HEGGIES

22 November 2010

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Xstrata Mangoola Pty Limited
PO Box 495
Muswellbrook NSW 2333

Attention: Ben de Somer

Dear Ben

Mangoola Coal Mine
Phelps Property Noise Mitigation Investigation

1 Introduction

Heggies Pty Ltd (Heggies) has been commissioned by Xstrata Mangoola Pty Ltd (Xstrata) to conduct a review of the feasibility and effectiveness of the noise mitigation measures discussed at the meeting with representatives of the Phelps Family on 31 March 2010 (refer Xstrata document 98-XMC-510-0004-LEO-0338 *Meeting Minutes for Phelps Property – 31 March 2010)*.

This review includes an assessment of the feasibility and effectiveness of the following proposed noise mitigation measures:

- Noise barriers and screening including:
  - Earth bund to the east of the Phelps property.
  - Localised barriers (with and without roofs) around specified outdoor amenity areas at the Phelps property, namely:
    - BBQ area.
    - Back porch area.
    - Eastern side bedroom windows.
- Architectural treatments including:
  - Double glazing and ventilation systems.
  - Treatments of doors and door jams.
  - Treatments of bathrooms and toilets.
  - Additional insulation in ceiling to reduce noise break-in through "*whirly birds".*

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2 Relevant Noise Guidance and Criteria

Noise design goals for residential occupancies are expressed as either internal or external design goals. In circumstances where external noise levels are likely to be above the recommended criteria, the building envelope will need to be designed so internal occupancy noise goals are satisfied.

2.1 External Noise Goals

The operational noise criteria for the Mangoola Coal Mine determined with reference to the NSW Industrial Noise Policy (INP) are set out in the Environmental Assessment (refer to *Anvil Hill Project Noise and Vibration Assessment* dated August 2006) and provide the desired external noise levels to be achieved at the Phelps property. The operational noise criteria are reproduced in **Table 1**.

Table 1 Operational Noise Criteria

Location	Period	Criteria (dBA)	
		Intrusive	**Amenity**
All residential locations	Day	35	50
	Evening	35	45
	Night	35	40

In accordance with the INP, in cases where the criteria are exceeded:

"*noise source managers should seek to achieve the criteria by applying feasible and reasonable mitigation measures. In this context feasibility relates to engineering considerations and what can practically be built, and reasonableness relates to the application of judgment in arriving at a decision, taking into account the following factors:*

- *Noise mitigation benefits – amount of noise reduction provided, number of people protected.*
- *Cost of mitigation – cost of mitigation versus benefit provided.*
- *Community views – aesthetic impacts and community wishes.*
- *Noise levels for affected land uses – existing and future levels, and changes in noise levels."*

It follows that the aim of noise mitigation applied at the Phelps property is to achieve an external noise level of 35 dBA in accordance with the INP operational noise criteria.

2.2 Internal Noise Goals

Australian Standard AS 2107-2000 *"Acoustics - Recommended design sound levels and reverberation times for building interiors"* recommends suitable internal noise levels for a range of building uses. This standard relates to continuous and semi-continuous noise sources such as road traffic, air conditioning and in this instance can be applied to noise emissions from Mangoola Coal Mine activity. The appropriate design sound levels from AS2107 for this development are presented in **Table 2.**

Table 2 AS2107 - Indoor Design Sound Levels

Type of Occupancy -	Recommended design sound level, L_{Aeq} (dBA)	
	Satisfactory	**Maximum**
Houses in areas with negligible transportation		
Sleeping Areas	25 dBA	30 dBA
Houses and apartments near minor roads		
Living Areas	30 dBA	40 dBA
Work Areas	35 dBA	40 dBA
Common Areas	45 dBA	55 dBA

Generally care should be taken in applying the "Satisfactory Design Levels" set out in **Table 2**. Some of these levels are relatively low and, while providing a suitable target for a prestige "up market" development with above-the-norm quality, achievement of these levels might be too onerous for a building of general, but still good, quality standard.

Notwithstanding this, given the low existing background noise levels in the vicinity of the Phelps property, and the predicted Mangoola mine noise level, an indoor noise level of 25 dBA should be achievable with appropriate mitigation treatments.

2.3 AS 3671-1989 Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction

AS 3671-1989 *Acoustics – Road Traffic Noise Intrusion – Building Siting and Construction* provides guidance for the building envelope construction required to achieve indoor sound levels recommended as satisfactory in **Table 2**. Four categories of construction are identified and are reproduced below.

- Category 1 – Standard construction; openings, including open windows and doors may comprise up to 10% of the exposed façade. Noise reduction of 10 dBA is expected.
- Category 2 – Standard construction, except for lightweight elements such as fibrous cement or metal cladding or all-glass facades. Windows, doors and other openings must be closed. Noise reduction of approximately 25 dBA is expected.
- Category 3 – Special construction, chosen in accordance with the construction requirements. Windows, doors and other openings must be closed. Noise reduction between 25 and 35 dBA is expected.
- Category 4 – Where noise reductions of greater than 35 dBA are required special acoustic advice should be sought.

Whilst the above is not strictly applicable to noise intrusion from coal mining projects it does give an indication of the likely noise level reduction which may be expected from different standards of building construction. The construction of the Phelps property is considered to fall into Category 1 with doors and windows open and Category 2 with all doors, windows and openings closed.

3 Specified Outdoor Amenity Areas

Discussions between the Phelps' and Xstrata have identified a number of areas that are to be considered as "*outdoor amenity areas*" where noise levels from the mine are to be reduced allowing the Phelps' to enjoy the outdoor setting of their property. **Figure 1** shows the location of the specified outdoor amenity areas of the Phelps property.

Figure 1 Specified Outdoor Amenity Areas at the Phelps Property

4 Noise Barriers and Screening

In order to determine the noise mitigation benefit of potential noise barriers and screening between the Phelps property and the mine, Heggies have developed a detailed computer noise model to predict noise emission levels from the Mangoola project at the site. The noise modelling was undertaken using SoundPLAN v7.0 software, developed by Braunstein and Berndt Gmbh in Germany. A three-dimensional digital terrain map giving all relevant topographic information was used in the modelling process. The model used this map, together with noise source data, ground cover, shielding by barriers and/or adjacent buildings and atmospheric information to predict noise levels at relevant locations around the Phelps property.

Topographic contours and operational plans were supplied by Xstrata for the purpose of modelling noise from the project.

Year 10 and Year 15 stages of mining operations have been considered to determine potential noise level reductions when mining operations are located in the eastern and western sections of the mine respectively. These stages are considered to represent the potentially worst-case acoustic scenarios at the Phelps property.

It should be noted that the aim of this study is to determine the level of noise reduction from mining operations afforded by the various proposals and not to determine the noise impact on the property from the mine. Therefore, for the purpose of this study, the mine has been considered as an area source and the sound power levels calibrated to the "worst case" noise levels predicted in the Environmental Assessment (refer to *Anvil Hill Project Noise and Vibration Assessment* dated August 2006) of 44 dBA at the Phelps property. Furthermore, the Heggies noise model considers the noise sources when they are operating at the surface (rather than in the pit) to provide a "worst case" noise mitigation scenario.

It is noted that a proposal for a modified mine plan are currently with the Department of Planning. Heggies have reviewed the proposed mine plans and note the following:

- Mine plans have been altered such that mining operations are now progressing in a generally north-south direction rather than east-west. This will mean that operations will generally be more screened with respect to the Phelps property and therefore it is anticipated that the noise impacts are likely to be reduced.
- The changes to the mine plans are not considered to impact on Heggies noise mitigation recommendations made in this report for the Phelps property.

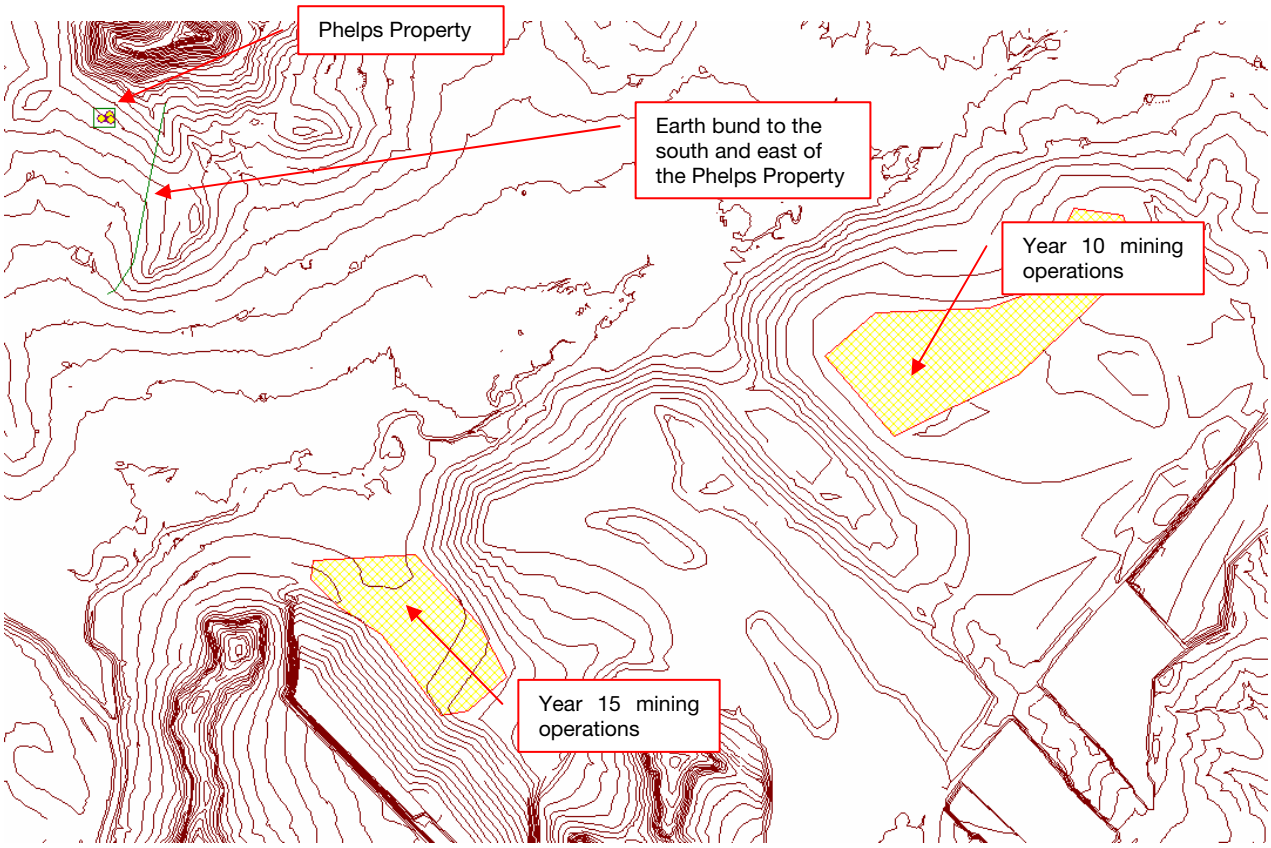
Noise contour maps of the predicted worst case noise levels at the Phelps property without noise mitigation are provided in **Appendices A** to **D** for Year 10 and Year 15 mining operations at 1:2500 and 1:250 scales.

Noise modelling has been conducted for each of the proposed noise barriers and is described below.

4.1 Earth bund to the east of the Phelps Property

It has been proposed that the construction of an earthen bund to the south and east of the Phelps property may be effective in the mitigation of mine noise levels during the lifetime of the Mangoola Coal Mine. Heggies has considered the construction of the proposed bund to a height of 10m. The location of the proposed bund is provided in **Figure 2**.

Figure 2 Proposed Earthen Bund



Predicted single point noise levels at each of the outdoor areas are provided in **Table 3**. A noise contour map with the 10m bund in place is provided in **Appendix E** and **Appendix F** for Year 10 and Year 15 mining operations respectively.

Table 3 Predicted noise levels at the Phelps property with earth bund to the south and east

Location	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)			
	Year 10		Year 15	
	Unmitigated	10m Bund	Unmitigated	10m Bund
Calibration point	44	30	44	44
BBQ area	44	34	44	44
Back porch area	44	31	44	44
Eastern bedroom windows	44	31	31	31

Discussion

Table 3 indicates that the construction of the proposed 10m earth bund to the east of the Phelps property will reduce noise levels by 10 to 14 dBA during worst case mining operations when mining operations are in the eastern part of the site (Year 10).

When mining operations are located in the western part of Mangoola Coal Mine and to the south of the Phelps property (Year 15), the construction of the earth bund is not predicted to reduce noise levels. The bund is ineffective during Year 15 due to the local topography and the elevated situation of the property with respect to the mine when operations are located to the south during this period. As indicated in **Appendix E** and **Appendix F** the greatest noise reduction is experienced in the area immediately behind the bund and decrease as distance from the bund increases.

Determination of whether or not construction of the 10m bund would be deemed reasonable and feasible would require consideration of many factors including; environmental impacts, achievable noise reduction, cost, and practicalities of constructing such a significant structure.

4.2 Localised Noise Barriers around Specified Noise Sensitive Locations

It should be noted that electronic drawings are not available of the Phelps property. The noise modelling has included the following assumptions:

- The buildings at the Phelps property have been modelled as being 3m high at the eaves.
- Noise barriers constructed around the specified outdoor amenity areas have been modelled to the full height of the building (i.e. 3m).
- Noise barriers have been modelled with and without roofs.

The proposed localised noise barriers considered at the Phelps property are shown in **Figure 3**.

Figure 3 Localised Noise Barriers

Predicted single point noise levels at each of the outdoor amenity areas are provided in **Table 4** and **Note: Bracketed numbers indicate noise levels for the localised barriers with roofs.**

Table 5 for Year 10 and Year 15 operations respectively.

Noise contour maps with the localized barriers in place are shown in **Appendices G** and **H** for Year 10 and Year 15 respectively**.**

Table 4 Predicted noise levels at the Phelps property with localised barriers – Year 10

Location	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)		Predicted Noise Level Reduction (dBA)
	Unmitigated	Local barriers (with roofs)	
Calibration point	44	N/A	N/A
BBQ area	44	30 (30)	14 (14)
Back porch area	44	31 (30)	13 (14)
Eastern bedroom windows	44	29 (29)	15 (15)

Note: Bracketed numbers indicate noise levels for the localised barriers with roofs.

Table 5 Predicted noise levels at the Phelps property with localised barriers – Year 15

Location	Predicted Noise Level $L_{Aeq(15minute)}$ (dBA)		Predicted Noise Level Reduction (dBA)
	Unmitigated	Local barriers (with roofs)	
Calibration point	44	N/A	N/A
BBQ area	44	30 (30)	12 (12)
Back porch area	44	33 (33)	11 (11)
Eastern bedroom windows	31	31 (29)	0 (2)

Note: Bracketed numbers indicate noise levels for the localised barriers with roofs.

Discussion

As shown in **Table 4** and **Note: Bracketed numbers indicate noise levels for the localised barriers with roofs.**

Table 5, the construction of 3m high noise barriers are predicted to reduce external noise levels by at least 10 dBA at all outdoor amenity areas with the exception of the eastern bedroom windows during Year 15 operations. It should be noted that the eastern bedroom windows already benefit from significant screening from the building itself.

Appendices G and **H** show that during both Year 10 and Year 15 operations, the localised noise barriers provide all the specified outdoor amenity areas with predicted noise levels below 35 dBA.

Based on the above, Heggies considers that the construction of the noise barriers (shown in **Figure 3**) will provide a feasible and effective method of mitigating the noise impact from the mine at the Phelps property, providing benefits for both external and internal noise amenity. Furthermore, the localised barriers will provide noise benefits to the Phelps throughout the life of the mine.

Noise barriers should be of a solid timber, concrete or masonry construction (or a combination i.e. concrete wall with timber fence on top) and should be sealed at the base with no gaps or holes. Alternatively, transparent acoustic barriers, such as those offered by Palram Australia Pty Ltd (www.palram.com) or Plastral Pty Ltd (www.plastral.com.au), may be used to maintain visual amenity.

As indicated in **Table 4** and **Note: Bracketed numbers indicate noise levels for the localised barriers with roofs.**

Table 5 the inclusion of roofs above the localised barriers are generally not predicted to provide significant additional noise mitigation benefits.

5 Building Construction and Architectural Treatments

5.1 Existing Building Construction

Based on the discussion in **Section 2.3**, the existing Phelps property would be classified as a Category 1 or Category 2 property. Therefore, provided all windows, doors and other openings are closed, a noise reduction of approximately 25 dBA would be expected from the existing building envelope. Based on the predicted mine noise level of 44 dBA this would result in an indoor noise level of 19 dBA which is well below the satisfactory level of 25 dBA required by AS 2107-2000.

Notwithstanding this, in order to ensure the acoustic integrity of the building envelope it is recommended that any gaps around existing door frames, windows and/or air conditioning units are sealed with suitable acoustic mastic and gaps around doors are appropriately sealed.

In addition to the above, the following architectural treatments have been considered:

- Double glazed windows.
- Passive or electrical assisted air ventilation and/or ducted air conditioning.
- Treatment to doors and door jams.
- Treatment of bathrooms and toilets.
- Additional insulation in the ceiling to reduce noise break-in through the *whirly birds*.

5.2 Glazing and Ventilation

5.2.1 Glazing

Windows exhibit poor noise reduction characteristics in comparison with other building elements such as external walls, doors and roof/ceiling and generally limit the total noise reduction capabilities of a building façade.

Heggies do not have any information with regard the existing windows at the Phelps property, therefore a standard 4mm single glazed window has been assumed. This will provide a noise reduction of approximately 25 dBA and is therefore anticipated to reduce the internal noise levels to below 25 dBA. Notwithstanding this, the windows remain the weakest component of the building envelope and hence, the installation of thick, laminated or double glazed windows in the southern and eastern facades will increase the sound reduction capabilities of the building.

Alternatively, *retrofit double glazing*, such as that offered by Magnatite (www.magnatitie.com.au), may be applied to existing windows, increasing the sound insulation of the windows without the need for replacement.

5.2.2 Ventilation

It should be noted that internal noise levels will only be achieved with windows and doors closed. As such, alternative means of ventilation would be required to allow adequate ventilation of the property.

Passive acoustic ventilators (such as those offered by Silenceair Pty Ltd (www.silenceair.com)) are focused on allowing air to freely enter and circulate through a property, whilst keeping noise out. If installed with double-glazing, Heggies anticipates that the installation of passive acoustic ventilators will assist in meeting the Phelps' requirements for indoor noise amenity, particularly at night, whilst also allowing them to ventilate the property with fresh air.

Heggies understands that the Phelps' are concerned about the use of air conditioning and other ventilation methods due to the power requirements and associated "carbon footprint" impacts. The term "passive" refers to the fact that these ventilation systems require no energy to operate. Passive ventilators allow air to pass freely through special arrangements of tubes but channel and redirect sound waves to reduce the passage of sound through the ventilation passage. As such they are considered an ideal solution for reducing the environmental impact of homes.

It is noted that Heggies have also been requested to model and show the noise reduction benefits of electrical assisted and ducted air conditioning ventilation systems. However, the general requirement for air conditioning is to maintain the acoustic integrity of the building envelope by allowing doors and window to remain closed. Therefore, providing air conditioning units are fitted with construction techniques which focus on sealing gaps around any wall mounted units or fittings, it is anticipated adequate noise insulation will be provided.

It follows that the consideration of air conditioning for the Phelps property should be guided by personal preference and ventilation requirements. Furthermore, it should be noted that ventilation requirements should be checked by a ventilation specialist.

5.3 Treatments of Doors and Door Jams

To maximise the acoustic integrity of doors and door jams it is recommended that any gaps between doors and frames are appropriately sealed when closed with an acoustic sealing system such as those offered by Raven Products Pty Ltd (www.raven.com.au). It is also recommended that doors are solid core.

5.4 Treatments of Bathrooms and Toilets

It is recommended that passive acoustic ventilators may be used to ventilate bathroom and toilet areas while reducing noise ingress (refer to **Section 5.2**).

Again, it should be noted that ventilation requirements should be checked by a ventilation specialist.

5.5 Additional Insulation in the Ceiling

Heggies have performed composite sound insulation and noise break-in calculations based to determine the likely level of noise break-in through the roof and the whirly birds/chimneys. These calculations are based on information provided by the Phelps' with regard to the current roof and ceiling construction of the property.

Calculations have also assumed the following:

- External roof is a corrugated iron roof with a 12mm plasterboard ceiling and a 400mm ceiling cavity.
- No insulation in the ceiling cavity (this is a worst case situation – it is understood that the Phelps have R1.5 insulation in the ceiling).
- 4 whirly birds and chimneys in the roof. These have been considered as 300mm by 300mm gaps in the roof construction (this is a worst-case situation and assumes that the existing whirly birds and chimneys offer zero sound attenuation).
- External noise levels of 44 dBA from mining operations.

Based on the above assumptions **Table 6** shows the calculated composite sound transmission loss for the existing roof.

Table 6 Composite Sound Transmission Loss

Partition	Transmission Loss (dB) Octave band Centre Frequency (Hz)									Rw
	31.5	63	125	250	500	1k	2k	4k	8k	
Calculated roof sound transmission loss	-	12	18	29	34	34	34	34	34	~32

It should be noted that the above assumptions are conservative and the sound insulation performance of the ceiling is likely to be higher than calculated.

Based on the above, noise levels from mining activities transmitted through the roof are predicted to be below 25 dBA. As such it is considered that the existing roof construction provides adequate sound insulation and additional insulation will be unnecessary.

6 Noise Impact of Proposed Changes to the High Voltage Powerline

It is anticipated that the noise mitigation methods described in **Sections 5** and **6** will also be effective at mitigating any additional noise impacts associated with the relocation of the high voltage powerline.

7 Conclusion

Heggies has conducted a review of the feasibility and effectiveness of the noise mitigation measures discussed at the meeting with the Phelps' on 31 March 2010. Noise modelling and calculations have been undertaken to determine the level of noise reduction afforded by the different proposals.

Recommendations with regard to the proposed noise mitigation strategies are provided in **Section 4** and **Section 5** of this report.

I trust the preceding meets your current requirements. If you have any questions or would like any further information please do not hesitate to contact me on (02) 4908 4500 or email nathan.archer@heggies.com.

Regards

Nathan Archer
Senior Consultant – Noise and Vibration

XStrata Mangoola Pty Ltd
Phelps Noise Mitigation Investigation

Noise Contour Map
Year 10 Mining Operations
Unmitigated - 10m grid

Appendix

A

Grid Spacing - 10m
Calculation Height - 1.5m

279000 279100 279200 279300 279400 279500 279600

6427900 6427800 6427700 6427600 6427500 6427400

Noise levels day
in dB(A)

< 35	
35 - 38	
38 - 41	
41 - 44	
44 - 47	
47 - 50	
50 - 53	
53 - 56	
56 - 59	
>= 59	

Signs and symbols

- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:2500

0 12.525 50 75 100 m

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Phelps Noise Mitigation Investigation

Noise Contour Map
Year 15 Mining Operations
Unmitigated - 10m grid

Appendix

B

Grid Spacing - 10m
Calculation Height - 1.5m

279000 279100 279200 279300 279400 279500 279600

6427900 6427800 6427700 6427600 6427500 6427400

Noise levels day
in dB(A)

< 35	
35 - 38	
38 - 41	
41 - 44	
44 - 47	
47 - 50	
50 - 53	
53 - 56	
56 - 59	
>= 59	

Signs and symbols

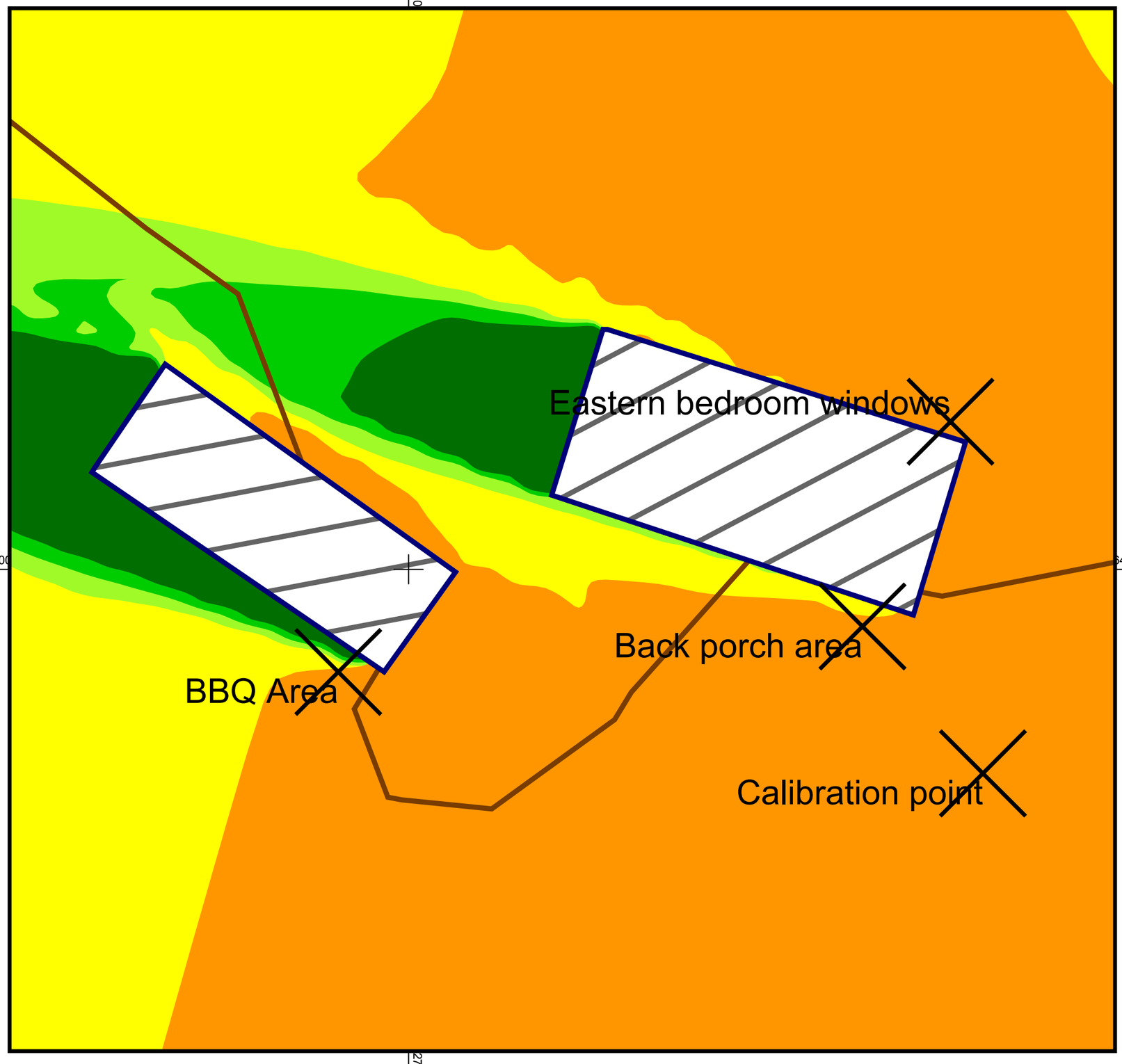
- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:2500

0 12.525 50 75 100 m

279100



6427900

6427900

279100

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Phelps Noise Mitigation Investigation

Noise Contour Map
Year 10 Mining Operations
Unmitigated - 1m Grid

Appendix
C

Grid Spacing - 1m
Calculation Height - 1.5m

Single Point Receiver Noise Levels

Calibration Point - 44 dBA
BBQ Area - 44 dBA
Back Porch Area - 44 dBA
Eastern Bedroom Windows - 44 dBA

Noise levels day
in dB(A)

	< 35
	35 - 38
	38 - 41
	41 - 44
	44 - 47
	47 - 50
	50 - 53
	53 - 56
	56 - 59
	>= 59

Signs and symbols

- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:250

0 1.25 2.5 5 7.5 10 m

279100

6427900

Eastern bedroom windows

Back porch area

BBQ Area

Calibration point

279100

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Phelps Noise Mitigation Investigation

Noise Contour Map
Year 15 Mining Operations
Unmitigated - 1m grid

Appendix

D

Grid Spacing - 1m
Calculation Height - 1.5m

Single Point Receiver Noise Levels

Calibration Point - 44 dBA
BBQ Area - 45 dBA
Back Porch Area - 46 dBA
Eastern Bedroom Windows - 33 dBA

Noise levels day
in dB(A)

<	35
35 -	38
38 -	41
41 -	44
44 -	47
47 -	50
50 -	53
53 -	56
56 -	59
>=	59

Signs and symbols

- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:250

0 1.25 2.5 5 7.5 10 m

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Phelps Nosie Mitigation Investigation

Noise Contour Map
10m Earth Bund on Eastern Ridge
Year 10 Mining Operations

Appendix

E

Grid Spacing - 10m
Calculation Height - 1.5m

Noise levels day
in dB(A)

< 35
35 - 38
38 - 41
41 - 44
44 - 47
47 - 50
50 - 53
53 - 56
56 - 59
>= 59

Signs and symbols

- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:3948

0 20 40 80 120 160 m

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Phelps Noise Mitigation Investigation

Noise Contour Map
10m Earth Bund
Year 15 Mining Operations

Appendix

F

Grid Spacing - 10m
Calculation Height - 1.5m

Noise levels day
in dB(A)

< 35	
35 - 38	
38 - 41	
41 - 44	
44 - 47	
47 - 50	
50 - 53	
53 - 56	
56 - 59	
>= 59	

Signs and symbols

- Main building
- Bund
- Terrain edge
- Point receiver

Length scale 1:4049

0 20 40 80 120 160 m

279100

6427900

Eastern bedroom windows

Back porch area

BBQ Area

Calibration point

279100

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Phelps Noise Mitigation Investigation

Noise Contour Map
Localised Noise Barriers
Year 10 Mining Operations

Appendix

G

Grid Spacing - 1m
Calculation Height - 1.5m

Single Point Receiver Noise Levels

BBQ Area - 33 dBA
Back Porch Area - 29 dBA
Eastern Side Bedrooms - 27 dBA

Noise levels day
in dB(A)

< 35	
35 - 38	
38 - 41	
41 - 44	
44 - 47	
47 - 50	
50 - 53	
53 - 56	
56 - 59	
>= 59	

Signs and symbols

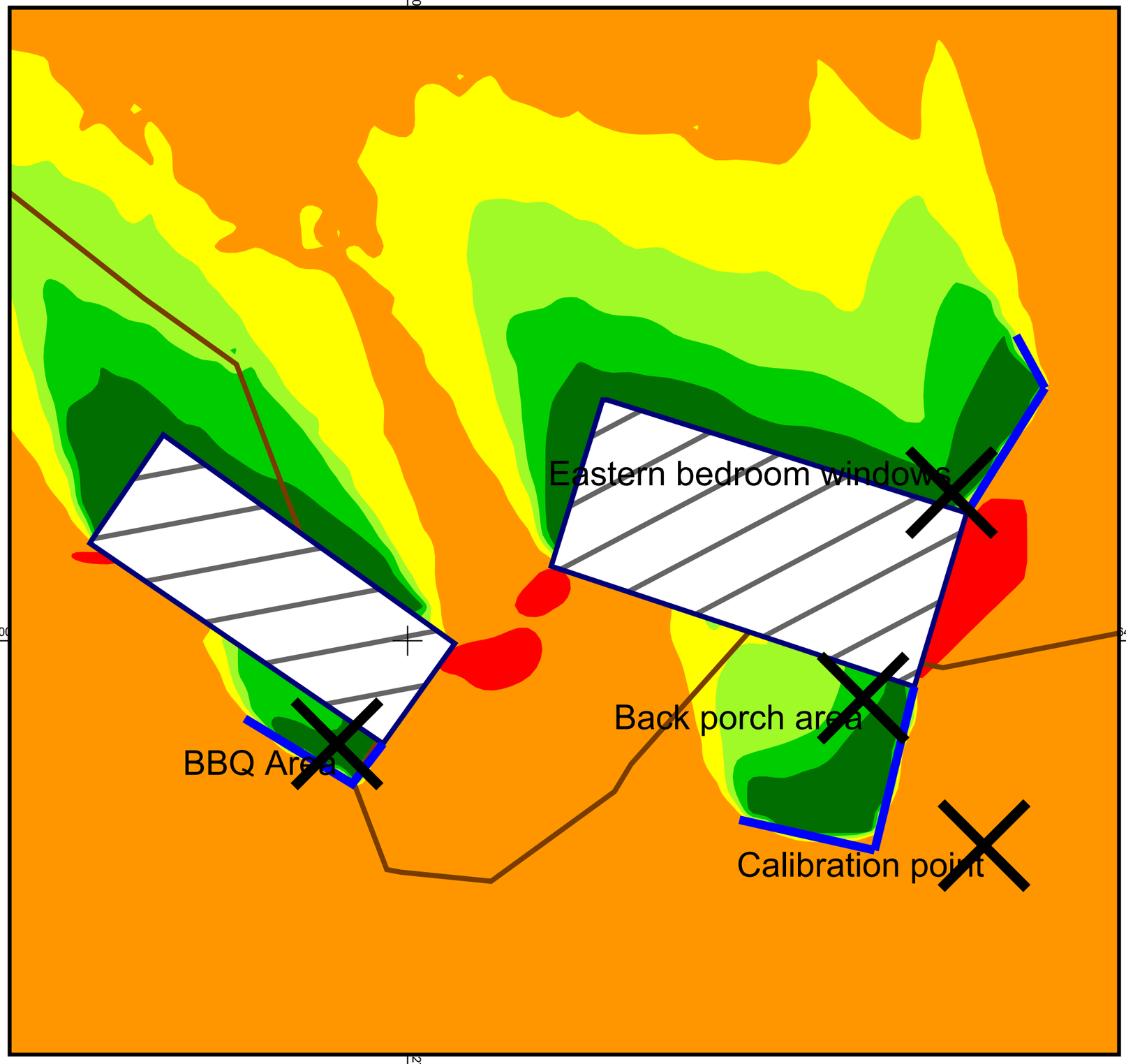
- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:250

0 1.25 2.5 5 7.5 10 m

279100



6427900

6427900

279100

XStrata Mangoola Pty Ltd
Phelps Noise Mitigation Investigation

Noise Contour Map
Localised Noise Barriers
Year 15 Mining Operations

Appendix

H

Grid Spacing - 1m
Calculation Height - 1.5m

Single Point Receiver Noise Levels

BBQ Area - 31 dBA
Back Porch Area - 36 dBA
Eastern Bedroom Windows - 31 dBA

Noise levels day
in dB(A)

< 35	
35 - 38	
38 - 41	
41 - 44	
44 - 47	
47 - 50	
50 - 53	
53 - 56	
56 - 59	
>= 59	

Signs and symbols

- Main building
- Wall
- Terrain edge
- Point receiver

N

Length scale 1:250

0 1.25 2.5 5 7.5 10 m