

Iluka Resources Limited

Wimmera Project Baseline Noise Assessment

April 2019

Table of contents

1.	Introc	luction1
	1.1	Acknowledgement of country1
	1.2	Context1
	1.3	Purpose of this report1
	1.4	Scope of works1
	1.5	Scope and limitations2
	1.6	Assumptions2
2.	Proje	ct site
	2.1	Location
	2.2	Topography and surrounding land use
	2.3	Noise sensitive receivers
	2.1	Review of existing noise reports7
3.	Basel	line noise monitoring
	3.1	Monitoring locations
	3.1	Instrumentation8
	3.2	Meteorological conditions10
	3.3	Existing noise environment10
	3.4	Background measurement results11
4.	Noise	e criteria13
	4.1	Relevant guidelines
5.	Conc	lusion17

Table index

Table 1	Potential sensitive receivers	4
Table 2	Results of background measurements at Douglas and Echo mines	7
Table 3	Noise monitoring locations	8
Table 4	Noise measurement instrumentation	9
Table 5	Noise observations at each logging location	10
Table 6	Applicable noise sensitive receivers representative of each logger location	11
Table 7	Summary of unattended noise monitoring results	12
Table 8	Project specific noise criteria based on NIRV	15

Figure index

Figure 1	Project site and identified noise sensitive receivers	.6
Figure 2	Areas covered by SEPP N-1 and planning UGB (EPA Victoria, 2011)	13

Appendices

- Appendix A Noise monitoring equipment installation
- Appendix B Meteorological analysis
- Appendix C Noise monitoring results

1. Introduction

1.1 Acknowledgement of country

The project team would like to acknowledge the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagalk Nations who are the traditional custodians of the land upon which noise, vibration and meteorological measurements were conducted during this assessment. We pay our respects to Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagalk Elders, past and present and extend this respect to all Aboriginal and Torres Strait people who may be reading this document.

1.2 Context

GHD Pty Ltd (GHD) was engaged by Iluka Resources Limited (Iluka) to prepare a background baseline noise assessment for the Wimmera Project site (herein after 'the subject the Project site').

It is understood that Iluka is currently preparing a preliminary feasibility study for the Wimmera Project. This report presents the results of a baseline environmental background noise monitoring assessment and the establishment of relevant environmental noise criteria at the nearest identified noise sensitive receivers relevant to the Project site. This will allow for a future analysis of potential noise impacts from mining operations to be made.

1.3 Purpose of this report

The purpose of the assessment in this report is to carry out a background noise monitoring assessment and establish the applicable environmental noise assessment criteria for the Wimmera Project.

1.4 Scope of works

The scope of works conducted for this assessment were in line with those outlined in Section 7 of the Iluka document *Scope of Work for WIM100 Baseline Noise Assessment Project.: 0-CR-00094*, as follows:

- A summary of the relevant legislative requirements relating to noise.
- A summary of the findings made during the literature review.
- A summary of the available topographic data for the project area.
- A summary of the available and accessible meteorological data relevant to the project area, an assessment of the suitability of that data for noise modelling or operational response purposes, and recommendations relating to any proposed new monitoring stations if deemed required – see Appendix B.
- Summary of identified sensitive receptors, including assessed status (occupied/not occupied) and associated mapping.
- Description of the noise monitoring approach used including mapping of monitoring locations.
- Presentation of the noise data obtained for (or relevant to) the project area, and a description of the existing noise environment.
- Description and discussion on the observations made during monitoring, including consideration of aspects such as seasonal activities, traffic, day/night noise patterns.
- Description of the existing noise environment for the project area.
- A summary of the applicable noise level criteria determined for each project area, including a description of the methodology used.

1.5 Scope and limitations

This report has been prepared by GHD for Iluka Resources Limited and may only be used and relied on by Iluka Resources Limited for the purpose agreed between GHD and the Iluka Resources Limited as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Iluka Resources Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Iluka Resources Limited and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.6 Assumptions

The following assumption have been made during this assessment and the writing of this report:

- This report has been written based on the information available as of March 2019.
- The selected monitoring locations are reasonably representative of the existing background environment at relevant noise sensitive receivers.
- The weather data obtained through the GHD Automatic Weather Station (AWS) installed at the test pit is (as discussed in Appendix B) is representative of local meteorological conditions at the noise logging sites.

2. Project site

2.1 Location

The Project site is to be located within clear land and will be surrounded predominantly by farming land, with some residential premises located nearby. The Project site is located on land zoned as Farming Zone (FZ), Public Conservation, and Resource Zone. The Indicative Project Extent with respect to the surrounding land uses is shown in Figure 1. The mine layout and footprint will be determined during the Pre-feasibility Study (PFS).

2.2 Topography and surrounding land use

A review of the available information such as aerial imagery and publicly available topographical datasets such as the VicMap elevation dataset indicates that the Project site and adjacent area are located over relatively flat terrain generally consisting of farming land with no significant topographical features. The nearest significant topographical features and land use features to the Project site include:

- Red Gum Swamp, Jallumba Wildlife Reserve located south of the Project site
- Jallumba Marsh Nature Conservation Reserve located within the Project site boundary to the west
- Darragan Swamp Wildlife Reserve located north east of the Project site

No major topographical features were identified which are likely to affect the noise assessment results during operation of the mine. GHD understands that LIDAR topographical data with vertical accuracy of 0.5 m based on surveys performed by Wimmera CMA are available for the majority of the project area and are likely be considered sufficient for future noise impact assessment purposes.

In addition to the above, the VicMap elevation dataset is also available for the project and surrounding areas which could be utilised for the operational noise impact assessment. The VicMap elevation dataset however has 10 - 20 m resolution elevation contour lines.

Based on a review of topographical information GHD considers a ground sound absorption coefficient of 0.5 - 0.6 appropriate for future operational noise impact modelling and assessment. A ground absorption coefficient of zero represents a fully sound reflective ground and a ground absorption coefficient of one represents a fully sound absorptive ground.

2.3 Noise sensitive receivers

Relevant sensitive receivers surrounding the Project site boundary are identified in Table 1 and shown in Figure 1. There are a total of two environmental receivers and 43 sensitive receivers that were identified. Noise sensitive receivers are identified based on the requirements of the following regulatory documents:

- EPA publication 1411 (EPA Victoria, 2011) Noise from Industry in Regional Victoria (NIRV): Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria
- EPA Victoria State Environment Protection Policy Control of Noise from Commerce, Industry and Trade No. N-1 (SEPP N-1)

ID	Easting	Northing	Approx. distance to Project site boundary (km)	Assessed status
E1 ¹	586035.4	5909092.5	0	Environmental receiver
E2	584482.8	5912035.9	0	Environmental receiver
R1	584617.2	5909425.5	0	Appears residential
R2	583422.8	5909679.1	0	Appears residential
R3	583461.9	5910616.3	0	Appears residential
R4	585290.8	5911994.8	0	Appears residential
R5	585834.4	5915102.1	0	Appears residential
R6	583434.2	5906296.3	2.4	Appears residential
R7	583246.3	5905607.3	3.2	Appears residential
R8	583327.1	5905644.7	3.1	Appears residential
R9	583246.5	5905715.3	3	Appears residential
R10	583284.8	5905729.4	3	Appears residential
R11	583308.7	5905635.1	3.1	Appears residential
R12	583268.9	5905647.7	3.1	Appears residential
R13	583545.0	5905690.8	3.1	Appears residential
R14	584187.0	5905728.2	3	Appears residential
R15	584196.5	5905763.3	3	Appears residential
R16	584242.2	5905771.4	3	Appears residential
R17	584414.5	5905796.3	3	Appears residential
R18	584470.6	5905784.8	3	Appears residential
R19	584513.1	5905808.9	3	Appears residential
R20	584698.5	5905823.0	3	Appears residential
R21	584756.8	5905779.8	3	Appears residential
R22	585729.6	5905893.3	2.9	Appears residential
R23	586580.7	5907934.6	0.8	Appears residential
R24	586526.6	5907784.5	1	Appears residential
R25	589031.9	5909017.1	2.4	Appears residential
R26	589433.7	5909979.2	2.6	Appears residential

Table 1 Potential sensitive receivers

ID	Easting	Northing	Approx. distance to Project site boundary (km)	Assessed status
R27	589750.9	5912278.1	3.1	Appears residential
R28	588386.5	5915108.2	1.7	Appears residential
R29	590348.3	5914473.0	3.7	Appears residential
R30	590465.3	5917027.7	3.7	Appears residential
R31	585846.3	5916723.1	0.5	Appears residential
R32	578898.5	5917548.2	4.5	Appears residential
R33	579041.3	5916645.2	4.1	Appears residential
R34	580615.7	5914029.9	2.6	Appears residential
R35	580733.9	5913633.4	2.6	Appears residential
R36	583027.2	5912526.1	0.6	Appears residential
R37	583058.3	5910650.3	0.05	Appears residential
R38	584464.6	5923123.1	6.9	Appears residential
R39	589670.7	5922060.3	6.5	Appears residential
R40	590738.7	5905219.6	5.5	Appears residential
R41	582428.9	5918418.1	2.4	Appears residential
R42	581883.8	5908259.5	1.4	Shed ⁽²⁾
R43	582982.2	5908315.2	0.5	Shed ⁽²⁾

(1) Receivers designated with an 'E' are environmentally sensitive receptors such as water bodies or areas of natural significance within the area.

(2) Based on aerial imagery, this receptor does not appear to be a residential dwelling. Further clarification to be sought from the relevant authorities.



LEGEND

- Indicative project extent
- Sensitive receiver
- Environmental receiver
- Noise logger location
- Automatic weather station
- 3136874 Iluka Resources Limited Project No. Paper Size A4 WIM100 1000 Revision No. 2000 m 27/03/2019 **Baseline Noise Assessment** Date. Map Projection: Universal Transverse Mercator Site and identified noise Horizontal Datum: Geocentric Datum of Australia 1994 Grid: Map Grid Of Australia, Zone 56 sensitive receivers FIGURE 1

N-KAUMelbournel/Projects\31\36874\GIS\Maps\Working 2018. While GHD has taken care to ensure the accuracy of this product, GHD and DATA CUSTODIAN(S), make no representations or warranties about its accuracy, completeness or suitability for any particular purpose. GHD and DATA CUSTODIAN(S) cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way Google Earth Imagery 2018. Created by: SM

2.1 Review of existing noise reports

Additional information is available from the noise assessments of other mine sites. Iluka supplied noise assessment reports for Douglas and Echo mines. Applicable criteria for these sites are 45 dB(A) for day time, 37 dB(A) for evening time and 32 dB(A) for night time (as described in the reports).

A summary of the background measurements at locations around the mines is given in Table 2 below, which also shows arithmetic averages where available. It can be seen that average background levels vary substantially from one location to another. Changes in the background can be significant at any time during the day. For example, background noise levels at one of the locations varied from 27 to 41 dB(A) during day time (Holmes) and another location was characterised by background levels variations from about 25 dB(A) to 44 dB(A) during night time (Westmeath).

Mine	Locality	Day	Evening	Night
	Westmeath	29-41, Average 34	26-40, Average 29	25-44, Average 29
	The Rises	37-46, Average 41	35-45, Average 40	34-46, Average 39
_	Handbury	25-35	-	25-28
Douglas	Robertson	28-37	-	27-30
	Farnsworth	30-47	-	32-40
	Turrell	29-45	-	40-53
Echo	Holmes	27-41	25-44	25-32

Table 2 Results of background measurements at Douglas and Echo mines

It is difficult to highlight any similarity of background noise measured at these two mines with results of the current background monitoring described in Section 3.

3.1 Monitoring locations

Continuous background noise monitoring was conducted at six locations between Friday 1 February 2019 to Friday 1 March 2019. The results of the background noise monitoring were used to understand the existing ambient noise conditions and assist with establishing the relevant environmental noise criteria for the Project site.

Noise monitoring was conducted at six locations deemed representative of the ambient noise levels in the area, as detailed in Table 3 below.

The noise monitoring locations and setup at each location are shown in Figure 1 and presented in Appendix A, respectively.

Site ID (receiver ID)	Easting	Northing	Location
Site 1 (E1)	586035.2	5909093.5	North end of Red Gum Swamp, Jallumba Wildlife Reserve (no residential address)
Site 2 (R3)	583477.4	5910648.3	Residence located at 2432 Natimuk-Hamilton Road
Site 3 (E2)	584482.7	5912038.1	North end of Jallumba Marsh Nature Conservation Reserve (no residential address)
Site 4 (R5)	585811.2	5915116.6	Residence located at 66 Nurrabiel Church Road
Site 5 (R27)	589745.9	5912263.4	Unoccupied residence located on Hutchinsons Road
Site 6 (R26)	589471.2	5910001.0	Residence located on Russells Road

Table 3Noise monitoring locations

3.1 Instrumentation

Ambient noise levels were monitored using SVAN 977 (Class 1) environmental noise loggers. Details of the noise measurement instrumentation used are presented in Table 4.

It is noted that the noise logger located at Site 5 failed after five days of operation and therefore only has data for the period of 1 February 2019 to 6 February 2016.

All noise monitoring instrumentation was in current National Association of Testing Authorities (NATA) calibration at the time of use. All instruments were field-checked and calibrated both before and after noise measurements using a Bruel & Kjaer Class 1 acoustic calibrator model 4231 No significant discrepancies were noted throughout the measurement period.

Logging Locations (refer to Table 3)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Model	SVAN 977	SVAN 977	SVAN 977	SVAN 977	SVAN 955	SVAN 977
Equipment Serial No.	36824	59674	36825	69212	27615	59668
Туре	Type 1	Type 1	Type 1	Type 1	Type 1	Type 1
Operating range	15 dB(A) RMS , 141 dB(A) Peak				18 dB(A) RMS , 141 dB(A) Peak	15 dB(A) RMS , 141 dB(A) Peak
Start Date (time)	01/02/2019 (15:00)	01/02/2019 (16:00)	01/02/2019 (16:00)	01/02/2019 (18:00)	01/02/2019 (17:00)	01/02/2019 (17:00)
Finish Date (time)	01/03/2019 (11:00)	01/03/2019 (10:00)	01/03/2019 (10:00)	01/03/2019 (12:00)	06/02/2019 (20:00)	01/03/2019 (12:00)
Measurement Time Interval	15 minute	15 minute	15 minute	15 minute	15 minute	15 minute
Comments	Nil	Nil	Nil	Nil	Logger failed after five days	Nil

Table 4 Noise measurement instrumentation

3.2 Meteorological conditions

Adverse meteorological conditions such as high winds and rainfall can influence noise monitoring results. Current Victorian environmental noise guidelines do not provide a clear explanation of what meteorological conditions should be avoided during noise monitoring period. SEPP N-1 requires background noise measurements be carried out in dry conditions with low to calm winds.

Australian Standard AS 1055:2018: Acoustics – Description and Measurement of Environmental Noise specifies that "Where the maximum wind speed exceeds 5 m/s at the measurement position and noise measurement are required caution should be applied and special windscreens should be utilised" (AS1055:2018, p. 13).

The NSW Noise Policy for Industry (NSW NPI, 2017) stipulates that "noise monitoring should not be conducted (or data should be excluded) when average wind speed (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs" (NSW NPI, 2017, p.50).

In order to obtain accurate site-specific meteorological data at the microphone level, GHD installed an ultrasonic automatic weather station (AWS) at the location of the test pit (see Figure 1). A detailed meteorological analysis is provided in Appendix B.

Data from this AWS was then used to exclude periods of adverse weather conditions from the baseline noise analysis. Based on the above discussion, periods were excluded where:

- Rain was recorded
- Wind speeds greater than 5 m/s at the microphone height were recorded

3.3 Existing noise environment

Table 5 below details the noise observations that were made at each of the noise monitoring locations at the time of equipment installation. From Table 5 it can be seen that the predominant noise sources controlling the ambient noise environment at each site are insects, birds and wind noise through trees and grass.

Site ID	Ambient noise source observations	
(refer to Figure 1)		
Site 1 North end of Red Gum Swamp, Jallumba Wildlife Reserve (no residential address)	 Traffic acceleration noise Breeze through trees Birds Insects 	
Site 2 Residence located at 2432 Natimuk- Hamilton Road	 Faint traffic noise to the south Insects Birds Wind noise through trees/grass Transformer noise approximately 100 m from site 	
Site 3 North end of Jallumba Marsh Nature Conservation Reserve (no residential address)	Wind noise through trees/grassInsectsBirds	

Table 5Noise observations at each logging location

Site ID (refer to Figure 1)	Ambient noise source observations
Site 4 Residence located at 66 Nurrabiel Church Road	 Wind noise through trees/grass Local traffic Birds Aircrafts
Site 5 Unoccupied residence located on Hutchinsons Road	Wind noise through trees/grassInsectsBirds
Site 6 Residence located on Russells Road	BirdsVehicle passbyWind noise through trees/grass

3.4 Background measurement results

Noise monitoring data was post-processed using the methodology described in section 3.2. Table 7 presents a summary of the overall established background noise levels for each site based on the measured hourly background noise levels (LA90) during day, evening and night-time periods. The established background noise levels are based on the provisions outlined in the NIRV guideline which refers to the SEPP N-1 procedures.

The results show that background noise levels at each site are all generally similar to each other. The highest average daytime background noise level measured occurred at sites 5 and 6 (34 dB), whilst the lowest was recorded at Site 3 (28 dB). The established background noise levels have been used to derive the applicable NIRV noise limits detailed in section 4. Each noise logger location is considered representative of similarly exposed noise sensitive receivers as outlined in Table 6.

Table 6 Applicable noise sensitive receivers representative of each logger location

Logger location	Representative receivers
Site 1	E1, R6 – R24
Site 2	R1 – R3, R37, R42 – R43
Site 3	E2, R4, R34 – R36
Site 4	R5, R31 – R33, R38 – R39, R41
Site 5	R27 – R30
Site 6	R25 – R26, R40

Site	Arithmetic average of hourly background L_{A90} dB						
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)				
Site 1	30	29	25				
Site 2	31	30	23				
Site 3	28	28	23				
Site 4	31	30	24				
Site 5	34	32	24				

31

24

Table 7 Summary of unattended noise monitoring results

34

Site 6

4.1 Relevant guidelines

Noise in Victoria is managed via two regulatory documents that apply to noise control in Victoria, namely:

- State Environment Protection Policy Control of Noise from Commerce, Industry and Trade No. N-1 (SEPP N-1) (Victorian Government, 1989)
- Noise from Industry in Regional Victoria (NIRV): Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria (EPA publication 1411) (EPA Victoria, 2011)

The SEPP N-1 is applicable for sensitive receptors located in a *Major Urban Area*, with potential impact from industrial noise. A '*Major Urban Area*' is defined as:

- The part of *Melbourne* that is within the SEPP N-1 boundary (see Figure 2); or
- The part of *Melbourne* that extends beyond the *SEPP N-1 boundary*, but is within the *Melbourne Urban Growth Boundary* (UGB) (see Figure 2)

Noise impact in the areas outside the above boundaries are managed by the NIRV guideline. The NIRV guideline is applicable for sensitive receptors located in a *Rural Area*, with potential impact from industrial noise. A *'Rural Area'* is defined as land that is not within a *'Major Urban Area'*, including land in cities or towns with population below 7000, and rural locations outside *'Major Urban Areas*'.

In addition, the NIRV guideline makes provision for a land located outside the SEPP N-1 boundary and Melbourne UGB, but has a population greater than 7000, to be assessed against the SEPP N-1 methodology.



Figure 2 Areas covered by SEPP N-1 and planning UGB (EPA Victoria, 2011)

4.1.1 Applicable method of assessment criteria

The Project site and the nearby sensitive receptors are located as follows:

- Beyond the 'SEPP N-1 Boundary'
- Beyond the Planning 'Urban Growth Boundary'
- Not within a 'major urban area'

Therefore the noise criteria applicable to the sensitive receivers were derived based on the NIRV guideline.

4.1.2 Noise from Industry in Regional Victoria (NIRV)

Noise from industry in regional Victoria is expected to meet the applicable criteria in the NIRV guideline. The NIRV guideline provides recommendations on the impact of noise for residential and other noise-sensitive uses.

NIRV (Part 3) sets the maximum noise level allowed in a noise sensitive area from commercial and industrial premises depending on the time of day and land use zoning. The established zoning limits are then adjusted depending on the receiver to source distance to obtain the maximum allowable noise levels.

However, for an earth resources industry (the case of this assessment), the NIRV guideline (Part 3.2) outlines specific earth resource levels, based on the time of day and zoning of the noise receiver to be used instead of the mentioned zoning limits. No distance adjustments applies for the earth resource levels. The earth resource limits applicable to all receptors in this assessment are as follows:

- Day: 46 dB(A)
- Evening: 41 dB(A)
- Night: 36 dB(A)

Time periods in the NIRV are defined as follows:

- Day: 07.00-18.00 (Monday- Friday), 07.00-13.00 (Saturdays)
- Evening: 18.00-22.00 (all days), 13.00-18.00 (Saturdays), 07.00-18.00 (Sundays and public holidays)
- Night: 22.00-07.00 (all days)

In accordance with the requirements of the NIRV, in a situation where background noise levels are expected to be higher than usual for a rural area (traffic noise, coastal areas, etc.), background noise monitoring should be undertaken. The assessment of background noise levels may only increase the maximum allowable noise limits above the zone noise level or leave it unchanged. As discussed above, GHD has conducted background noise monitoring for this assessment (results presented in Table 7).

In order to determine the day evening and night time criteria at each sensitive receptor, the NIRV guideline requires the following assessment to be made:

- Day: the greater of:
 - The day time earth resource limit
 - The day background level plus 8 dB
- Evening: the greater of:
 - The evening time earth resource limit
 - The evening background level plus 5

- Night: the greater of:
 - The night time earth resource limit
 - The night background level plus 5

The NIRV guideline also outlines a methodology for developing noise criteria in relation to earth resources in high traffic areas. This assessment is not located in a high traffic area and therefore the criteria derived using the above methodology will become the recommended levels.

4.1.3 Project specific noise criteria

Table 8 below details the derived noise criteria at each noise logging site, utilising the methodology outlined above. As stated in section 3.4, each noise logger location is considered representative of similarly exposed noise sensitive receivers. For specific criteria at each sensitive receptor location, refer to Table 6 for the applicable noise sensitive receivers representative of each logger location. One can see that the earth resource limits are applicable to all of the monitoring sites. Average background levels measured at the monitoring locations are typical for a quiet rural environments.

Based on the analysis of background data, the same noise limits are applicable to sensitive receivers in areas adjacent to the project site:

- Day: 46 dB(A)
- Evening: 41 dB(A)
- Night: 36 dB(A)

Table 8 Project specific noise criteria based on NIRV

Site	Time period	Earth resource limit (dB(A))	Measured background (L _{A90} dB) (taken from Table 7)	Adjusted background based limit	Project specific n criteria dB(A) L _{Aeq (30-min)}
1	Day	46	30	38	46
	Evening	41	29	34	41
	Night	36	25	30	36
2	Day	46	31	39	46
	Evening	41	30	35	41
	Night	36	23	28	36
3	Day	46	28	36	46
	Evening	41	28	33	41
	Night	36	23	28	36
4	Day	46	31	39	46
	Evening	41	30	35	41
	Night	36	24	29	36
5	Day	46	34	42	46
	Evening	41	32	37	41
	Night	36	24	29	36

Site	Time period	Earth resource limit (dB(A))	Measured background (L _{A90} dB) (taken from Table 7)	Adjusted background based limit	Project specific n criteria dB(A) L _{Aeq (30-min)}
6	Day	46	34	42	46
	Evening	41	31	36	41
	Night	36	24	29	36

It should be noted that NIRV (Part 4) allows for higher noise limits for mine operations in some circumstances. Noise impacts from short projects and necessary works which are unshielded may result in a higher levels. A relevant approval body may allow for noise levels that can be up to 10 dB(A) greater than the recommended level during the day time to a maximum of 68 dB(A). This is a substantial increase to the relevant limit allowance that can be applied to specific project activities during certain types of works.

5. Conclusion

GHD was engaged by Iluka to prepare a background noise assessment for the Wimmera Project site. Environmental background noise monitoring was conducted at locations surrounding the Project site during the period 1 February 2019 to 1 March 2019.

Relevant noise sensitive receivers that can be potentially affected by noise emissions from the Project site were identified. Background noise monitoring was undertaken at six locations considered representative of the ambient noise levels at the nearest noise sensitive receivers surrounding the Project site.

A preliminary review of the local topography indicated that Project site and surrounds are generally located on a relatively flat terrain with no significant topographical features.

A review of existing noise assessments undertaken in the area surrounding the Project site was conducted. It was determined that the average background levels varied substantially from one location to another. It was noted that changes in the background could be significant during any time of the day.

The results of the background noise monitoring was utilised to establish relevant environmental noise emission criteria based on the requirements of the guideline *Noise from Industry in Regional Victoria (NIRV): Recommended maximum noise levels from commerce, industry and trade premises in regional Victoria.*

Noise emissions from the future operation of the Project site should comply with the established project specific noise criteria as outlined in this report.

Appendices

 $\ensuremath{\textbf{GHD}}\xspace$ | Report for Iluka Resources Limited - Wimmera Project, 3136874

Appendix A – Noise monitoring equipment installation





Imagery provided by Iluka, sourced from ArcGIS Map Service, World_Imagery database



Site 2 - Residence located at 2432 Natimuk-Hamilton Road



Site 3 - North end of Jallumba Marsh Nature Conservation Reserve



Site 4 - Residence located at 66 Nurrabiel Church Road



Site 5 - Unoccupied residence located on Hutchinsons Road





Appendix B – Meteorological analysis



Iluka Resources Limited

Wimmera Project Meteorological Assessment

April 2019

Table of contents

1.	Introd	luction	1
	1.1	Acknowledgement of country	1
	1.2	Context	1
	1.3	Purpose of this report	1
	1.4	Scope of works	1
	1.5	Scope and limitations	2
	1.6	Assumptions	2
2.	Data	collection	3
3.	Data	validation	5
4. Comparison of meteorological parameters			8
	4.1	Temperature	8
	4.1	Relative humidity	8
	4.1	Pressure	9
	4.2	Wind speed	9
	4.3	Wind pattern	9
	4.4	Conclusion1	1
5.	Reco	mmendation1	2
	5.1	Use of nearby BOM data1	2
	5.2	Alternative methods1	2
	5.3	Potential approach1	2

Table index

Table 1	Horsham wind roses February 2019 - GHD AWS (top) and BOM AWS (bottom)	6
Table 2	Kanagulk wind roses February 2019 - GHD AWS (top) and BOM AWS (bottom)	7
Table 3	Comparison of measured temperature	8
Table 4	Comparison of measured relative humidity	8
Table 5	Comparison of measured pressure	9
Table 6	Comparison of measured wind speed	9
Table 7	GHD AWS wind roses February 2019 – Test Pit (top), Horsham Aero (centre) and Kanagulk (bottom)	10

Figure index

Figure 1	Weather station locations	4
----------	---------------------------	---

Appendices

Appendix A – Photos of GHD automatic weather stations as installed

1. Introduction

1.1 Acknowledgement of country

The project team would like to acknowledge the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagalk Nations who are the traditional custodians of the land upon which noise, vibration and meteorological measurements were conducted during this assessment. We pay our respects to Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagalk Elders, past and present and extend this respect to all Aboriginal and Torres Strait people who may be reading this document.

1.2 Context

It is understood that Iluka Resources Limited (Iluka) is currently preparing a preliminary feasibility study for the Wimmera Project site (herein after 'the Project site'). As a component of the feasibility study, GHD was engaged to complete an assessment of available meteorological data surrounding the Project site.

The meteorological data is proposed for use in various applications at the Project site, including:

- As a part of the EES for the Wimmera Project, it is likely that an Air Quality Impact Assessment (AQIA) will be required. Dispersion modelling completed in an AQIA requires measurement, sourcing or development of site-specific of site-representative meteorological data.
- Operational management including:
 - Response to adverse weather events (high winds, rainfall)
 - Assessment and response to non-compliance events (dust, noise, surface water)

1.3 Purpose of this report

The purpose of this assessment was to identify which of the nearby Bureau of Meteorology (BoM) Automatic Weather Stations (AWS), if any, would be able to provide site representative meteorological data for various applications at the Project site.

1.4 Scope of works

The scope of works included the following:

- Measurement of the local meteorological environment for a period of one month at the following three locations:
 - Wimmera project test pit
 - Horsham Aerodrome BoM AWS
 - Kanagulk BoM AWS
- Validation of GHD AWS measurements through comparison against data purchased from BoM for the same time period.
- Comparison of meteorological parameters, most importantly wind pattern measured at each of the GHD AWS's with the aim of:
 - Determining if the Horsham BoM AWS is sufficiently site-representative of the Wimmera Project site
 - Determining if the Kanagulk BoM AWS is sufficiently site-representative of the Wimmera Project site

- Where either station are deemed unsuitable provide recommendations on either of the following options:
 - Utilising some combination of meteorological models TAPM /CALMET to simulate the meteorological environment at the site
 - Installation of an AWS at the Wimmera Project site to be used for sampling

1.5 Scope and limitations

This report has been prepared by GHD for Iluka Resources Limited and may only be used and relied on by Iluka Resources Limited for the purpose agreed between GHD and the Iluka Resources Limited as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Iluka Resources Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Iluka Resources Limited and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.6 Assumptions

- The conclusions and recommendations presented in this report are based on meteorological monitoring conducted for a period of one month only. Any similarities or differences observed in the wind pattern at each site are for this period only and are likely to change based on seasonal influences.
- The assessment utilises data obtained from Bureau of Meteorology weather stations. GHD cannot confirm the quality or representativeness of this data.
- Recommendations are subject to interpretation and should be confirmed with EPA Victoria.

2. Data collection

GHD installed three Vaisala WXT536 Automatic Weather Stations (AWS) from 01 February 2019 to 01 March 2019. The units were installed on a 2 m mast, and are each shown as installed in Appendix A.

The locations of each WXT536 AWS are shown in Figure 1 and described below:

- Test pit located on the Wimmera Project test pit site, deemed representative of the Project site and surrounds and utilised in the baseline noise assessment
- Horsham Aero collocated with BoM AWS approximately 35 km north-east of Test Pit site
- Kanagulk collocated with BoM AWS approximately 25 km south-west of Test Pit site



LEGEND





N:\AU!Melbourme\Projects\31\36874\GIS\Maps\Working 2019. While GHD has taken care to ensure the accuracy of this product, GHD and DATA CUSTODIAN(S), make no representations or warranties about its accuracy, completeness or suitability for any particular purpose. GHD and DATA CUSTODIAN(S) cannot accept liability of any kind (whether in contract, tor tor otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way Google Earth Imagery 2019. Created by: SM
3. Data validation

GHD purchased a complete set of meteorological data from the Horsham and Kanagulk BoM stations for the previous five years.

In order to validate measurements undertaken at the GHD AWS sites, comparisons were made with the data measured by BoM for the same period and the GHD measurements would be considered valid if the wind pattern recorded was similar for both measurement sets.

Note, BoM measurements were conducted at a mast height of 10 m and as such some variance to the wind speeds are expected due to wind shear with wind speeds at 10 m expected to be stronger than at 2 m.

Comparisons of the Horsham Aero and Kanagulk sites with the GHD sites are shown in Table 1 and Table 2 respectively. As expected, the wind speeds measured at the BoM AWS sites are elevated in comparison to the GHD AWS sites, however the wind patterns (directions) measured at each BoM AWS and GHD AWS are sufficiently similar at each site, thus validating the GHD measurements.



Table 1 Horsham wind roses February 2019 - GHD AWS (top) and BOM AWS (bottom)



Table 2 Kanagulk wind roses February 2019 - GHD AWS (top) and BOM AWS (bottom)

4. Comparison of meteorological parameters

The following sections present comparisons of key meteorological parameters measured at each GHD site. The following key statistics are presented:

- 10th Percentile (10% of measurements below this value)
- Average
- 90th Percentile (90% of measurements below this value)

A percentile is a measure used in statistics to indicate the value below which a given percentage of observations such as meteorological parameters fall. For example, the 10th percentile is the value below which 10% of the observations are found.

4.1 **Temperature**

A statistical overview of the measured temperatures at each site is shown in Table 3 below. Each site shows a good comparison for each statistic, with a maximum variance of ~10%.

Table 3 Comparison of measured temperature

Parameter	Test Pit	Horsham	Kanagulk
10 th Percentile Temperature (C)	11	12	12
Average Temperature (C)	20	21	20
90 th Percentile Temperature (C)	30	31	30

4.1 Relative humidity

A statistical overview of the measured relative humidity at each site is shown in Table 4 below. Each site shows a good comparison for each statistic, with a maximum variance of \sim 10%.

Table 4 Comparison of measured relative humidity

Parameter	Test Pit	Horsham	Kanagulk
10 th Percentile Relative Humidity (%)	19	19	21
Average Relative Humidity (%)	48	48	54
90th Percentile Relative Humidity (%)	79	80	85

4.1 Pressure

A statistical overview of the atmospheric pressure at each site is shown in Table 5 below. Each site shows a good comparison for each statistic, with a maximum variance of ~10%.

Table 5 Comparison of measured pressure

Parameter	Test Pit	Horsham	Kanagulk
10 th Percentile Pressure (hPa)	987	990	984
Average Pressure (hPa)	995	998	992
90 th Percentile Pressure (hPa)	1003	1006	1000

4.2 Wind speed

A statistical overview of the wind speed at each site is shown in Table 6 below. Whilst wind speeds at the Test Pit and Horsham sites compare well, wind speeds measured at Kanagulk are significantly lower.

Table 6 Comparison of measured wind speed

Parameter	Test Pit	Horsham	Kanagulk
10 th Percentile Wind Speed (m/s)	0.9	1.3	0.5
Average Wind Speed (m/s)	3.2	3.4	2.3
90 th Percentile Wind Speed (m/s)	5.8	6.0	4.3

4.3 Wind pattern

Wind roses for each site for the period (February 2019) are shown in Table 7 below. The following observations are made relating to the observed wind pattern at each site:

Test Pit

The wind pattern at the Test Pit site for the period was dominated by south through southwesterly component winds, occurring ~50% of the time. Winds from these directions ranged from light (< 2 m/s) through strong (> 8 m/s). Winds from the north-west through south-east quadrants were infrequent and were primarily light to moderate when observed.

Horsham Aero

The wind pattern at the Horsham Aero site for the period was dominated by south-west component winds, occurring ~40% of the time. Winds from these directions ranged from light (< 2 m/s) through strong (> 8 m/s). Winds from the north-west through north-east quadrants were infrequent. Light to moderate south-easterly component winds were observed for approximately 20% of the period.

Kanagulk

The wind pattern at the Kanagulk site for the period was dominated by south and south southeasterly component winds, occurring ~40% of the time. Winds from these directions ranged from light (< 2 m/s) through moderate (< 8 m/s), with winds > 6 m/s only occurring from the south and south south-easterly directions at this location. Winds from the east were infrequent. Very light winds (0.5 m/s) were observed from all directions.







4.4 Conclusion

Measured data for temperature, relative humidity and pressure were sufficiently aligned at each site.

The wind pattern at Kanagulk was significantly different to the Test Pit Site and is therefore deemed not-representative of the wind pattern at the Project site. The wind pattern at Horsham was more closely aligned with the measured pattern at the Test Pit Site, however important differences are observed including:

- The average measured wind speed at the Test Pit Site was lower than at Horsham (3.2 m/s vs 3.4 m/s). Whilst this does not represent a large difference in average wind speed, there is a more significant difference between the frequency of light winds (<2 m/s) at each site (34% at Test Pit vs 26% at Horsham). In most dispersion modelling applications, maximum impacts are predicted during light wind conditions and as such proper characterisation of the frequency of light winds is important.
- The wind pattern, including winds less than 2 m/s, are distributed more evenly across the compass sectors at Horsham than at the Test Pit Site. It is expected that the strong south through south-west winds observed at the Test Pit Site are a result of terrain influences. For example Gariwerd (Grampians) to the east providing funnelling effects and blocking effects against easterly component winds. This effect leading to strong southerlies is not seen at Horsham, which has a proportion of winds from the southeast instead. It is also noted that at the Test Pit site, the test pit overburden stockpile was located south-east of the GHD AWS. GHD considers it unlikely that the stockpile could lead to blocking of winds from the south-easterly direction. However, if this were to occur to, we would likely observe a substantially higher frequency of winds from both the south-south east and east south-east.

Therefore based on the available data, GHD does not consider the measured meteorological data at either Horsham or Kanagulk BoM AWS sites to be suitably representative of the Wimmera Project site.

5.1 Use of nearby BOM data

Based on the conclusion presented in section 4.4, GHD does not recommend the standalone use of meteorological data from either Horsham or Kanagulk BoM AWS sites for dispersion modelling purposes for the Wimmera Project.

5.2 Alternative methods

Alternative methods available for characterisation of the local meteorological environment at the Wimmera Project site include the following:

- Installation of an AWS at the Project site for a duration of at least one-year to enable capture of one complete 12 month cycle across all seasons and months
- Using meteorological models (prognostic (e.g TAPM) and/or diagnostic models (e.g. CALMET))

The most robust method for characterisation of the local meteorological environment of a site for use in dispersion modelling is the collection of data from an on-site instrument. However, Iluka will need to ascertain the risk-level of the project and weigh this against the cost and time constraints associated with this type of data collection.

Use of meteorological models to simulate the wind environment at a site are commonly utilised and accepted for characterising the meteorological environment where site representative data are not available. GHD typically use a combination of the prognostic and diagnostic models, TAPM and CALMET, with either of the following combinations:

- No-observations mode CALMET uses 3-D gridded data from TAPM only used where no data are available within reasonable proximity to the investigation area
- Hybrid mode CALMET uses 3-D gridded data from TAPM and surface observations from nearby AWS- used where data are available within reasonable proximity to the investigation area but are not deemed site representative

In this case, GHD would recommend use of CALMET in Hybrid mode, which will allow for the inclusion of data measured at Horsham Aero and Kanagulk. The resultant wind field developed for the subject site would be some 'blend' of terrain and land use affected wind outputs from TAPM as well as winds observed at Horsham Aero and Kanagulk BoM sites. Hence, while the two sites may not be suitable as standalone sites, their inclusion in the hybrid model helps to guide the regional wind fields predicted in TAPM and CALMET.

5.3 Potential approach

Should Iluka wish to proceed with the Air Quality Impact Assessment (AQIA) without unnecessary delay, GHD would recommend the following approach.

- Iluka proceed with generating modelled meteorological data for the Project site as described above in section 5.2 (hybrid approach).
- Present results of meteorological modelling to EPA for their agreement for use in the AQIA.
- Should EPA not deem the meteorological modelling to be sufficient then Iluka would likely be required to install an onsite AWS for 12 months, otherwise if approved continue forward with the AQIA.

- The initial meteorological modelling could be used for sensitivity analysis which would be suitable for mine planning applications, identification of most affected premises, understanding which mitigation measures may be required and development of any Air Quality Management Plans.
- If required and upon collection of a 12 month data set at the site, update modelling and AQIA based on new data.

Appendices

 $\ensuremath{\textbf{GHD}}\xspace$ | Report for Iluka Resources Limited - Wimmera Project, 3136874

Appendix A – Photos of GHD automatic weather stations as installed



Figure A 1 GHD AWS installed at Test Pit site - Photo 01/02/2019



Figure A 2 GHD AWS installed at Horsham Aero site - Photo 01/02/2019



Figure A 3GHD AWS installed at Horsham Aero site - Photo 01/02/2019 - BoM
AWS in background



Figure A 4 GHD AWS installed at Kanagulk site - Photo 01/02/2019



Figure A 5 GHD AWS installed at Kanagulk site - Photo 01/02/2019 – BoM AWS in background

GHD

Level 18 180 Lonsdale Street Melbourne VIC 3000 T: 61 3 8687 8000 F: 61 3 8687 8522 E: melmail@ghd.com

© GHD 2019

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited. 3136874-

20928/https://projects.ghd.com/oc/Victoria3/wim100baselinenoisea/Delivery/ Documents/3136874-REP-0_Meteorological Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	D.Craggs	M.Asimakis	U-lunly	C. McVie	alten	17/04/19

www.ghd.com



Appendix C – Noise monitoring results

































```
Site 2
```






























































```
Site 4
```






































```
Site 6
```































GHD

Level 18 180 Lonsdale Street Melbourne VIC 3000 T: 61 3 8687 8000 F: 61 3 8687 8522 E: melmail@ghd.com

© GHD 2019

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

3136874-

70972/https://projects.ghd.com/oc/Victoria3/wim100baselinenoisea/Delivery/Documents/3136874-REP-Baseline Noise Assessment.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A						29/03/2019
0	S.Materia	V.Lenchine	the	C.McVie	allan	17/04/2019

www.ghd.com

