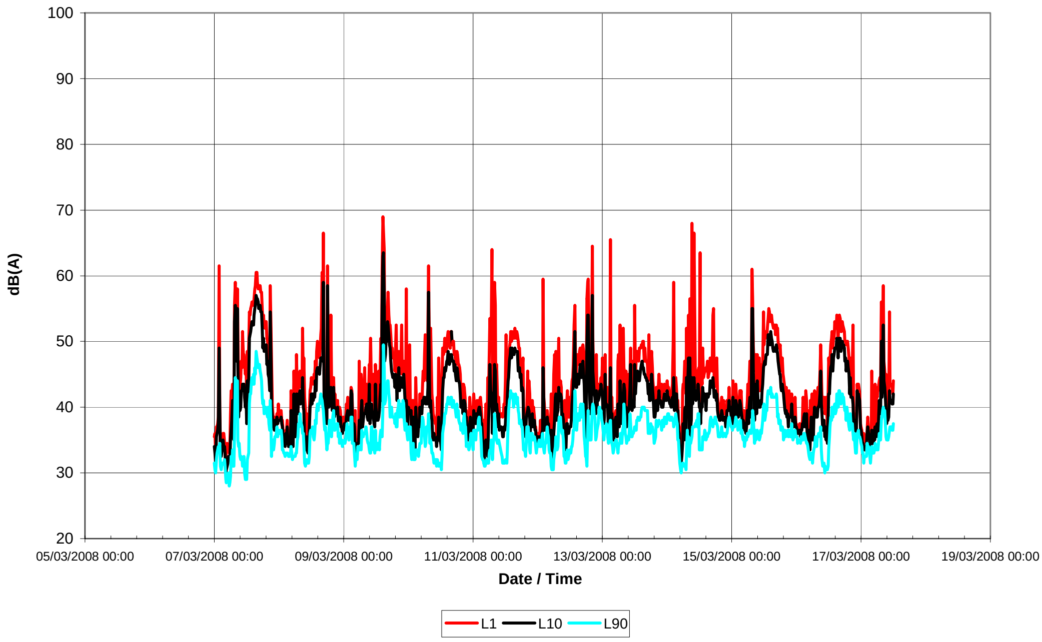


Figure 11-9 HBI PLant noise monitoring results for week 1 and week 2

Appendix D-9 : Rural Village

The results show a typical daily cycle of noise levels with higher levels experienced during daytime and evening hours and lower levels at night-time. The underlying background noise (i.e. L_{90} of L_{A90}) was typically of the order of 29 dB(A), irrespective of the time of day.

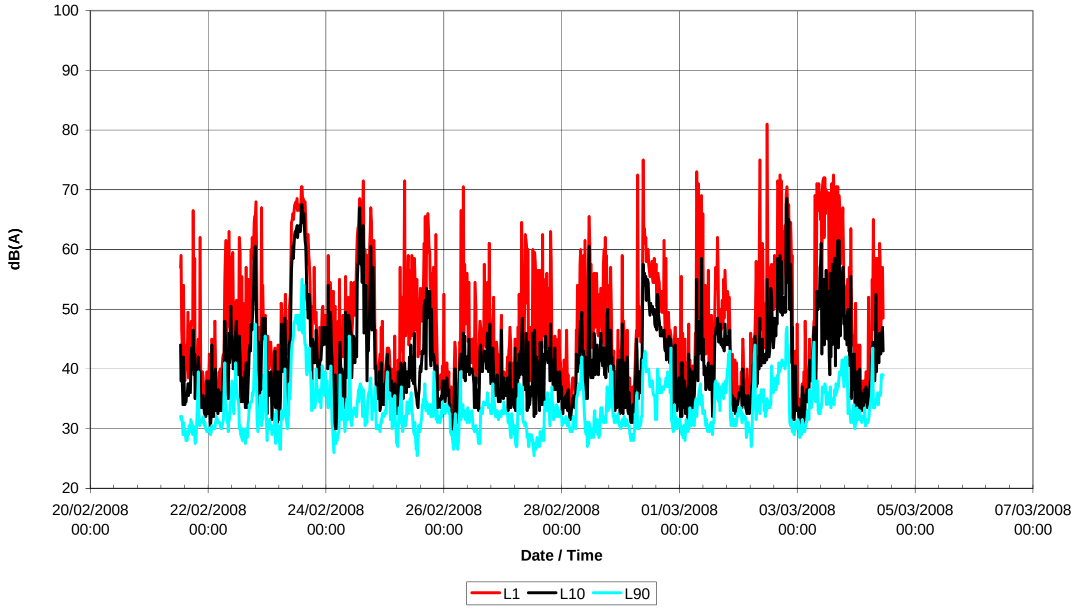


Figure 11-10 Rural Village noise monitoring results for week 1 and week 2

APPENDIX E : LAYOUT OF PROPOSED RAIL

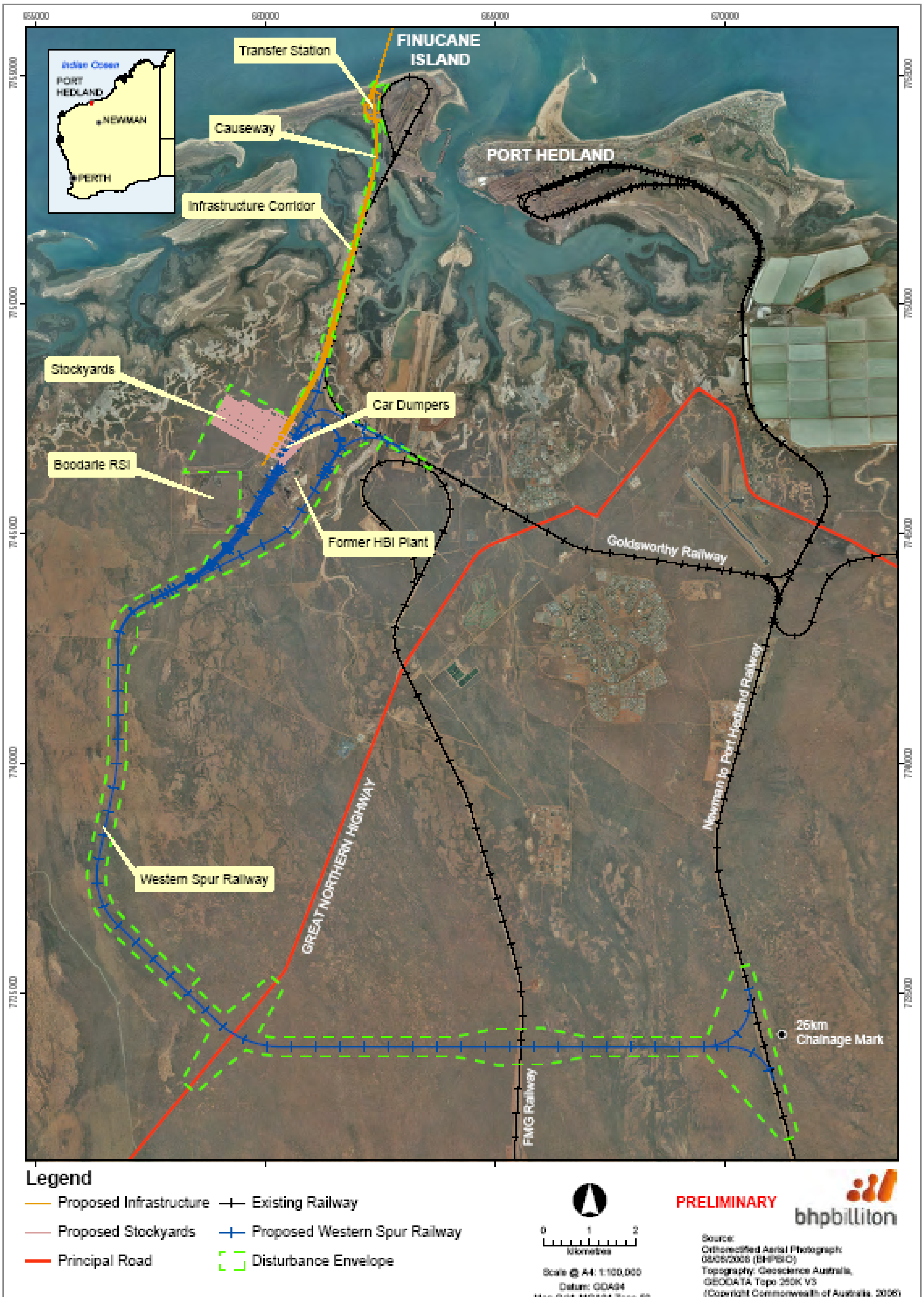


Figure 2.4 Proposed Landside Infrastructure Layout

APPENDIX F : RAIL MODEL IN SOUND PLAN

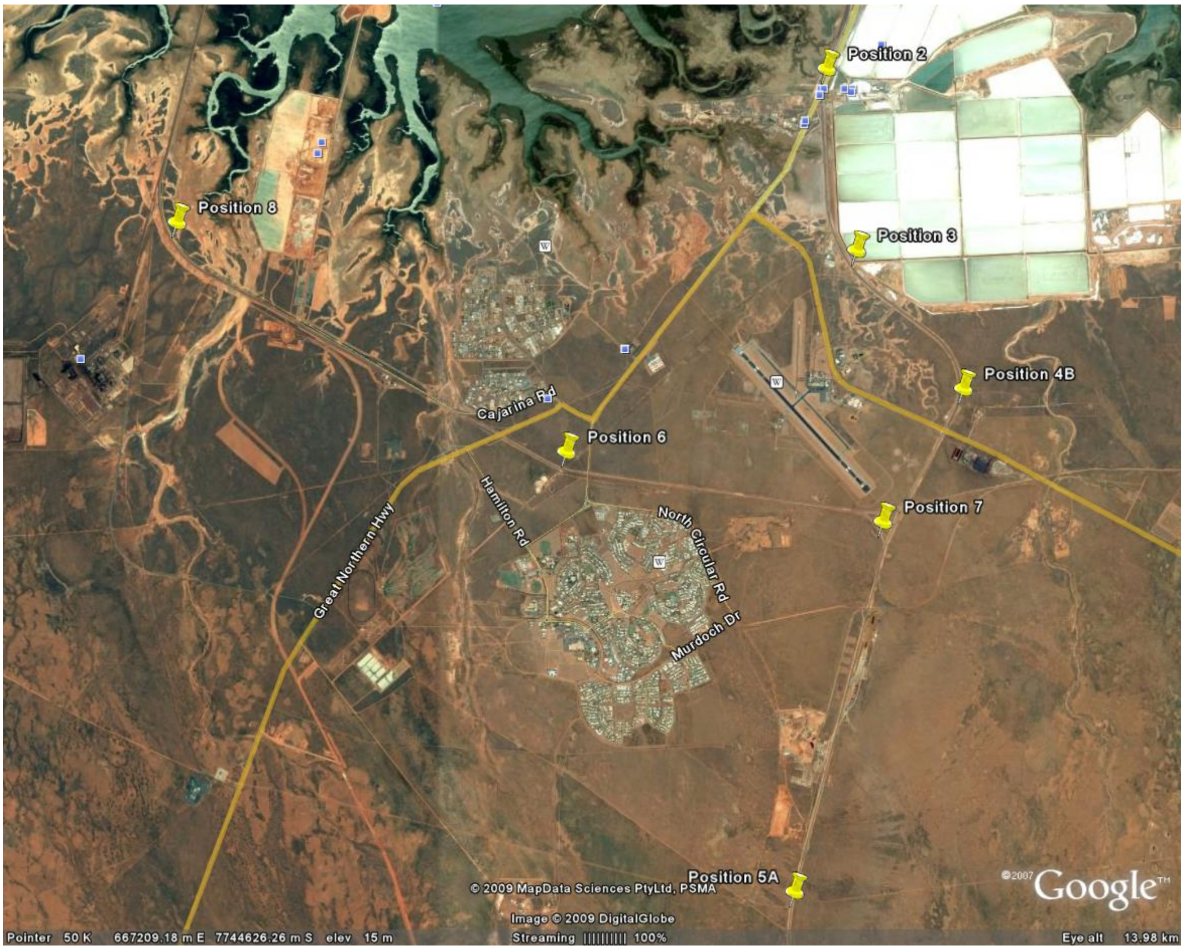


Figure 11-11: Measurement Positions for Rail