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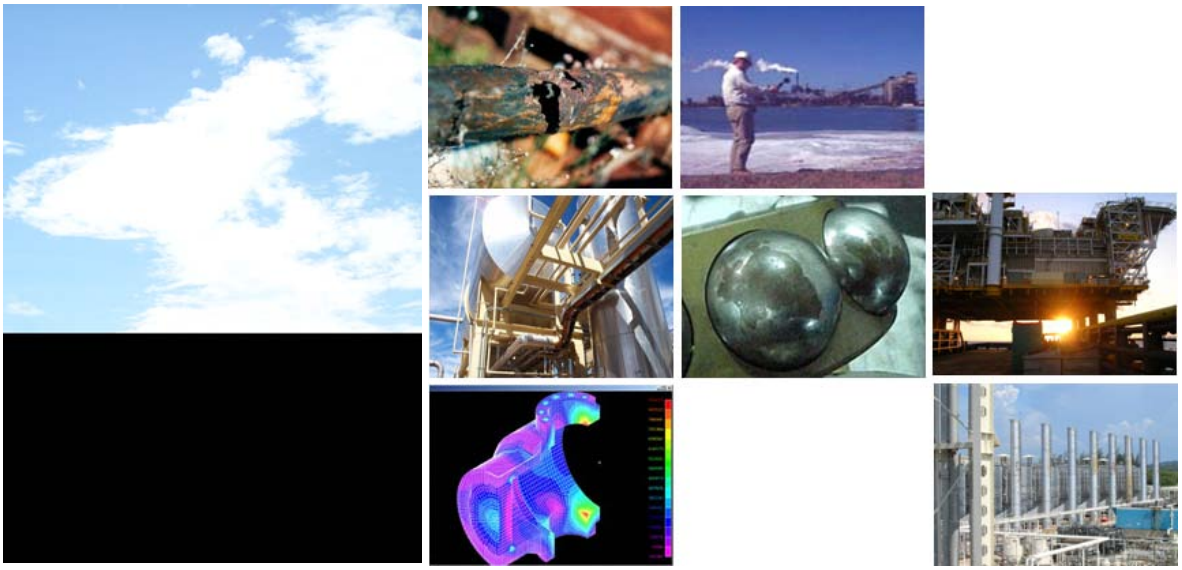
OUTER HARBOUR DEVELOPMENT RAIL NOISE ASSESSMENT : WESTERN SPUR



BHP BILLITON IRON ORE

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EXECUTIVE SUMMARY

SVT was requested by BHP Billiton Iron Ore to provide an assessment of the impact of rail noise on the town of South Hedland and Green Acres as a result of the BHP Billiton Iron Ore's Outer Harbour Development expansion activities.

The aim of this document is to assess the impact of rail noise on South Hedland as a result of the Outer Harbour Development Stage 1 to stage 4 expansion with respect to the State Planning Policy 5.4 "*'Road and Rail Transport Noise and Freight Considerations in Land Use Planning*" (SPP 5.4) gazetted in September 2009.

ROAD AND RAIL TRANSPORT POLICY

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.

For major or minor redevelopments, the noise criteria (Table E- 1) in the policy need not be applied, but instead should be used as guidance.

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.

RAIL NOISE MODEL

An acoustic model has been developed using the SoundPlan noise modelling program. Rail noise was modelled from the main line (south of South Hedland) to Finucane Island as presented in Figure E- 1.

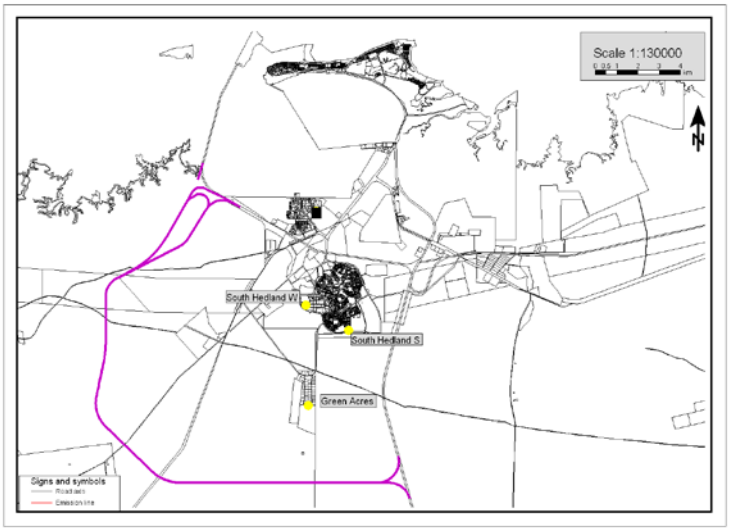

Figure E- 1 Location of Rail Line near South Hedland and Closest Receivers

The new planning policy does not specify meteorological conditions to be applied to the noise model. Therefore, the noise modeling results have been calculated using worst case meteorological conditions as outlined in the Environmental Protection Authority (EPA) Draft Guidance Note No.8.

Two noise sensitive receivers located on the southern boundary of South Hedland and one receiver on the southern side of the rural village Green Acres have been defined as closest receivers to the western spur rail line. These receivers (Green Acres, SH West and SH South) are shown in Figure E- 1.

Table E- 2 presents the number of rakes per day to and from Nelson Point, Finucane Island and Boodarie port facilities for each stage of BHP Billiton Iron Ore expansions

.

Table E- 2 Noise Model Configuration – Number of rakes entering and exiting for each expansion

Rakes	PHIHP 240MTpa	OHD Stage 1-5
Nelson Point		
Total rakes per day (loaded and unloaded)	48	
Finucane Island (Goldsworthy Line)		
Total rakes per day (loaded and unloaded)	40.6	
Boodarie		
Total rakes per day (loaded and unloaded)		240 MTpa

RESULTS

The predicted received noise levels at each sensitive receiver are presented in Table E- 3. All results include the applicable 2.5dB façade correction factor[1].

Table E- 3 Noise Modelling Results at South Hedland Receivers for PHIHP and Outer Harbour

Expansion Project	Receiver		
	South Hedland W	South Hedland S	Green Acres
PHIHP	32.0	33.9	30.1
Outer Harbour Development Stage 1	32.3	34.1	30.9
Outer Harbour Development Stage 2	32.5	34.2	31.5
Outer Harbour Development Stage 3	32.8	34.3	32.1
Outer Harbour Development Stage 4	33.1	34.4	32.6

As can be seen from the table the received noise at all receivers is below the noise target of L_{Aeq} 50dB(A).

[1] See 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" .

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1. INTRODUCTION

SVT was requested by BHP Billiton Iron Ore to assess the impact of rail noise on the town of South Hedland and Green Acres as a result of the BHP Billiton Iron Ore Outer Harbour Expasion activities. The Outer Harbour Development Stage 1 to stage 4 expansion project requires the development of the Western Spur rail line on the southern and western sides of South Hedland and Green Acres in order to meet the expected tonnage of ore for this rail corridor.

1.1 Aim

The aim of this document is to assess the impact of rail noise on South Hedland and Green Acres as a result of the Outer Harbour expansion with respect to *"State Planning Policy 5.4 Road and Rail Transport Noise and Freight Considerations in Land Use Planning"* gazetted in September 2009.

1.2 Scope of Work

SVT has undertaken field measurements and a desktop noise model in order to assess the impacts of rail noise on the town of South Hedland and Green Acres.

1.3 Location of South Hedland and Green Acres

South Hedland is comprised primarily of private residences with a central shopping and office district which is zoned as a commercial area. South Hedland is some 9 km south of Port Hedland as shown in Figure 1-1. Green Acres is a rural village situated to the South of South Hedland. Figure 1-2 shows the location of the sensitive receivers used in this assessment.

Figure 1-1 South Hedland Location

Figure 1-2 Location of Rail Line near South Hedland and Closest Receivers

1.4 Rail Operations – General Overview

Current rail operations in Port Hedland consist of rail movements along the main line to either Finucane Island or Nelson Point. Trains into and out of these two port facilities consist of multiple rakes, where each rake consists of two locomotives and 120 ore cars. The trains are broken into individual rakes at either Bing Siding or the Nelson Point holding area before entering the car dumpers where the ore cars are offloaded. The offloaded ore cars are then reconstituted into multi rake trains at either Bing Rail Yard or Nelson Point departure yard.

Trains bound for Finucane Island are broken into individual rakes at Bing Siding. Once broken the single rake trains travel from the Bing Siding through the Goldsworthy Junction, passing north of South Hedland, along the Goldsworthy Line to the Boodarie Rail Yard. From the Boodarie Rail Yard the trains continue on to Car Dumper 4 (CD4) at Finucane Island. Once the ore cars have been emptied the train moves from CD4 back to Boodarie. At this point the ore cars inspected for any defects prior to returning to the main line.

Both loaded and unloaded trains pass-by South Hedland en-route to and from the Finucane Island load out facility. There is only 1 rail line into and out of Finucane Island and therefore the number of loaded and unloaded trains passing South Hedland is always equal.

1.4.1 Previous Modelling

Rail modelling has been undertaken for the BHP Billiton Iron Ore Main line, Goldsworthy rail line, Nelson Point and Finucane Island for RGP5[2] and RGP6[3] expansions. The number of rail movements has not changed between RGP6 and the Port Hedland Inner Harbour Project (PHIHP) and as a result a rail noise assessment was not undertaken for PHIHP as the received levels for PHIHP are the same as for RGP6. PHIHP is referred to in this document as it is the latest approved expansion in Port Hedland. The PHIHP received noise levels referred to in the document are RGP6 noise levels.

1.4.2 Outer Harbour Development Rail Configuration

For each expansion project a defined tonnage of ore is expected to be transported to the port facilities at Nelson Point and Finucane Island. The total tonnage of ore and number of rakes required to transport that ore for each growth project are outlined in Table 1-1.

The proposed western spur rail line for the outer harbor development will leave the main line south of Green acres and will pass to the south of South Hedland with the rail loop ending in Boodarie yard as shown in Figure 1-2.

Table 1-1 shows the number of rakes to be transported to Nelson Point and Finucane Island port facilities for each stage of expansion.

[2] SVT Document Rpt02A 075063, 'Port Hedland Noise Assessment Report for RGP5'

[3] SVT document 075063-11-100, 'RGP6 – South Hedland Rail Noise Assessment'.

Table 1-1 Number of rakes used in noise modelling configurations

Rakes	PHIHP 240MTpa	OHD Stage 1-4
Nelson Point		
Total rakes per day (loaded and unloaded)	48	
Finucane Island (Goldsworthy Line)		
Total rakes per day (loaded and unloaded)	40.6	
Western Spur		
Total rakes per day (loaded and unloaded)		240 MTpa

2. APPLICABLE REGULATIONS

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.

The outdoor noise assessment criteria is given in Table 2-1 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 2-1 ***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 2-1, 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.

For major and minor redevelopments the noise criteria in Table 2-1 should be used as guidance. The policy recognizes that in a number of instances it may not be reasonable and practicable to meet the noise target criteria. 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.

2.1 Application of State Planning Policy 5.4 to Outer Harbour Development

The Western Spur rail line is defined as per the policy as a major redevelopment. For major or minor redevelopments, the noise criteria in the policy need not be applied, but instead be used as guidance.

The policy does not apply to warning devices installed on road and rail vehicles. Therefore, the policy is not applicable to Locomotive horns (used at road crossings) and hence Locomotive horns have not been considered in this rail noise assessment.

3. NOISE MODELLING

3.1 Rail Noise Impacts

Rail noise can be classified as a transient noise (i.e. a relatively short duration noise which comes and goes with time). This type of noise usually has a larger impact on communities, as normal industrial operations noise is more continuous and homogenous and as a result a certain level of tolerance and habituation occurs. By comparison, rail noise tolerance and habituation are a lot more difficult for residents to develop over time. This is especially difficult during the early morning hours when ambient noise levels are at their lowest and people are trying to sleep.

3.2 Noise Model Software

An acoustic model has been developed using the SoundPlan[4] 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.

3.3 Methodology

Rail noise was modelled from the main line rail along the Western Spur line (south of South Hedland) to Boodarie Loop (see Figure 1-2 for model layout). Rail operations within the port facility at Finucane Island were also modelled. The rail noise model has incorporated the following assumptions:

- The frequency of rail movements is independent of date and time;
- Train speed for each track is as per current operations (i.e. maximum of 60 km/h for the rail and 20 km/h through the facility yards);
- Each full rake is loaded to capacity with 15480 T ore, and pulled 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 (noise levels[5] are based on the site measurements specific for each rail curve); and
- 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 rail model can be seen in Appendix A.

[4] http://www.soundplan.com/

[5] Noise levels are based on L_{AEQ} levels from the site field measurements for each curve. See SVT document 075063-51-100, 'Rail Biannual noise monitoring for Port Hedland – October 2010'.

3.3.1 Measured Noise Levels – Site Field Measurements

Field Measurement - Methodology

As per the minimum requirements outlined in the "*Implementation Guidelines*" for the policy, sound level measurements were taken using a Brüel & Kjaer type 2260 sound level meter which meets the requirements for Type 1 sound level meters as specified in AS 1259. The meter also meets the requirements for octave band filters as specified in IEC 1260 and AS/NZS 4476:1997. The sound level meter was calibrated on site before and after measurements was taken using a Brüel & Kjaer type 4231 reference sound source.

Field noise measurements were taken in accordance with Australian Standard AS2377:2002 "*Acoustics-Methods for the measurement of railbound vehicle noise"*.

Field Measurements - Calculation of Sound Power 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 the BHP Billiton Port Hedland facility in April 2009 and September 2009. Sound power levels were calculated from noise measurements taken for rail squeal, loaded/unloaded moving trains (at varying speeds), car dumper shunting and locomotive noise (at various notch settings). The sound power levels for items used in the model are presented in Table 3-1, Table 3-2 and Table 3-3. Positions referenced in these tables can be found in Appendix B.

Table 3-1: Ore Car Sound Power Level

Position	Octave Band Sound Power Levels in dB (lin)									
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Overall dB(A)
Loaded P3	91.7	103.5	100.5	95.7	89.3	83.4	87.1	86.7	77.5	94.4
Loaded P4	92.3	93.6	91.8	92.3	89.3	81.9	86.4	85.3	85.6	93.3
Unloaded P4	100.1	102.3	105.1	102.4	95.2	97.1	96.7	92.0	89.2	102.7
Unloaded P5	96.2	102.6	100.1	98.9	87.2	83.9	87.8	82.5	74.6	94.6
Unloaded P6	100.0	103.6	104.6	102.2	93.9	89.1	91.6	84.4	84.6	98.8
Loaded P8	98.5	102.7	108.6	101.3	99.4	91.2	90.4	88.9	86.8	100.8
Loaded Straight	85.5	88.7	87.3	93.1	80.9	72.0	77.8	70.9	62.0	86.7
Loaded P6	82.9	92.2	99.0	96.3	94.7	88.4	92.5	90.9	90.0	98.8
Loaded P7	104.9	110.0	109.3	102.4	98.6	92.9	94.6	96.7	93.3	103.3
P1	89.0	101.4	96.1	87.3	86.5	84.4	92.9	96.6	96.8	101.0
P2	91.1	106.0	91.7	83.2	81.3	78.3	86.2	88.7	82.8	92.9

Table 3-2 Locomotive Sound Power Level

Position	Octave Band Sound Power Levels dB (lin)									
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Overall dB(A)
Loco P3	103.5	118.1	103.5	100.9	98.1	92.0	90.1	85.1	82.9	100.1
Loco P4 Unloaded	102.6	110.2	113.6	100.3	96.0	94.0	95.3	94.5	92.5	103.3
Loco P5	97.8	112.1	106.1	99.0	91.8	89.2	88.9	83.1	74.5	97.3
Loco P5 Unloaded	98.0	94.6	97.8	99.7	87.5	84.5	89.3	85.4	78.3	95.6
Loco P6	101.6	109.2	110.9	101.2	98.0	93.8	94.4	93.8	92.4	102.6
Loco P6 unloaded	100.8	115.4	105.3	102.6	92.8	90.7	91.6	84.7	77.3	99.3
Loco P8	97.6	101.6	108.6	102.0	96.2	88.4	89.0	88.3	85.9	99.5
Loco Straight	101.5	106.4	111.8	97.1	88.9	87.2	86.4	83.6	78.1	98.0
Loco P4	103.0	109.8	101.6	98.1	96.4	95.2	91.9	88.1	87.4	100.1

Table 3-3: Yard Sound Power Levels

Position	Octave Band Sound Power Levels dB (lin)									
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Overall dB(A)
Yard Squeal	103.0	115.9	99.9	98.6	103.7	105.9	112.2	107.5	107.3	115.8
CDShunt UL	112.6	111.3	108.9	104.7	102.4	101.3	99.7	94.2	86.0	106.4
CDShunt Loaded	90.2	90.3	91.4	89.8	93.7	95.7	96.5	92.7	83.9	101.3
Road100 Squeal	104.0	110.7	97.3	96.2	95.4	99.5	108.5	109.5	108.9	114.4
Bilo Crossing	78.1	90.0	75.5	73.6	72.7	77.8	87.4	88.7	87.9	93.5

3.3.2 Rail Model Overview

Within the noise model the rail line was divided and defined according to speed, radius of curvature and rail squeal potential as per Table 3-1 and Table 3-2. The NORD 2000 assessment method was used for the model calculations, based on *Nordic Rail Traffic Noise Prediction Method (1984). "NORD 2000"* which calculates L_{Aeq} and L_{max} values using spectral data of the trains. It calculates absorption loss, propagation and considers the terrain and reflections.

3.3.3 Meteorological Conditions Applied

The new road and rail transport policy ('*Road and Rail Transport Noise and Freight Considerations in Land Use Planning*') does not specify the meteorological conditions to be used for rail noise modelling.

The predicted L_{Aeq} noise levels have been calculated using worst case meteorological conditions (as outlined in EPA Draft Guidance Note No.8. The conditions applied are as follows;

- 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.

3.4 Rail Movements

Table 1-1 shows the number of rakes to be transported to Nelson Point, Finucane Island and the Western Spur.

4. RESULTS

4.1 Noise Modelling Results

The predicted received noise levels at each sensitive receiver and noise contour plots are given in Table 4-1[6] and Figure 4-1 respectively. All results include the applicable 2.5dB façade correction factor.

Table 4-1 Rail Noise Modelling Results in South Hedland

Expansion Project	Receiver		
	South Hedland W	South Hedland S	Green Acres
PHIHP	32.0	33.9	30.1
Outer Harbour Development Stage 1	32.3	34.1	30.9
Outer Harbour Development Stage 2	32.5	34.2	31.5
Outer Harbour Development Stage 3	32.8	34.3	32.1
Outer Harbour Development Stage 4	33.1	34.4	32.6

As can be seen in Table 4-1 the received noise at all the receivers are below the noise target of L_{Aeq} 50dB(A).

Figure 4-1 shows noise contour map for the Western Spur line.

[6] Worst case meteorological conditions have been applied.

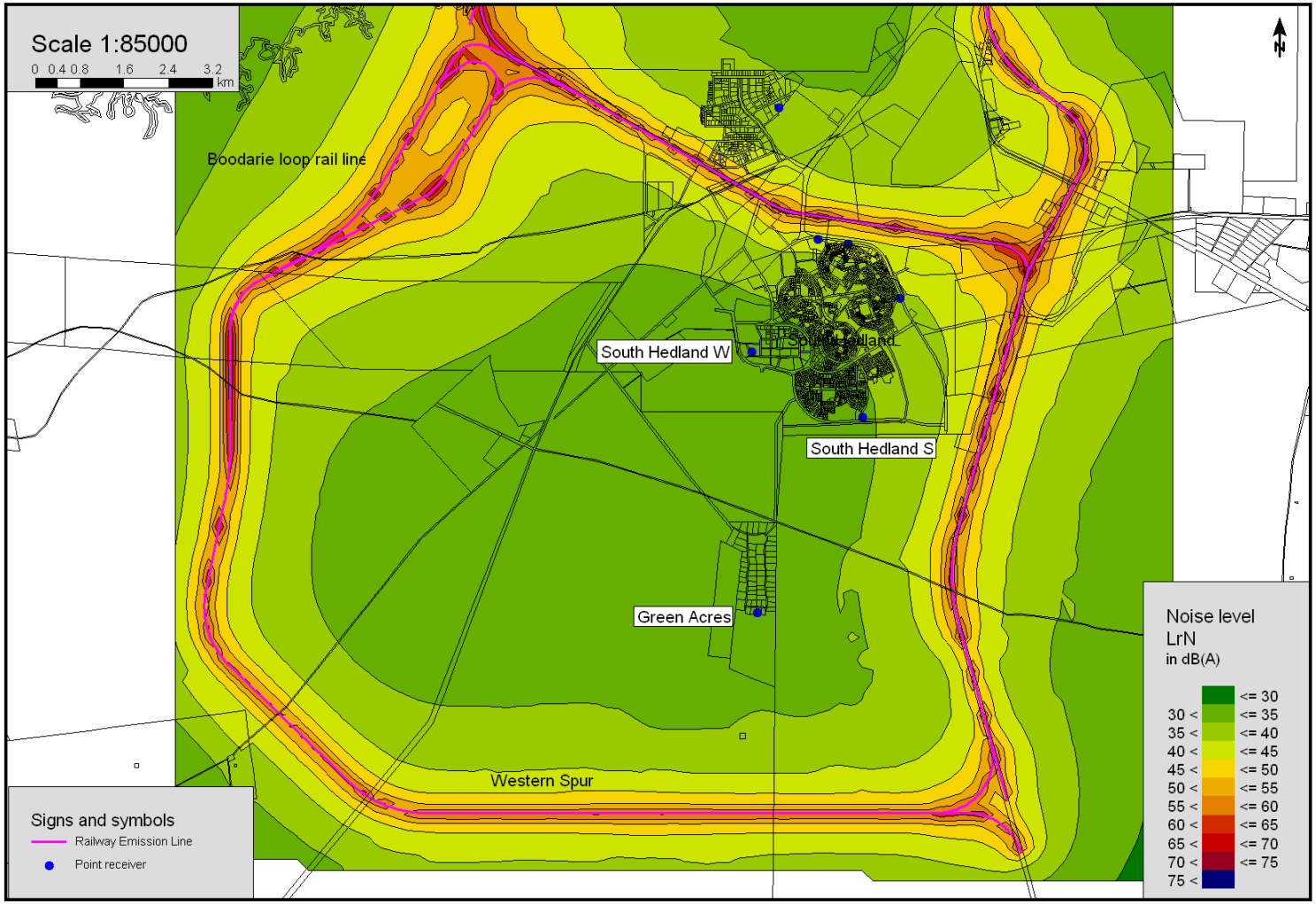

Figure 4-1 Noise Contour plot showing the,Goldsworthy and Western Spur and main lines.

APPENDIX A : RAIL NOISE MODEL LAYOUT

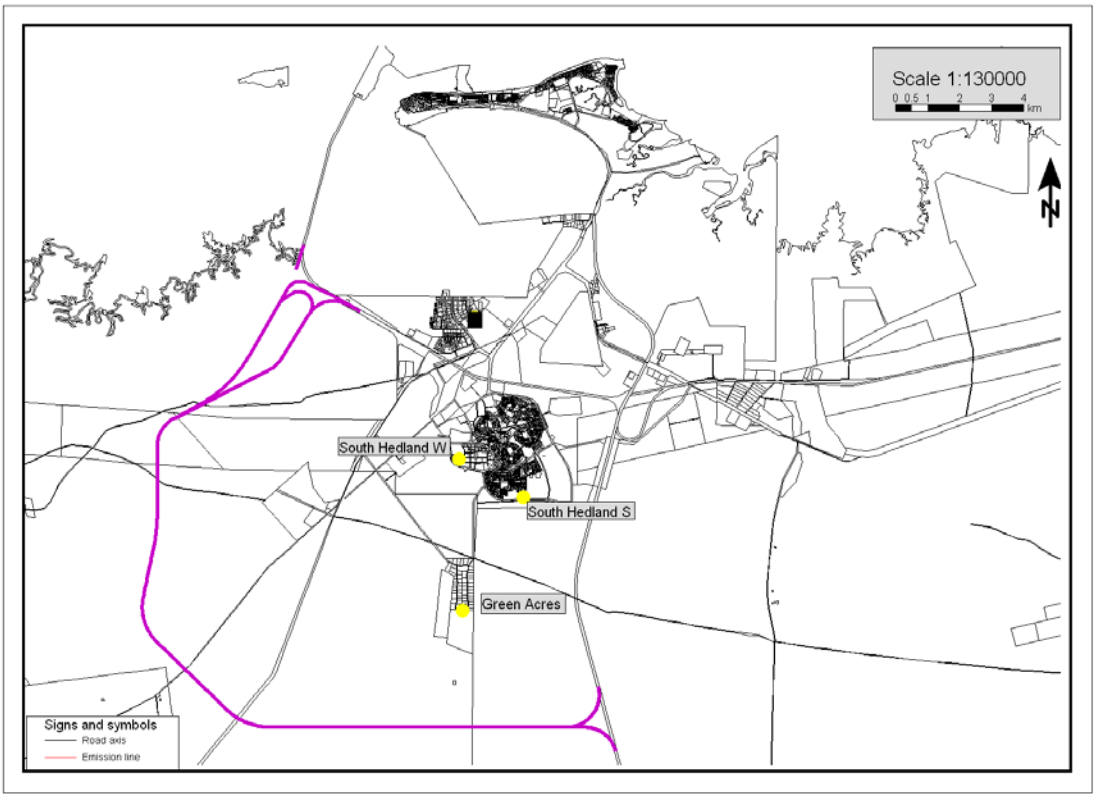

Figure 4-2 Model screen shot showing sensitive receivers and Western Spur rail line.