Noise Impact Assessment

Keysbrook Titanium Minerals Proposal

A STUDY OF POSSIBLE NOISE IMPACT FROM MINING OF MINERAL SANDS BETWEEN THE TOWNS OF KEYSBROOK AND NORTH DANDALUP

Prepared For

MBS Environmental

February 2006

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Report: 511442-03c

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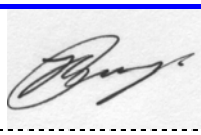
Approved for Issue:	Terry George 
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APPENDICES

1 INTRODUCTION

Olympia Resources Ltd is planning a short-term mining project on farmland in the Keysbrook area. The proposal is to produce titanium minerals and zircon from a mineral sands deposit, covering an approximate area of 1200 hectares. The land will be mined in small sections with the heavy minerals extracted on site and then transported by truck to Picton for separation and export.

The life of the mine is approximately 8 years and the mine area has been divided into sections representing each year – refer *Figure A01* in *Appendix A*. Nearby houses to the mine are also shown on *Figure A01* and referred to as Houses 1 to 12. Agreements with the owners of other houses, which are within the resource zone but not shown on *Figure A01,* have been reached and these are considered to be 'caretaker residences'.

The basic mining operation will comprise of a scraper collecting the ore and dumping into a hopper. A slurry mixture is formed and pumped to the wet concentrator plant where the minerals are separated. The majority of the sand is returned to the mining pit to re-establish the pre-mining land contours.

It is the above operation that is the subject of this noise impact assessment, with the results compared with the prescribed standards of the *Environmental Protection (Noise) Regulations 1997*. Where exceedances are found, management and noise control strategies are discussed.

2 DEFINITIONS

The following is an explanation of the terminology used throughout this report.

Sound Power Level

Under normal conditions, a given sound source will radiate the same amount of energy, irrespective of its surroundings, being the sound power level. This is similar to a 1kW electric heater always radiating 1kW of heat. The sound power level of a noise source cannot be measured using a sound level meter but is calculated. Noise modelling incorporates source sound power levels as part of the input data.

Sound Pressure Level

The sound pressure level of a noise source is dependent upon its surroundings, being influenced by distance, ground absorption, topography, meteorological conditions etc and is what the human ear actually hears. Using the electric heater analogy above, the heat will vary depending upon where the heater is located, just as the sound pressure level will vary depending on the surroundings. Noise modelling predicts the sound pressure level from the sound power levels taking into account ground absorption, barrier effects, distance etc.

Decibel

The decibel (dB) is the unit that describes the sound pressure and sound power levels of a noise source. It is a logarithmic scale referenced to the threshold of hearing.

A-Weighting

An A-weighted noise level has been filtered in such a way as to represent the way in which the human ear perceives sound. This weighting reflects the fact that the human ear is not as sensitive to lower frequencies as it is to higher frequencies. An A-weighted sound pressure level is described as L_A dB or dB(A).

L_{Amax}

An L_{Amax} level is the maximum A-weighted noise level.

L_{A1}

An L_{A1} level is the A-weighted noise level which is exceeded for 1 per cent of the measurement period and is considered to represent the average of the maximum noise levels measured.

L_{A10}

An L_{A10} level is the A-weighted noise level which is exceeded for 10 per cent of the measurement period and is considered to represent the "*intrusive*" noise level.

3 CRITERIA

Environmental noise in Western Australia is governed by the *Environmental Protection Act 1986*, through the *Environmental Protection (Noise) Regulations 1997*. Regulation 7 defines the prescribed standard for noise emissions as follows:

"7. (1) Noise emitted from any premises or public place when received at other premises –

(a) Must not cause or *significantly contribute to*, a level of noise which exceeds the assigned level in respect of noise received at premises of that kind; and

(b) Must be free of –

i. Tonality;

ii. Impulsiveness; and

iii. Modulation".

A "…noise emission is taken to *significantly contribute to* a level of noise if the noise emission exceeds a value which is 5 dB below the assigned level…"

Tonality, impulsiveness and modulation are defined in Regulation 9. Noise is to be taken to be free of these characteristics if:

(a) The characteristics cannot be reasonably and practicably removed by techniques other than attenuating the overall level of noise emission; and

(b) The noise emission complies with the standard after the adjustments of *Table 3.1* are made to the noise emission as measured at the point of reception.

Table 3.1 – Adjustments For Intrusive Characteristics

Tonality	Modulation	Impulsiveness
+ 5 dB	+ 5 dB	+ 10 dB

Note: The above are cumulative to a maximum of 15 dB.

The assigned levels (prescribed standards) are specified in Regulation 8 and are shown below in *Table 3.2*.

Table 3.2 – Assigned Noise Levels For Noise Sensitive Premises

Premises Receiving Noise	Time Of Day	Assigned Level (Db)		
		L_{A10}	L_{A1}	L_{Amax}
Noise Sensitive[1]	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor

1. Applies within 15 metres of a building associated with a noise sensitive use, as defined in Schedule 1, Part C.

In the above, the influencing factor, L_{A10}, L_{A1} and L_{Amax} are defined as follows:

Influencing factor in relation to noise received at noise sensitive premises, means –

$$= \frac{1}{10}\left(\%\ \text{Type A}_{100} + \%\ \text{Type A}_{450}\right) + \frac{1}{20}\left(\%\ \text{Type B}_{100} + \%\ \text{Type B}_{450}\right)$$

where:

$\%\ \text{Type A}_{100}$ = the percentage of industrial land within a 100m radius of the premises receiving the noise

$\%\ \text{Type A}_{450}$ = the percentage of industrial land within a 450m radius of the premises receiving the noise

$\%\ \text{Type B}_{100}$ = the percentage of commercial land within a 100m radius of the premises receiving the noise

$\%\ \text{Type B}_{450}$ = the percentage of commercial land within a 450m radius of the premises receiving the noise

+ Traffic Factor (maximum of 6 dB)

= 2 for each secondary road within 100m

= 2 for each major road within 450m

= 6 for each major road within 100m

L_{A10} assigned level	means an assigned level which, measured as a $L_{A\ slow}$ value, is not to be exceeded for more than 10% of the *representative assessment period*.
L_{A1} assigned level	means an assigned level which, measured as a $L_{A\ slow}$ value, is not to be exceeded for more than 1% of the *representative assessment period*.
L_{Amax} assigned level	means an assigned level which, measured as a $L_{A\ slow}$ value, is not to be exceeded at any time.

Where *representative assessment period* means a period of time not less than 15 minutes, and not exceeding 4 hours, determined by an inspector or authorised person to be appropriate for the assessment of a noise emission, having regard to the type and nature of the noise emission.

The influencing factor at the nearest residences has been assumed to be 0 such that the applicable criteria for noise present for more than 10% of the time is 45 dB L_{A10} during the day and 35 dB L_{A10} during the night.

A map showing the locations of residences is contained in *Appendix A*.

4 METHODOLOGY

The assessment involved using a computer modelling programme (*SoundPlan 6.1*) to predict the noise propagation to the surrounding areas. *SoundPlan* was developed by Braunstein + Berndt, GmbH, a European company and is endorsed by the Department of Environment (DoE). The programme was selected to use the *CONCAWE* algorithms, which requires the following input data:

- Meteorological Information;
- Topographical data;
- Ground Absorption;
- Source sound power levels.

4.1 Meteorological Information

Meteorological information utilised was initially in accordance with the default conditions nominated in the draft *EPA Guidance for the Assessment of Environmental Factors No. 8* as shown below in *Table 4.1*. These represent worst-case conditions, in that noise propagation is at a maximum whilst background noise, as a result of wind, is at a minimum.

Table 4.1 – Modelling Meteorological Conditions

Parameter	Value	
	Day	Night
Temperature (^{o}C)	20	15
Humidity (%)	50	50
Wind Speed (m/s)	4	3
Temperature Gradient (^{o}C/100m)	0	2

1. *SoundPlan* does not allow the incorporation of a temperature gradient, but rather a Pasquil Stability Factor (PSF). For Day/Evening conditions, a PSF of Type B was chosen and for Night conditions, a PSF of Type F was chosen.

Following the results of preliminary modelling, specific wind directions and calm conditions were also considered.

4.2 Topographical Data

The topography of the site is relatively flat. The mining operations are also quite shallow so noise calculations are based on the assumption of flat ground.

4.3 Ground Absorption

Ground absorption can vary from a value of 0 to 1, with 0 being for an acoustically reflective ground (e.g. water or bitumen) and 1 for acoustically absorbent ground (e.g. grass). A value of 0.65 has been used in this instance.

4.4 Sound Power Data

The major noise producing components of the operations are the wet plant concentrator and the scraper. To predict the noise levels to the surrounding areas, knowledge of the equipment sound power levels is required.

Sound power levels of a scraper were obtained from file data from a similar operation.

To determine the sound power levels of a wet concentrator plant, including the tailings pumps, noise level measurements were undertaken at the Cable Sands site in Ludlow. Individual items of equipments were measured and their sound power levels determined. The sound power levels were then incorporated into the noise modelling programme *SoundPlan* with noise levels predicted to the near-field (within 50 metres). The results were then compared against the same distance and wind condition measurements and the model of the concentrator calibrated. It should be noted that a new concentrator plant would likely be quieter than the Ludlow plant, so that the modelling is considered conservative.

Sound power levels of the hopper/screen and pumps were based on the equipment achieving a sound pressure level of 90 dB(A) and 85 dB(A) respectively at 1 metre. The specification for this equipment is expected to be 80 dB(A) at 1 metre. The screen and pump will also be surrounded by a minimum 2 metre high bund. If any booster pumps are required (where the distance between the wet concentrator and hopper is greater than 750

metres), these will have a sound pressure level of no more than 75 dB(A) at 1 metre. Note to achieve a 75dB(A) sound pressure level will likely require an acoustic enclosure.

Table 4.2 provides the sound power levels for the equipment. Modelling was undertaken in 1/3 octave bands, however for efficiency, the equivalent 1/1 octave band data is provided.

Table 4.2 – Equipment Sound Power Levels

Item	Octave Band Centre Frequency								dB(A)
	31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	
Scraper	76	86	101	99	106	108	106	102	113
Wet Concentrator Plant									
Rougher Pump	45	61	72	76	82	84	84	78	**89**
Head Feed & Overflow Cyclone	57	70	85	85	91	93	94	92	**99**
Tails Retreat Cyclone	54	66	76	78	87	88	88	86	**94**
Final Tails Pump	48	61	68	77	85	87	86	83	**92**
Plant Overflow Pump	47	61	70	78	85	88	85	83	**92**
Tails Retreat Pump	51	68	74	80	84	90	90	87	**95**
Scavenger Pump	52	70	75	82	87	90	91	88	**96**
Recleaner & Cleaner Pump	47	62	70	79	81	87	85	81	**91**
RTB Pump & Mids Pump	45	63	72	77	82	90	88	84	**93**
Final Cons Pump	53	62	73	78	85	92	87	84	**95**
Head Feed Pump	53	63	75	81	86	92	88	83	**95**
Agitators	56	64	75	85	89	93	90	84	**96**
Grizzly W/water Pump	50	62	76	82	91	92	89	85	**97**
Plant W/water Pump	50	63	76	87	94	97	92	86	**100**
Deck Water Pump	46	55	67	76	76	79	81	79	**86**
Tails Water Pump	47	55	71	71	80	81	81	81	**87**
Thickener Water Pump	51	59	76	78	78	90	79	78	**91**
Hopper Plant									
Screen	65	72	86	92	96	94	94	93	**101**
Pump	50	62	76	82	91	92	89	85	**97**
Booster Pump	40	52	66	72	81	82	79	75	**87**

5 NOISE MODELLING RESULTS

Preliminary modelling examined the noise propagation from individual parts of the operations, under worst-case meteorological conditions. Based on the outcomes, the fixed plant locations can be determined and noise management strategies developed for the mobile plant (scraper).

The analysis determines distances that are required in order to achieve 30 dB L_{A10} for fixed plant and 30 dB L_{A10} and 45 dB L_{A10} for the scraper. The 30 dB(A) value is 5 dB less than the assigned night-time noise level, thus allowing for the + 5 dB tonal penalty, which may be applicable in some instances. The 45 dB L_{A10} is also examined for the scraper as there may be areas which would be unacceptable to mine during the night-time, but acceptable during the daytime. During the daytime it is assumed that the scraper will not be considered tonal due to other background noise, particularly road traffic from Southwest Highway, wind, animals and farming/household activities.

5.1 Fixed Plant Noise Modelling

Noise levels from the fixed plant are required to comply with the most stringent night-time assigned noise level of 35 dB L_{A10} under worst-case wind conditions to allow for 24 hour operation. The three fixed parts of the operation examined were as follows:

1. Wet Concentrator Plant
2. Hopper / Screen and Pump
3. Booster Pumps

Each of the above items is discussed separately below.

5.1.1 Noise Modelling Results – Wet Concentrator Plant

It was determined that a distance of approximately 1000 metres was required from the wet concentrator plant, in order to achieve a noise level of 30 dB L_{A10}. Based on this, three locations were found where the concentrator could be positioned and the mine still operated efficiently. Note that only one location will operate at any one time with the same plant being moved as required.

- Location 1 - Wet Plant North: 400,894 E 6,406,822 N
- Location 2 - Wet Plant Central: 402,554 E 6,403,787 N
- Location 3 - Wet Plant South: 400,179 E 6,409,855 N

Appendix B, *Figures B01 to B03*, show the predicted noise levels under worst-case wind conditions for each of these plant locations. The results are also summarised below in *Table 5.1*, noting that this assumes light winds are occurring in all directions simultaneously.

Table 5.1 – Worst-Case Predicted Noise Levels from Wet Concentrator Plant

House	Wet Plant Location 1 North	Wet Plant Location 2 Central	Wet Plant Location 3 South
1	26	8	0
2	26	9	0
3	24	24	3
4	19	25	5
5	7	12	1
6	4	24	19
7	4	23	19
8	1	17	29
9	0	14	28
10	0	13	30
11	0	12	18

5.1.2 Noise Modelling Results - Hopper / Screen and Pump

To achieve a noise level of 30 dB L_{A10} from the hopper/screen and pump, it was determined that a distance of 215 metres was required. This is shown in *Appendix C* on *Figure C01* with the plant located in a random location. Note that this prediction includes a 2 metre high bund around the plant, which is already 2 metres below ground level.

This plant may be situated in a number of locations so management will ensure that the above minimum distance is maintained.

5.1.3 Noise Modelling Results - Booster Pumps

Booster pumps will only be required if the distance between the wet concentrator plant and hopper is greater than 750 metres.

Noise level contours for such a pump are shown in *Appendix D*, *Figure D01*. A noise level of 30 dB L_{A10} is achieved at a distance of 200 metres.

5.2 Scraper Noise Modelling

The scraper will move throughout each section of the mine, covering large areas and carting the ore to the hopper. The scraper has the highest noise emission of all the plant on the site and therefore needs to be managed carefully. Initially two contours were calculated being for worst-case wind conditions (light winds in all directions) and calm conditions. These contours are attached in *Appendix E*, *Figures E01 and E02*. When winds blow from a residence to the scraper, noise levels will be less than those shown.

From the two noise contour plots, the following was determined:

- Under downwind conditions, a distance of 2.1 km is required to achieve 30 dB L_{A10}.
- Under downwind conditions, a distance of 640 metres is required to achieve 45 dB L_{A10}
- Under calm conditions, a distance of 1.0 km is required to achieve 30 dB L_{A10}.
- Under calm conditions, a distance of 300 metres is required to achieve 45 dB L_{A10}

Working within a distance of 300 metres is possible if winds are calm or upwind and a 3.2 metre high bund is constructed on the boundary of the mine and the residence.

Note that all of the above distances are from the actual dwelling, not from the mine/property boundary.

Table 5.2 summarises the time and wind conditions in order for the scraper to operate at certain distances from residences.

Table 5.2 – Scraper Operating Conditions

Distance Between Scraper and Residence	**Operating Conditions**	
	Daytime	**Night-time**
Greater than 2100 metres	Unconditional	Unconditional
Between 1000 metres and 2100 metres	Unconditional	Winds to be calm or upwind
Between 640 metres and 1000 metres	Unconditional	Unacceptable
Between 300 metres and 640 metres	Winds to be calm or upwind	Unacceptable
Less than 300 metres	Winds to be calm or upwind and 3.2 metres high bund on boundary	Unacceptable

From the above distances, a plan was developed to show the areas where there are restrictions and this is contained in *Appendix F* as *Figure F01*.

The outer edge of the orange area (1000 metres from house) relates to a noise level of 30 dB L_{A10} for calm conditions. The inner edge of the orange area and outer edge of the green area (640 metres from a residence) relates to a noise level of 45 dB L_{A10} for downwind conditions. The inner edge of the green area and outer edge of the blue area relates to a noise level of 45 dB L_{A10} for calm conditions.

As there is no location within the mine that is greater than 2.1 kilometres from a house, there is no location where night time scraper operation is unconditional (*Figure F01).* Daytime operations can be unrestricted for significant parts of the mine area, being anywhere in the orange and hatched areas.

To determine the practicalities of mining under restricted conditions, wind information was obtained from the Bureau of Meteorology. The data provided (refer *Appendix G*) is for the Perth Airport, which was deemed to be the closest, most representative monitoring station. Note other stations are located closer but are effected by the Darling Scarp.

The restricted scraper operations for each of the zones in *Appendix F, Figure F01* are based on time (day or night) and wind direction and speed, relative to adjacent houses.

Historical wind data was obtained as part of this study (*Appendix G*), however, actual wind monitoring on site is required to provide the real time information needed for mine planning and scheduling on a daily operational basis. Wind monitoring has commenced on site in order to obtain some site specific data prior to operations commencing.

6 CONCLUSION

Noise from the proposed mining operation consists of two main items being fixed and mobile plant.

The fixed plant will operate 24 hours a day and as it is fixed, it will comply with the night-time assigned noise levels. It has been determined that compliance with a level of 30 dB L_{A10} (5 dB less than the assigned noise level to allow for another noise source contributing or a tonal penalty) can be readily achieved based on the following:

- Wet plant concentrator to have three locations as described in *Section 5.1.1* and shown on *Figures B01 to B03*. Noise levels to be equivalent to the Cable Sands plant at Ludlow. A blanket specification of 80 dB(A) at 1 metre for each item of plant should be provided to suppliers with there being some scope to relax this if required.

- Screen and Pump at the hopper location to be 2 metres below ground with a 2 metre high bund around, as close as practicable to the equipment. A specification of 85 dB(A) at 1 metre should be used for this equipment, which will comply with the *Occupational Safety and Health Regulations 1996*. Minimum separation distance between the plant and a house to be 215 metres.

- Booster pumps to have a minimum separation distance to a house of 200 metres.

Scraper operations are more difficult as the scraper will be continually moving. The sound power level of the scraper should be no more than 113 dB(A) and *Figure F01* used to determine acceptable areas to be mined depending on the time of day, wind speed and direction.

In order to supply ore to the wet concentrator plant on a continuous basis, the implication for mine planning include options such as separate day and night pits, being located within the appropriate zones, to provide the flexibility required for continuous scraper operation.

In some locations, the proximity of adjacent houses may prevent scraper operations at night.

APPENDIX A

Mining Area

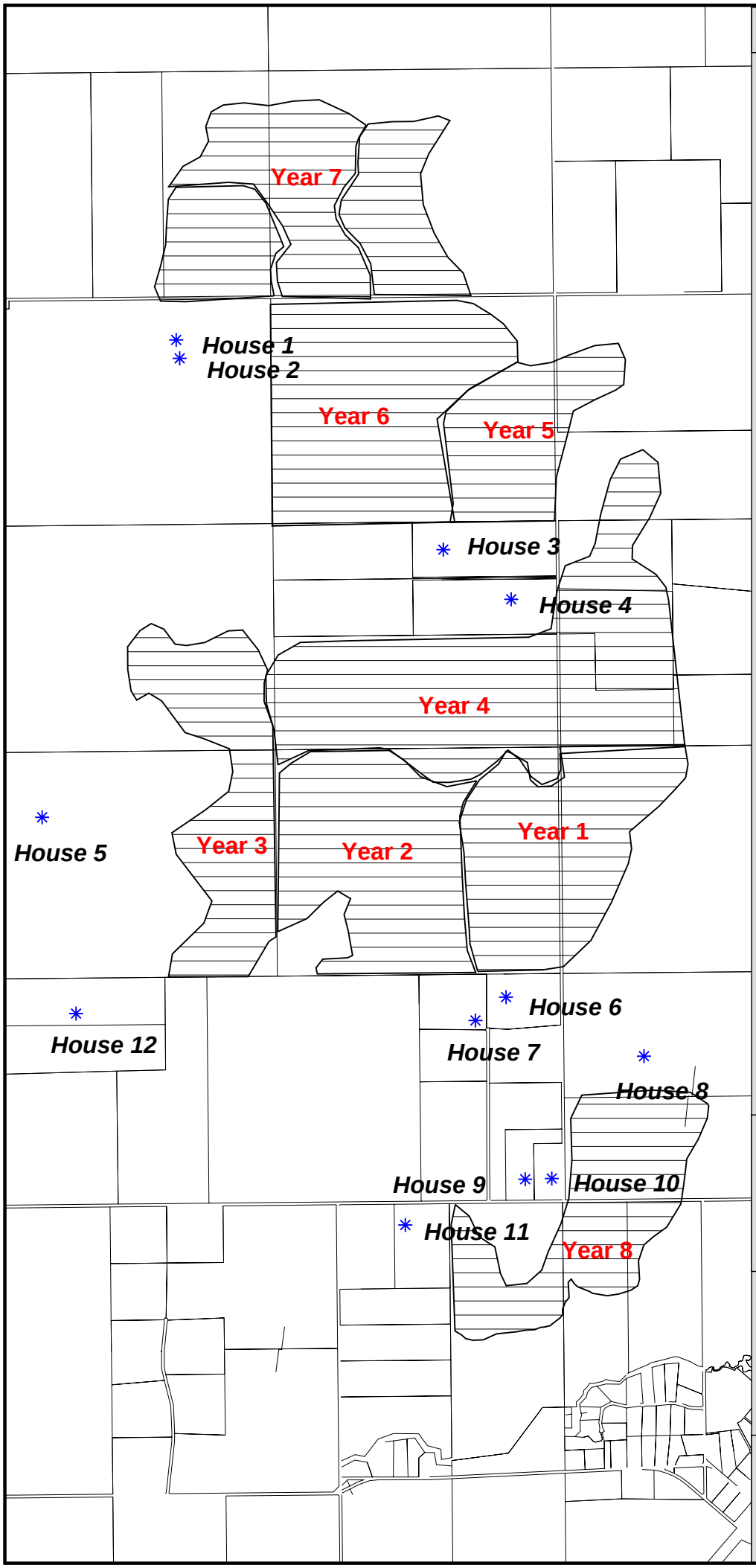

Figure A01

OLYMPIA RESOURCES Keysbrook Mineral Sands Project

Mining Areas

Job No. 511442
Client: MBS Environ
Project Engineer: TG

Length scale 1:40000

0 0.2 0.4 0.8 1.2 1.6 km

APPENDIX B

Noise Level Contours – Wet Plant Concentrator

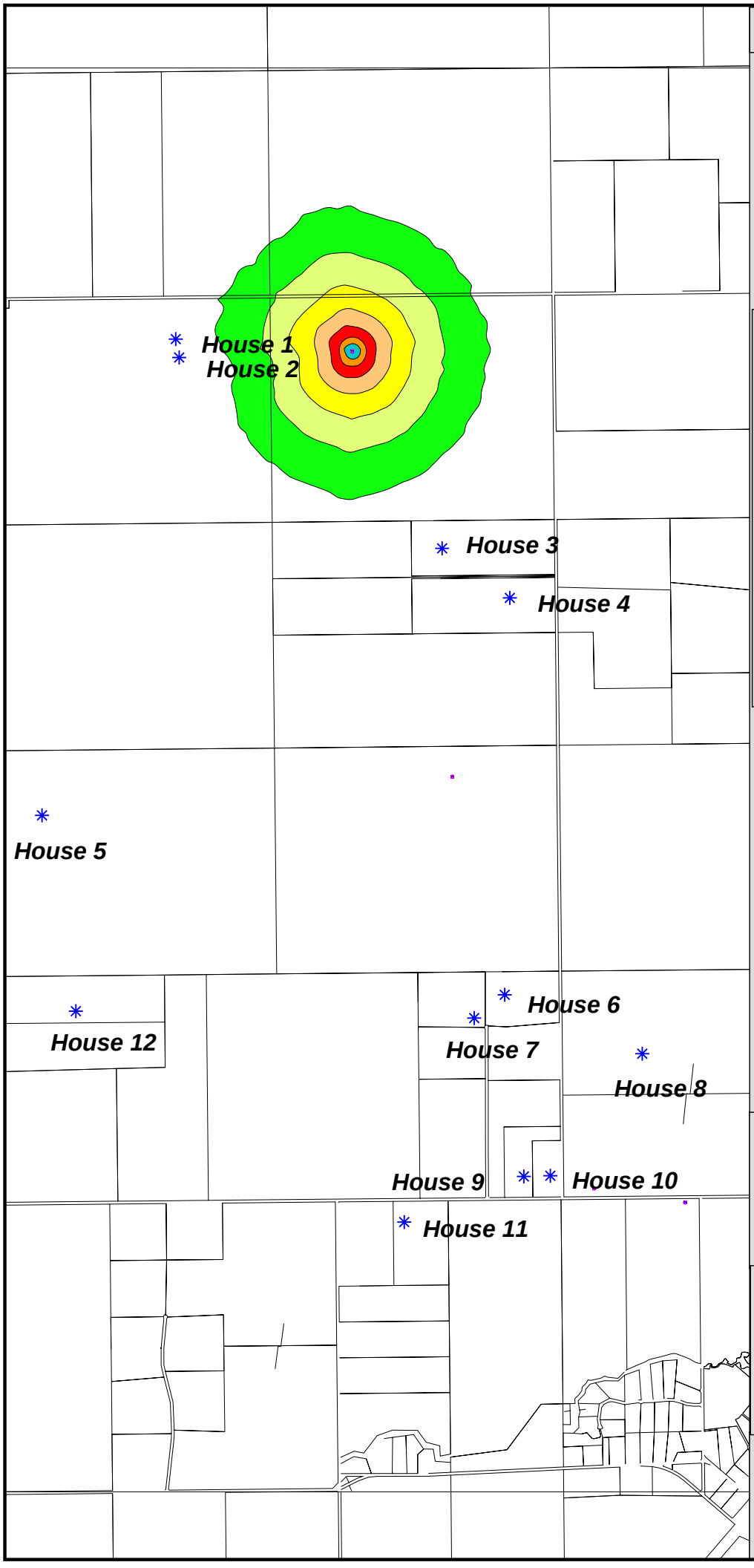

Figure B01

OLYMPIA RESOURCES Keysbrook Mineral Sands Project

Wet Plant North Location

PREDICTED NOISE LEVEL CONTOURS LA10

WINDS IN ALL DIRECTIONS

Temp - 15degC
Humidity - 50%
Wind Speed - 3m/s
Pasquil - Type F

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

Job No. 511442
Client: MBS Environ
Project Engineer: TG

Lloyd Acoustics

Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

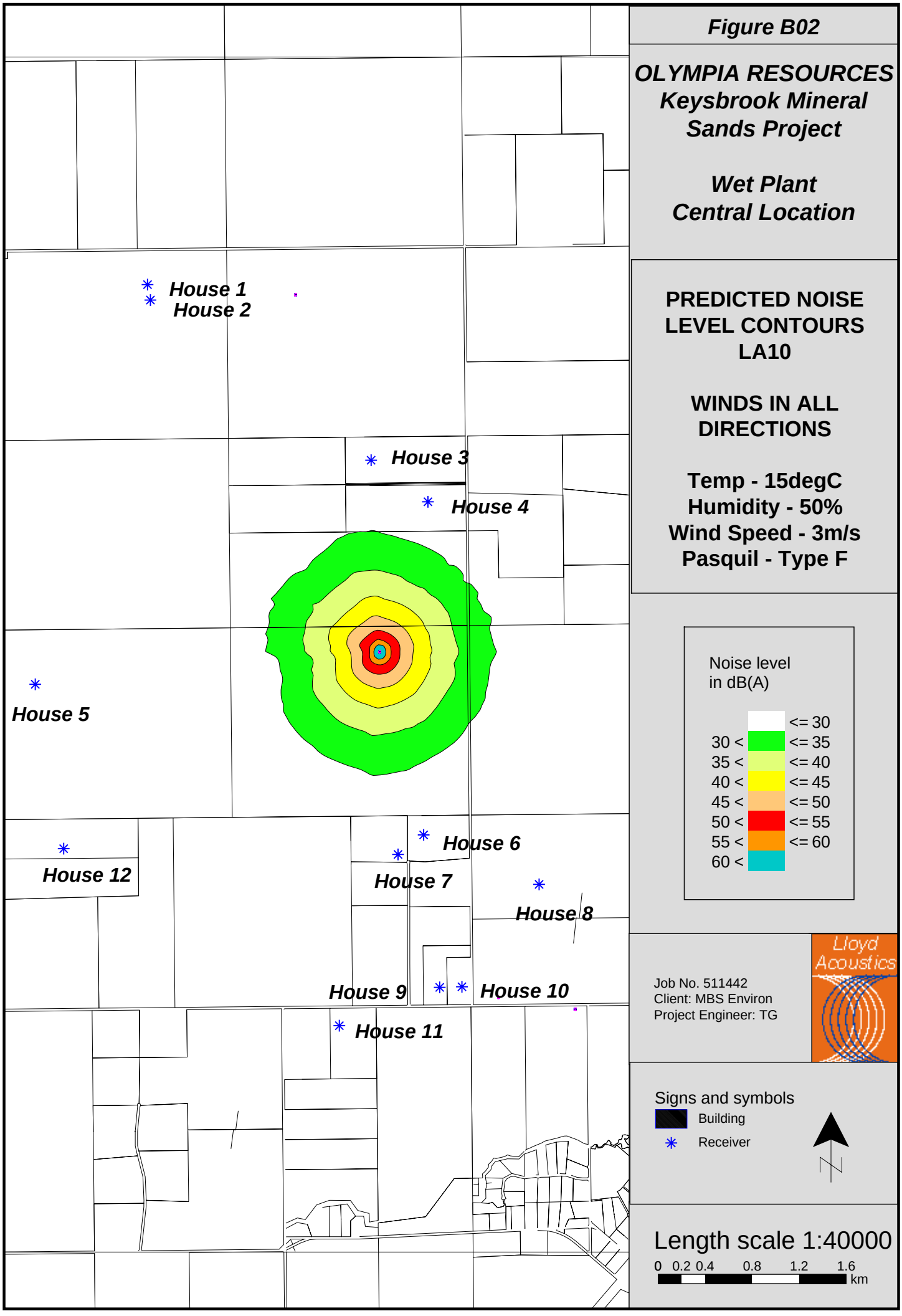

Figure B02

OLYMPIA RESOURCES Keysbrook Mineral Sands Project

Wet Plant Central Location

PREDICTED NOISE LEVEL CONTOURS LA10

WINDS IN ALL DIRECTIONS

Temp - 15degC
Humidity - 50%
Wind Speed - 3m/s
Pasquil - Type F

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

Job No. 511442
Client: MBS Environ
Project Engineer: TG

Lloyd Acoustics

Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

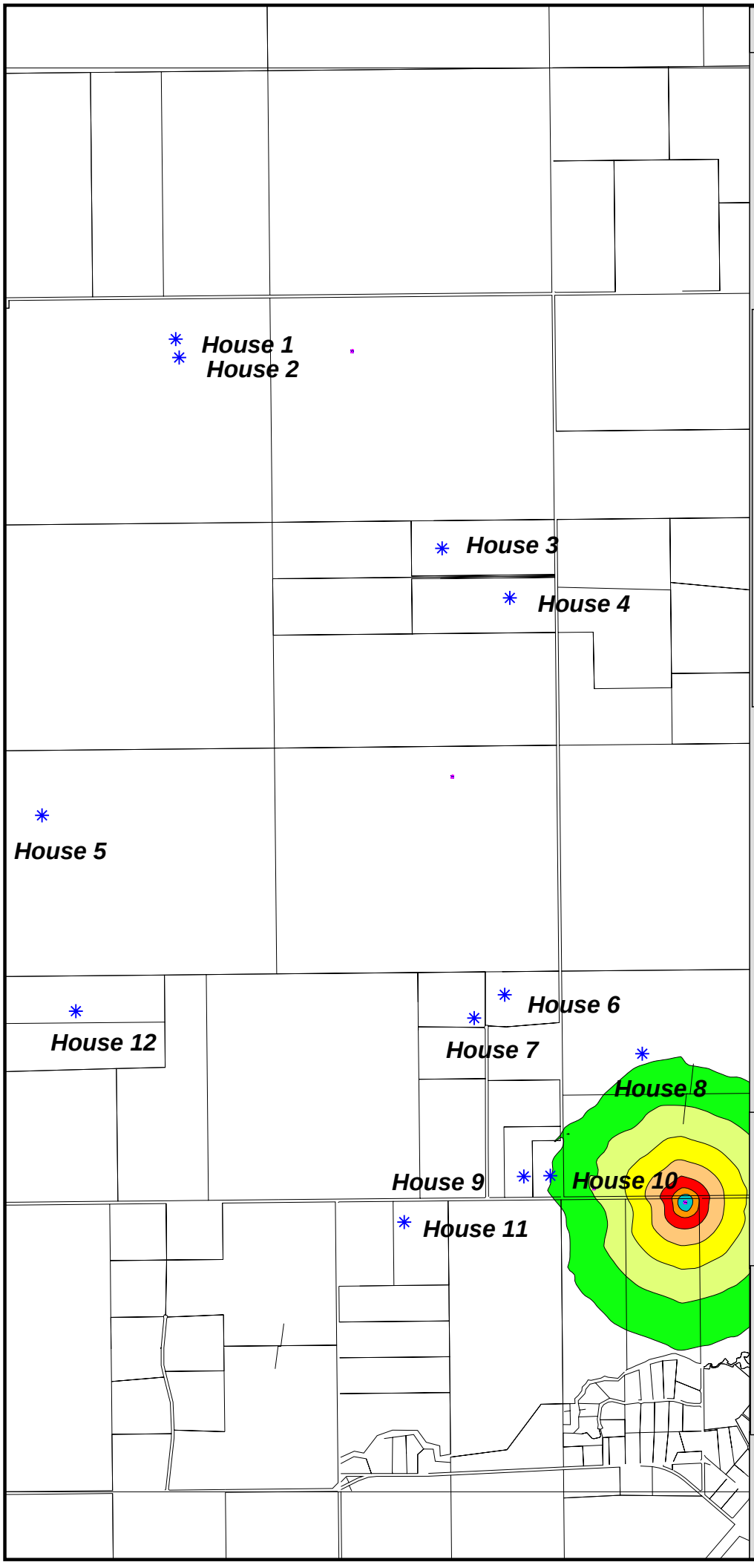

Figure B03

OLYMPIA RESOURCES
Keysbrook Mineral Sands Project

Wet Plant
South Location

PREDICTED NOISE LEVEL CONTOURS LA10

WINDS IN ALL DIRECTIONS

Temp - 15degC
Humidity - 50%
Wind Speed - 3m/s
Pasquil - Type F

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

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Client: MBS Environ
Project Engineer: TG

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Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

APPENDIX C

Noise Level Contours – Hopper/Screen and Pump

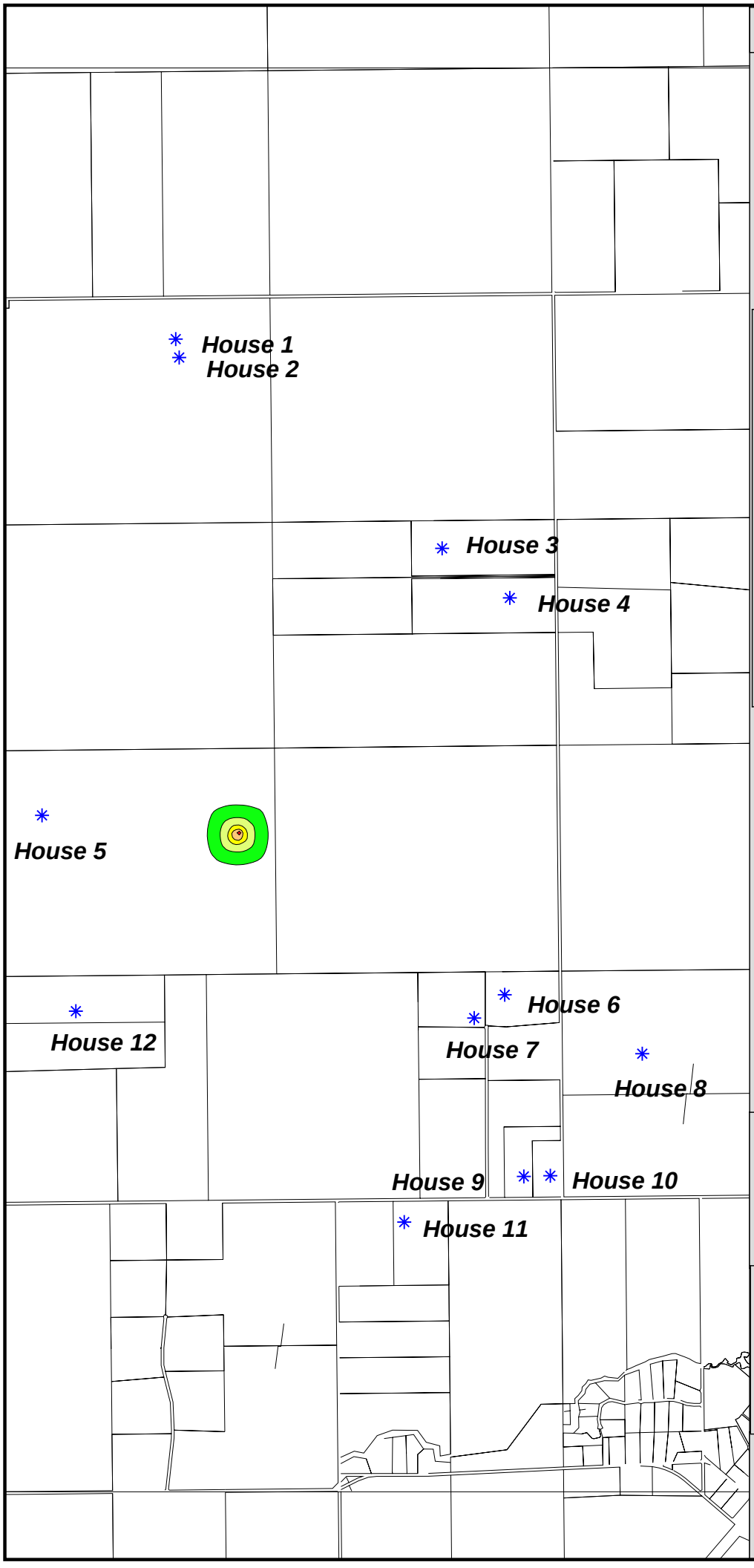

Figure C01

OLYMPIA RESOURCES Keysbrook Mineral Sands Project

Screen & Pump Plant

PREDICTED NOISE LEVEL CONTOURS
LA10
WINDS IN ALL DIRECTIONS
Pump in sump
& 2m bund around
Temp - 15degC
Humidity - 50%
Wind Speed - 3m/s
Pasquil - Type F

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

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Client: MBS Environ
Project Engineer: TG

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Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

APPENDIX D

Noise Level Contours – Booster Pump

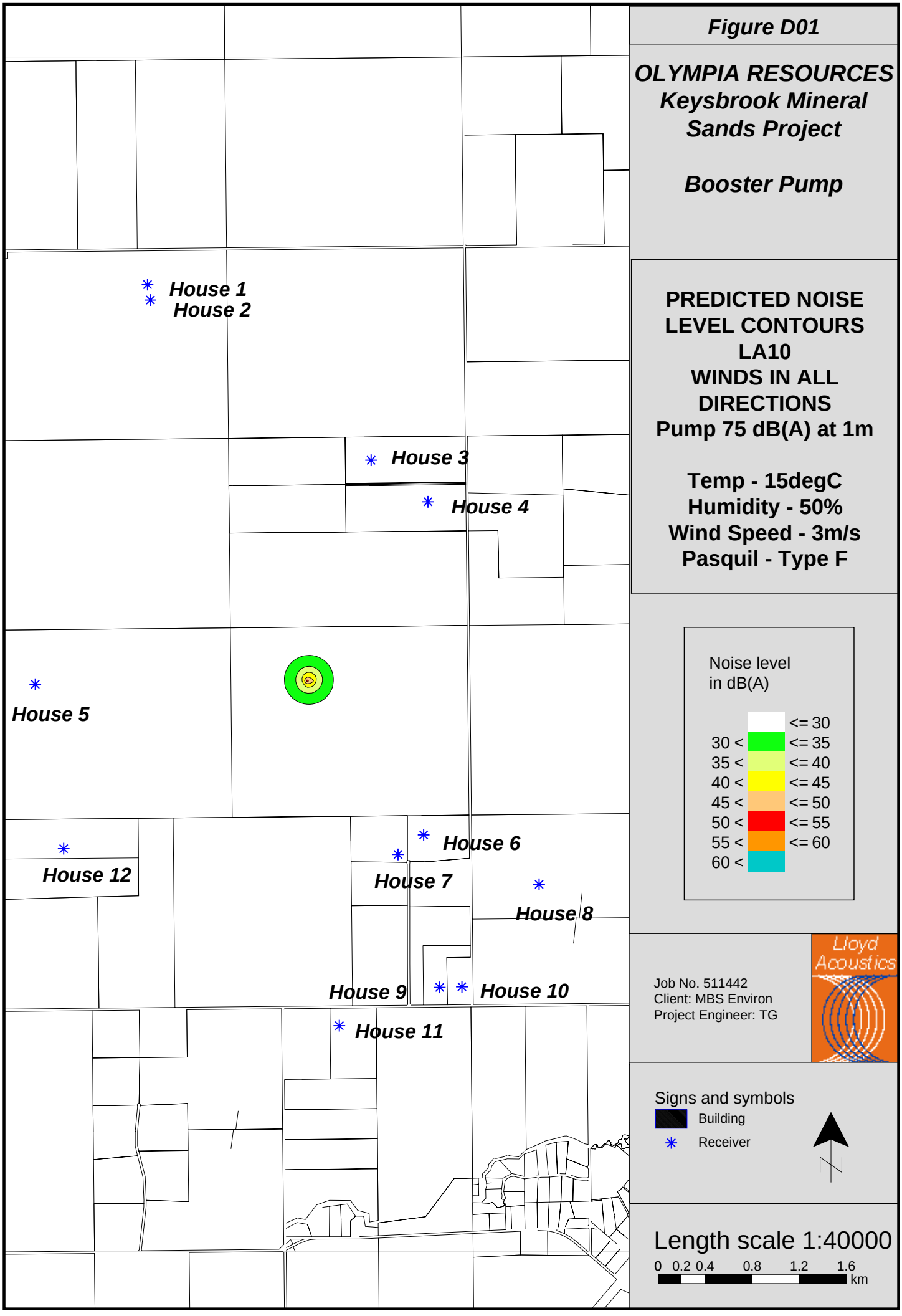

Figure D01

OLYMPIA RESOURCES
Keysbrook Mineral Sands Project

Booster Pump

PREDICTED NOISE LEVEL CONTOURS
LA10
WINDS IN ALL DIRECTIONS
Pump 75 dB(A) at 1m

Temp - 15degC
Humidity - 50%
Wind Speed - 3m/s
Pasquil - Type F

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

Job No. 511442
Client: MBS Environ
Project Engineer: TG

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Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

APPENDIX E

Noise Level Contours – Scraper

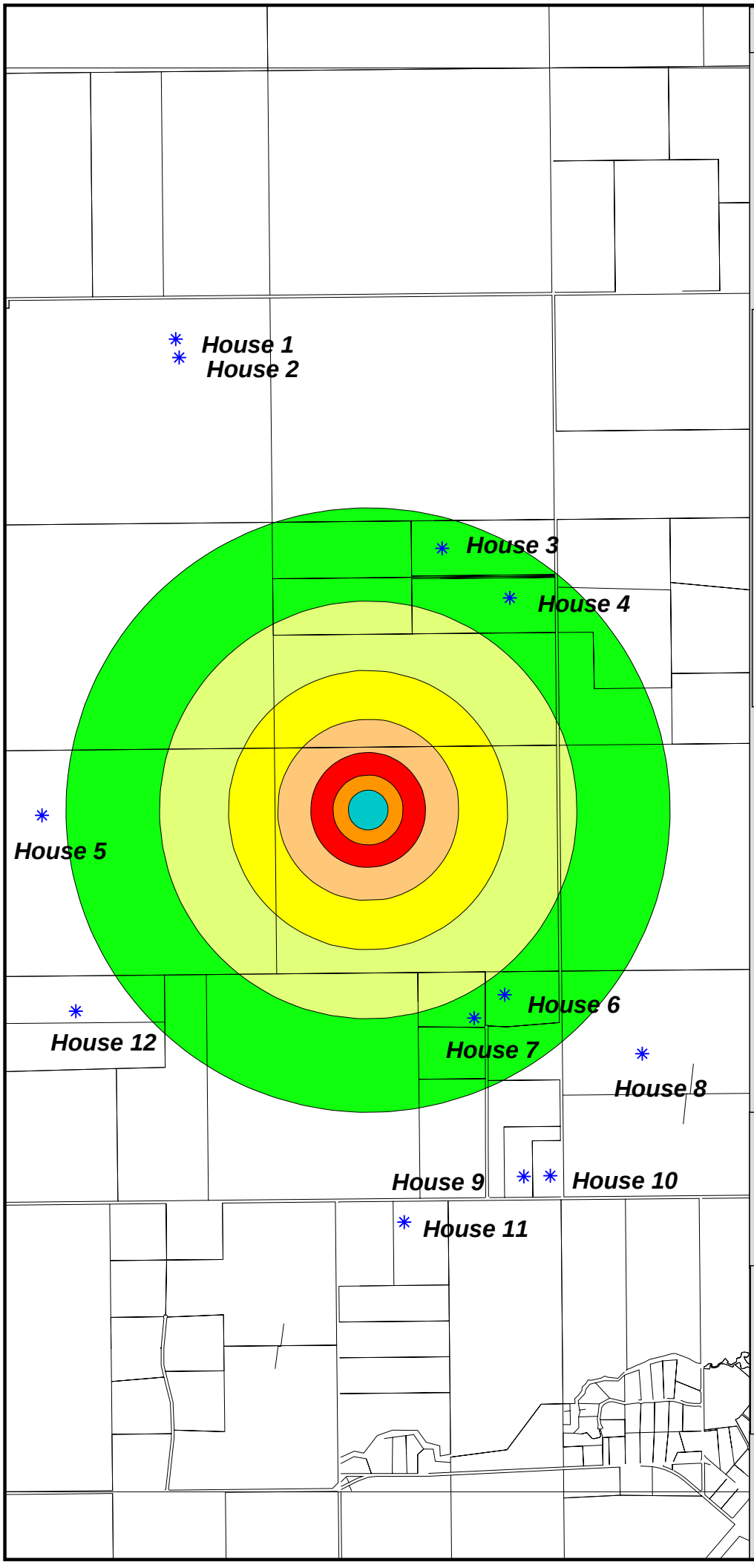

Figure E01

OLYMPIA RESOURCES Keysbrook Mineral Sands Project

Scraper

PREDICTED NOISE LEVEL CONTOURS LA10

WINDS IN ALL DIRECTIONS

Temp - 15degC
Humidity - 50%
Wind Speed - 3m/s
Pasquil - Type F

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

Job No. 511442
Client: MBS Environ
Project Engineer: TG

Lloyd Acoustics

Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

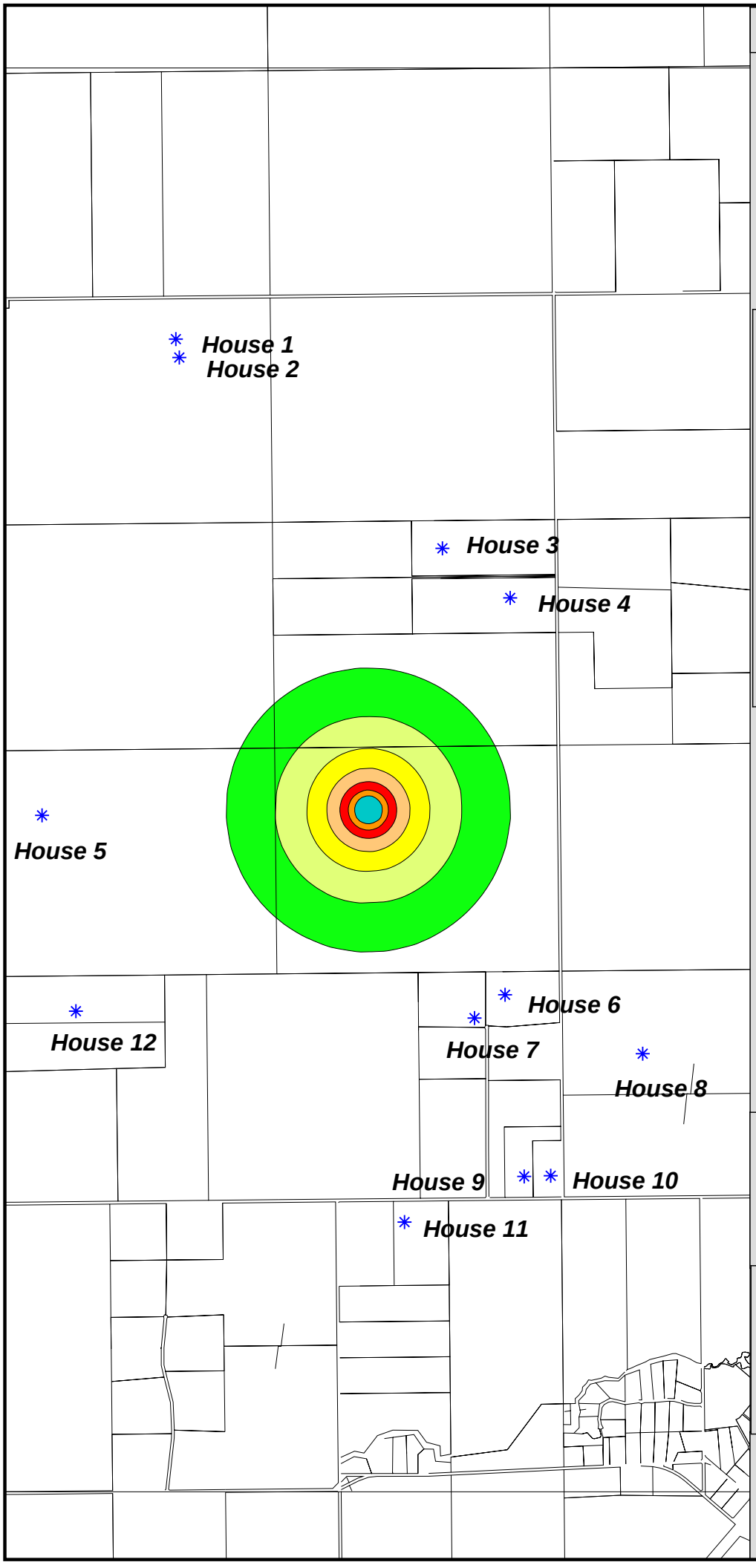

Figure E02

OLYMPIA RESOURCES Keysbrook Mineral Sands Project

Scraper

PREDICTED NOISE LEVEL CONTOURS LA10

CALM CONDITIONS

Temp - 15degC
Humidity - 50%
Wind Speed - 0m/s
Pasquil - Type B

Noise level in dB(A)

	<= 30
30 <	<= 35
35 <	<= 40
40 <	<= 45
45 <	<= 50
50 <	<= 55
55 <	<= 60
60 <	

Job No. 511442
Client: MBS Environ
Project Engineer: TG

Lloyd Acoustics

Signs and symbols
Building
Receiver

N

Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6 km

APPENDIX F

Scraper Operational Distance to Houses

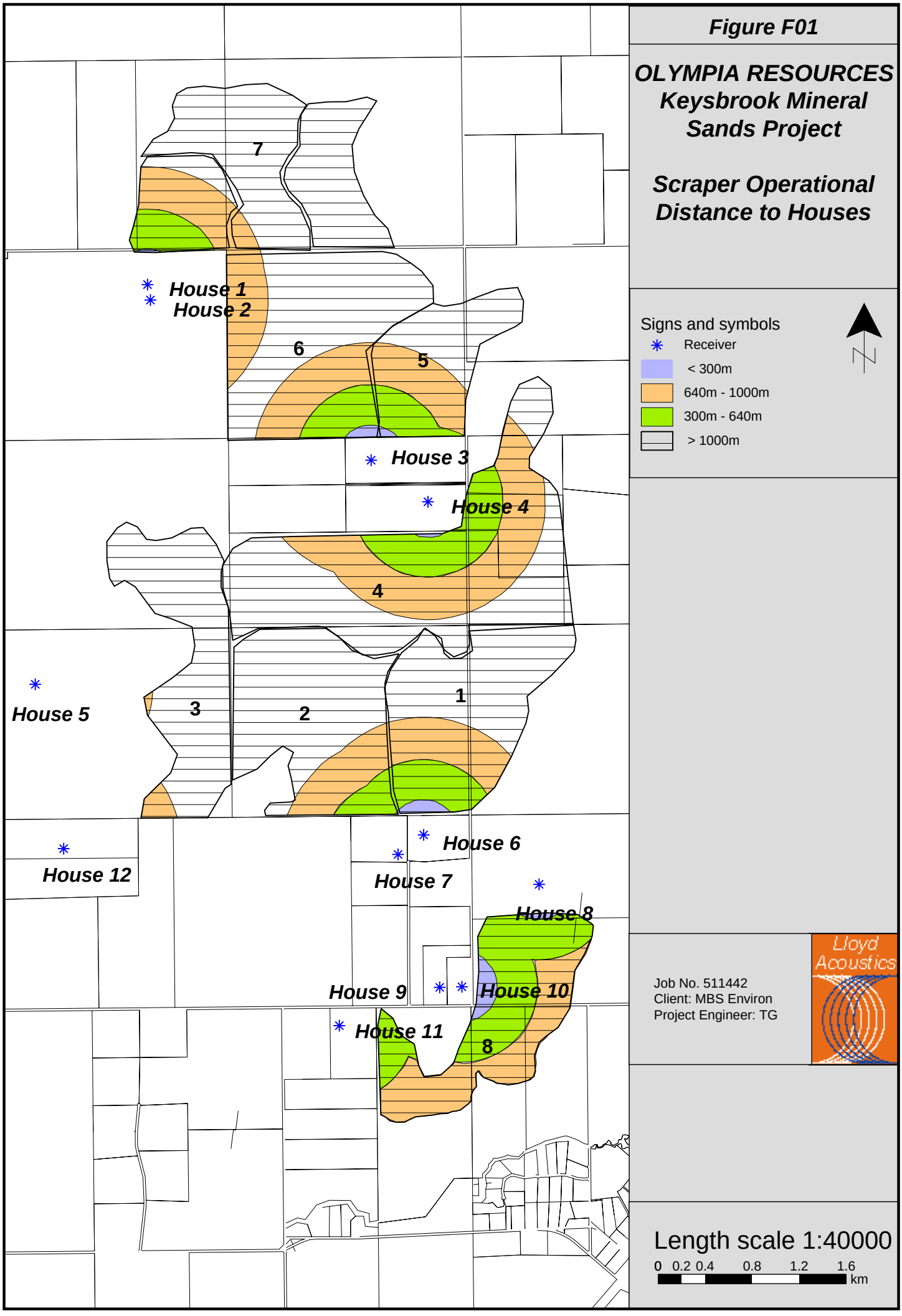
Figure F01
OLYMPIA RESOURCES
Keysbrook Mineral Sands Project
Scraper Operational Distance to Houses
Signs and symbols
Receiver
< 300m
640m - 1000m
300m - 640m
> 1000m
N
House 1
House 2
House 3
House 4
House 5
House 6
House 7
House 8
House 9
House 10
House 11
House 12
1
2
3
4
5
6
7
8
Job No. 511442
Client: MBS Environ
Project Engineer: TG
Lloyd Acoustics
Length scale 1:40000
0 0.2 0.4 0.8 1.2 1.6
km

APPENDIX G

Perth Airport Wind Information

Wind Frequency analysis using available data between May 1944 and Dec 2005 for Perth Airport

Site Number 009021 • Locality: Belmont • Opened Jan 1944 • Still Open • Latitude 31°55'39"S • Longitude 115°58'35"E • Elevation 15.4m

Values are percentage frequencies; * indicates the range has occurred but with a frequency of less than 0.5%.

January

Calm 11	A total of 14280 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	1	1	3	2	6	4	1	*	**18**
11–20	1	2	7	4	8	8	3	*	**33**
21–30	*	2	8	3	4	11	4	*	**31**
>30	*	*	4	1	*	2	*	*	**7**
All	**2**	**5**	**22**	**10**	**17**	**24**	**8**	**1**	**100**

February

Calm 12	A total of 13015 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	1	2	3	3	5	3	1	1	**19**
11–20	*	2	8	5	6	7	3	*	**32**
21–30	*	2	10	4	3	8	3	*	**29**
>30	*	*	5	1	*	1	*	*	**7**
All	**2**	**6**	**26**	**12**	**15**	**19**	**7**	**1**	**100**

March

Calm 16	A total of 14090 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	1	3	4	3	5	4	1	1	**22**
11–20	1	3	9	4	6	7	3	1	**33**
21–30	*	2	9	2	2	5	2	*	**23**
>30	*	*	4	*	*	1	*	*	**6**
All	**2**	**8**	**25**	**10**	**13**	**16**	**7**	**1**	**100**

April

Calm 23	A total of 13669 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	3	4	4	3	5	4	2	1	**26**
11–20	1	4	8	3	4	6	3	1	**30**
21–30	1	2	6	1	1	2	2	1	**16**
>30	*	*	2	*	*	*	*	*	**4**
All	**5**	**11**	**21**	**7**	**10**	**12**	**8**	**3**	**100**

May

Calm 27	A total of 14415 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	4	9	5	2	3	3	2	1	**30**
11–20	4	7	7	1	3	3	3	1	**27**
21–30	1	2	3	*	1	1	2	1	**13**
>30	*	*	1	*	*	*	1	*	**3**
All	**10**	**18**	**16**	**4**	**7**	**8**	**7**	**4**	**100**

June

Calm 23	A total of 13971 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	6	12	5	2	2	2	2	1	**31**
11–20	6	8	5	1	2	2	3	2	**29**
21–30	3	2	2	*	1	2	2	1	**13**
>30	*	*	*	*	*	*	1	1	**3**
All	**15**	**23**	**12**	**3**	**5**	**6**	**8**	**5**	**100**

July

Calm 25	A total of 14680 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	6	11	4	1	3	2	2	2	**30**
11–20	6	7	5	1	2	3	4	2	**28**
21–30	2	2	2	*	1	2	3	2	**14**
>30	*	*	*	*	*	1	1	1	**4**
All	**14**	**20**	**11**	**2**	**5**	**7**	**10**	**6**	**100**

August

Calm 24	A total of 14687 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	5	9	4	1	3	3	2	1	**29**
11–20	4	6	4	1	3	4	4	2	**29**
21–30	2	1	2	*	1	2	4	2	**14**
>30	*	*	1	*	*	1	1	1	**4**
All	**11**	**17**	**11**	**3**	**8**	**10**	**11**	**6**	**100**

September

Calm 22	A total of 14273 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	4	6	3	2	5	3	2	1	**27**
11–20	3	4	4	2	5	6	5	2	**30**
21–30	1	1	2	1	2	4	4	2	**17**
>30	*	*	1	*	*	1	1	1	**5**
All	**8**	**11**	**11**	**4**	**11**	**15**	**13**	**5**	**100**

October

Calm 18	A total of 14776 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	3	4	3	2	5	4	2	1	**23**
11–20	2	2	4	2	7	8	5	1	**30**
21–30	*	1	4	1	3	8	5	1	**23**
>30	*	*	2	*	*	1	1	1	**6**
All	**5**	**8**	**12**	**5**	**15**	**20**	**13**	**4**	**100**

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Prepared by Climate Section in the Perth Office of the Bureau of Meteorology. Contact us by phone on (08) 9263 2222, by fax on (08) 9263 2233, or by email on climate.wa@bom.gov.au

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Site Number 009021 • Locality: Belmont • Opened Jan 1944 • Still Open • Latitude 31°55'39"S • Longitude 115°58'35"E • Elevation 15.4m

Values are percentage frequencies; * indicates the range has occurred but with a frequency of less than 0.5%.

November

Calm 14	A total of 14291 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	1	2	2	2	6	4	2	1	**20**
11–20	1	2	5	3	7	8	4	1	**30**
21–30	*	1	5	2	3	11	5	1	**29**
>30	*	*	3	*	*	2	1	*	**7**
All	**3**	**5**	**16**	**7**	**16**	**24**	**12**	**3**	**100**

December

Calm 12	A total of 14367 observations analysed								
km/h	**N**	**NE**	**E**	**SE**	**S**	**SW**	**W**	**NW**	**All**
1–10	1	1	2	2	6	4	1	1	**18**
11–20	1	1	6	4	7	8	4	1	**31**
21–30	*	1	6	2	4	12	5	*	**31**
>30	*	*	4	*	*	2	1	*	**7**
All	**2**	**5**	**18**	**8**	**17**	**26**	**11**	**2**	**100**

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 Prepared on 6 December 2005