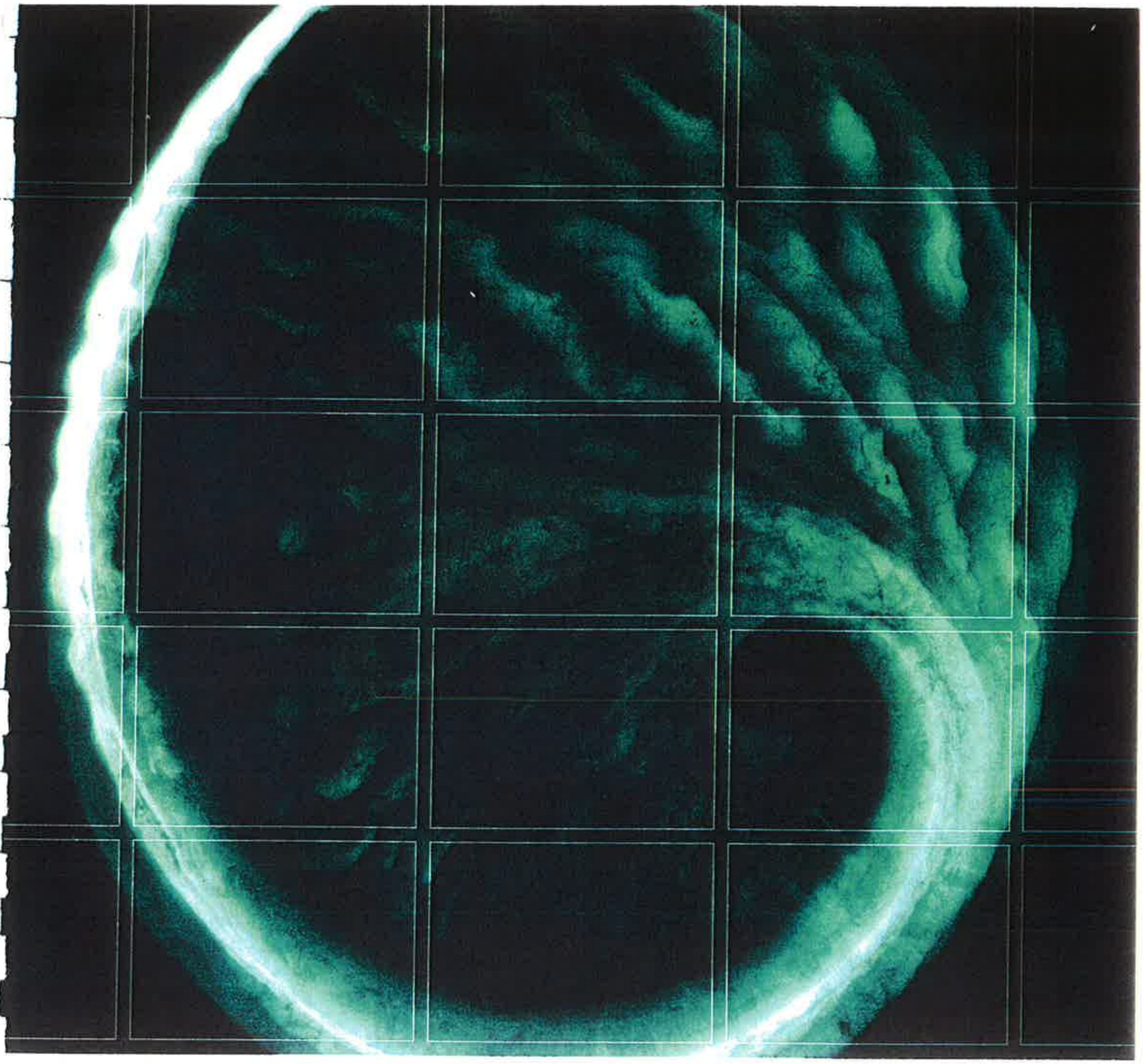
APPENDIX 8

Noise Assessment



Jandra Quarry Section 96 Modification Noise Assessment

CSR Construction Materials

19 March 2002

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Jandra Quarry Section 96 Modification Noise Assessment

CSR Construction Materials

19 March 2002

Approved by:	Murray Curtis
Position:	Project Director
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Date:	21 March, 2002

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1 INTRODUCTION

1.1 BACKGROUND

Jandra quarry is located approximately 20 kilometres south of Taree on the mid north coast of NSW. Access is from the Pacific Highway. The quarry locality is shown on *Figure 1.1*.

ERM Australia were commissioned by CSR Construction Materials to undertake a noise assessment to accompany a Section 96 Modification for Jandra Quarry. An Environmental Impact Statement for the Jandra Quarry Extension was prepared by ERM Mitchell McCotter in 1999. A Section 96 Modification is now required to make small changes to the operation to include an overburden dump as detailed in *Figure 1.1*.

1.1.1 *Quarry Development Plan*

Future quarry development is planned to take place in four stages as assessed previously by ERM Mitchell McCotter (1999). The following summaries of quarry development assessed in the EIS have been provided by CSR:

- Stage 1 comprises the westerly development of the quarry towards the Pacific Highway. The western limit of extraction is 400 metres from the Highway with the floor level of the quarry remaining at the existing level of RL 50m;

- Stage 2 involves the easterly development of the RL 50, 62, 74, 86 and 98 faces half way to the proposed eastern limit of the quarry and developing a cut to RL 35 in the latter part;

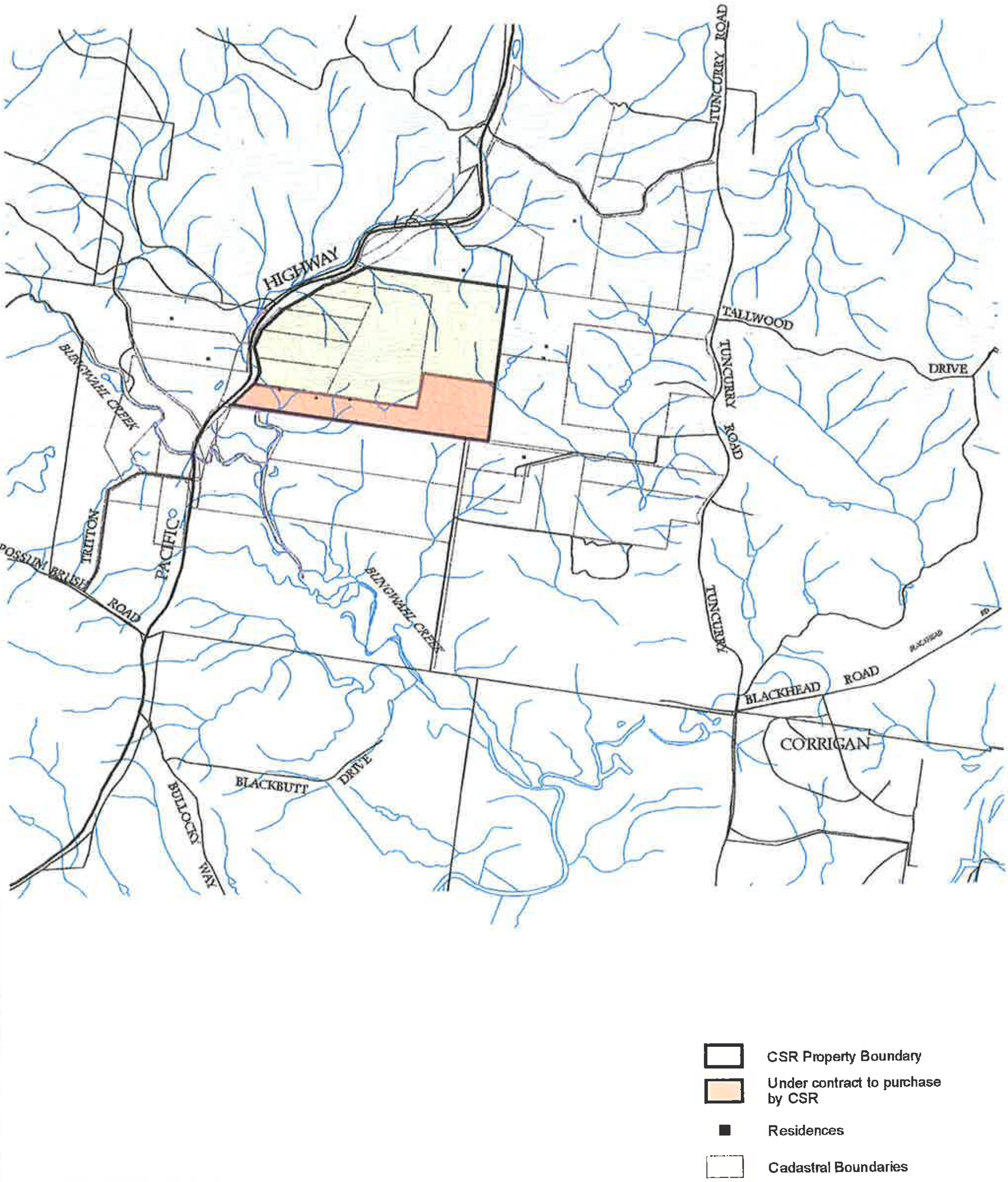
- Stage 3 sees the continued development east of the RL35, 50, 62, 74 and 98 benches to their most eastern limit. At no stage will the eastern ridge be breached. Towards the end a drop cut to RL20 will be developed.; and

- Stage 4 comprises development of the final bench resulting in a floor level at RL 20, and some peripheral clean up.

The overburden dump will operate through all quarry stages with progress as detailed below:

- Stage 1 Placement of overburden will start during this stage at the base of the hill and will fill over half of the dump area. Noise modelling has assumed that equipment will be approximately two thirds of the way up the dump as a worst case;

- Stage 3 will see the continued filling of the overburden dump area at the highest RL. Noise modelling has assumed that the equipment will be at the top of the dump as a worst case.



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F:/Jobs/2002/8020041.02-Fg1.1 Locality Plan.cdr 23 01 2002 JD Environmental Resources Management Australia Pty Ltd

ERM

0 800m
Approximate only

Figure 1.1

Locality Plan

CSR Construction Materials - Jandra Quarry Pacific Highway Rainbow Flat, NSW

As detailed in the EIS, prediction of noise levels generated by the proposed expansion of the quarry during Stage 4 is not considered warranted as extraction operations would be on either previously worked benches or on benches below natural ground level. Any worst case noise scenario during this stage would not create noise levels above those predicted for Stage 1 or Stage 3.

Stage 2 operations have not been assessed as Stage 3 represents worst case noise exposures for residences to the east of the quarry with mobile plant located at the eastern extremity of extraction during Stage 3.

In order to allow comparison with levels predicted in the EIS, noise prediction of Stage 1 and Stage 3 will be undertaken.

1.2 *STATISTICAL DESCRIPTORS*

Environmental noise levels vary with time, requiring statistical descriptors to characterise the noise environment. The following descriptors are commonly used to assess noise:

- dB(A). Noise level measurement units are decibels (dB). The "A" weighting scale is used to describe human response to noise;
- L_{eq}, this level represents the average noise energy during a measurement period;
- L_{10}, the noise level which is exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels;
- L_{90}, the level exceeded for 90 per cent of the time and is approximately the average of the minimum noise levels. The L_{90} level is often referred to as the "background" noise level and is commonly used to determine noise criteria for assessment purposes;
- ABL, the Assessment Background Level is defined in the EPA's *NSW Industrial Noise Policy* (2000) (INP) as the single figure background level representing each assessment period (day, evening and night). It is determined by the tenth percentile method described by the EPA for the measured L_{90} statistical noise level; and
- RBL, the Rating Background Level is defined in the INP as the overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used for determining the intrusiveness criterion for noise assessment purposes, and is the median value of the ABL.

2 *METHODOLOGY*

2.1 BACKGROUND NOISE MEASUREMENTS AND CRITERIA

2.1.1 *Neutral Weather*

As part of the noise assessment undertaken for the EIS, noise levels were measured at three locations using noise data loggers. These locations are detailed as follows and shown in *Figure 2.1*:

- Yala 3 residence;
- Loveday residence; and
- Jones residence.

The following equipment was used to measure and record environmental noise levels and weather conditions:

- ARL EL215 noise data loggers; and
- Bruel and Kjaer Type 4230 sound level calibrator.

Noise levels were measured over 15 minute intervals with statistical parameters calculated including L_{eq}, L_1, L_{10}, L_{90}, L_{99}, L_{max} and L_{min}.

Weather data (hourly wind and rainfall) sourced from Taree Airport allowed correlation of atmospheric parameters and measured noise levels. The weather information was used to filter data where wind speed exceeded five metres per second and/or rainfall occurred.

For the purposes of consistency, background levels and criteria calculated in the EIS will be used for this assessment.

Results of background noise measurements are shown in *Table 2.1*. Graphs of measured noise levels are provided in *Appendix B* of the EIS.

Table 2.1 ***Background Noise Levels and Intrusiveness Criteria***

Location	Minimum Repeatable L_{90} dB(A)	"Intrusiveness" Noise Criteria, L_{eq} dB(A)
Yala	37.0	42.0
Loveday	36.8	41.8
Jones	35.0	40.0

1. Data where wind speed exceeded 5 m/s or where rainfall occurred not included.
2. Minimum repeatable L_{90} over hours of operation. Mon to Fri: 6:00 am to 6:00 pm & Sat: 7:00 am to 3:00 pm.

F:/Jobs/2002/8020041.02-Fg2.1Noise Monitoring Locations & Receptors.cdr 23 01 2002 JD Environmental Resources Management Australia Pty Ltd

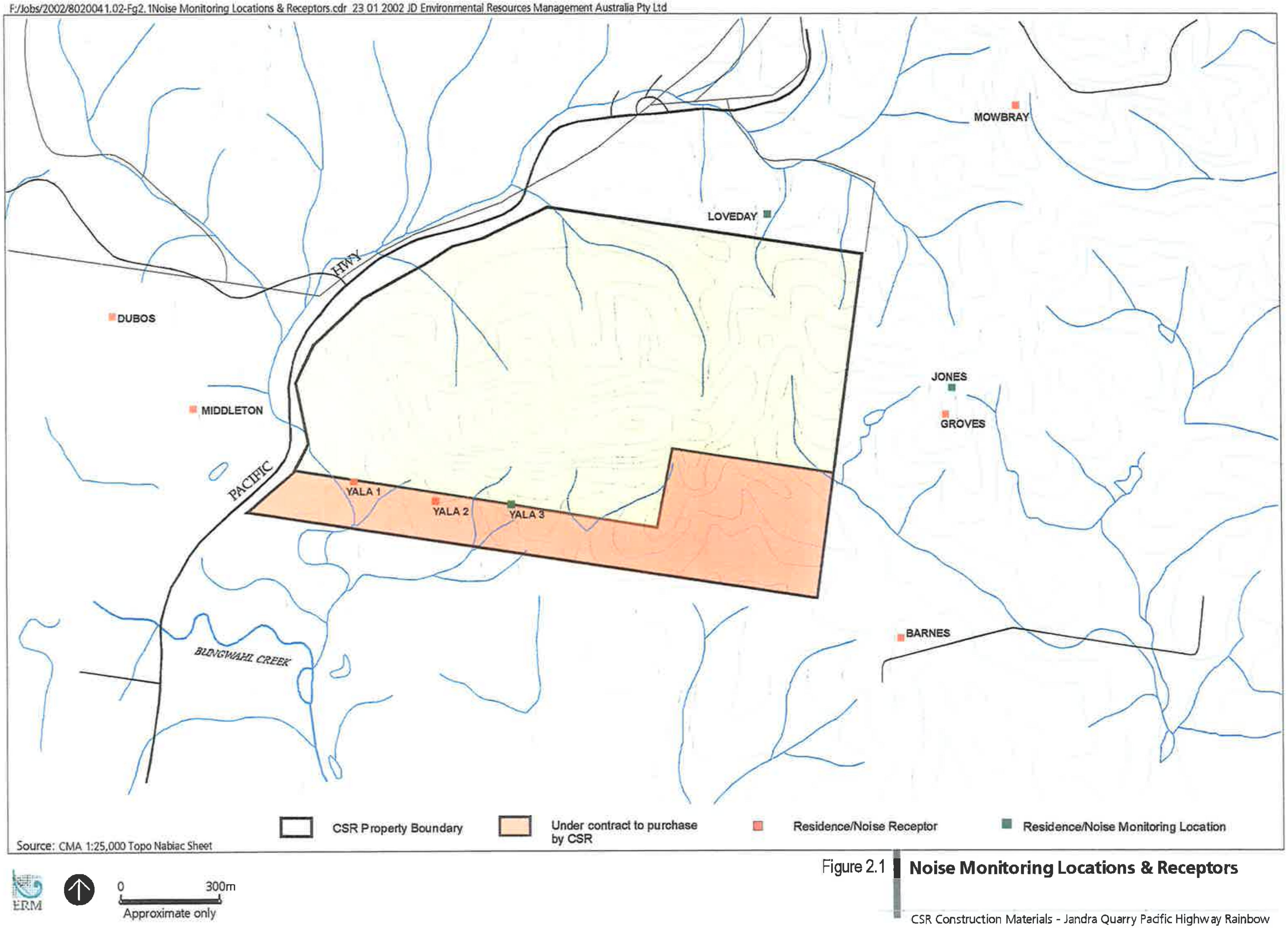

Figure 2.1 **Noise Monitoring Locations & Receptors**

CSR Construction Materials - Jandra Quarry Pacific Highway Rainbow Flat, NSW

2.1.2 *Adverse Weather Conditions*

The "intrusiveness" noise criterion has traditionally been applied under non-adverse meteorological conditions. Experience indicates that if the criterion is met under these conditions, noise under more adverse conditions is generally (but not always) acceptable.

Based on experience in similar rural areas such as the Hunter Valley, people become more noise sensitive if night-time noise levels exceed about 40 dB(A) on a regular basis. This is 5 dB above the level, which would be set as a noise criterion under non-adverse conditions. Hence, one possible formulation for additional criteria would be that noise should not exceed the non-adverse criterions by more than 5 dB on more than ten per cent of occasions throughout a year. This goal would relate to all meteorological conditions.

To provide consistency with the EIS, the following procedure has been used to provide an assessment under the complete range of meteorological conditions, which supplements the assessment under non-adverse conditions:

- an additional "intrusiveness" criterion is used, that under prevailing meteorological conditions, noise levels should not exceed the standard intrusiveness criterion by more than 5 dB(A) for more than 10 per cent of the operating period during a year; and

- additional calculations are performed to define the probability of occurrence of various noise levels accounting for the range of wind speeds and wind directions (and the interactions between these parameters) which are found at the site.

The production of "tenth percentile" noise levels involves detailed and complex noise level calculations. However, this level of detail of the likely noise environment provides regulatory bodies and residents with a more comprehensive and representative understanding of the extent and level of potential noise impacts from the development. This assessment describes the range of noise levels at each potentially affected residence under prevailing meteorological conditions, as well as graphically indicating the tenth percentile noise level.

Using the probability of occurrence of wind speed and wind direction requires more calculation than would a procedure involving a single set of meteorological parameters. This method of assessment represents best available technology and is among the most comprehensive methods to estimate actual noise levels received at a receptor as a percentage of time accounting for atmospheric effects.

2.2 SOUND POWER LEVEL DETERMINATION

The plant sound power levels (SWL's) used in noise modelling were determined during the EIS. Equipment at Jandra Quarry has not changed significantly since the preparation of the EIS and the same SWL's have been used in this assessment.

Sound power levels for plant items used in noise modelling are shown in *Table 2.2.*

Table 2.2 ***Maximum Plant Sound Power Levels***

Item	63	125	250	500	1000	2000	4000	8000	Total dB(L)	Total dB(A)
Asphalt Plant	107	113	107	105	101.2	98.9	96.8	94.5	**116**	**108**
Crusher	121.2	122.1	112.6	111.3	110.0	111.8	112.0	105.1	**126**	**118**
Drill	94.1	94.0	93.5	100.2	101.9	106.7	108.9	103.0	**113**	**113**
D8 Dozer	85.0	91.0	101.0	109.0	109.0	107.0	101.0	88.0	**114**	**113**
WA420 FEL	107	107	103	106	104	103	97	89	**113**	**109**
Cat 966C FEL	107	107	103	106	104	103	97	89	**113**	**109**
Cat 980C FEL	105	116	109	111	111	107	100	92	**119**	**115**
Water Cart (International 18 t)	106.0	107.0	108.0	109.0	106.0	105.0	100.0	91.0	**115**	**112**
Transport Truck	93	96	100	101	103	103	98	88	**109**	**108**
Volvo 18t Haul Truck	106.0	107.0	108.0	109.0	106.0	105.0	100.0	91.0	**115**	**112**
Hitachi EX300-2	108.0	113.0	104.0	103.0	101.0	97.0	90.0	84.0	**115**	**106**
Cat D30D 30T	102	106	106	107	106	106	99	91	**114**	**111**

1. Spectrum dB(Lin)

Measurements at similar quarries and mines have indicated that there is a difference of up to 7 dB(A) between the maximum noise level, and the L_{eq} level generated by quarrying. To estimate the L_{eq} level, a value of 7 dB(A) was deducted from the maximum sound power levels of all mobile plant. The exception was the asphalt plant, drill and crusher, which have assumed to have similar L_{max} and L_{eq} levels.

3 RESULTS

3.1 NOISE MODEL

Noise levels from the quarry were calculated using the NSW EPA approved Environmental Noise Model (ENM). This model takes account of noise attenuation due to distance, atmospheric absorption, barriers and the 'ground effect'. It gives consistently reliable predictions of environmental noise levels. Initial calculations were performed with no wind or temperature gradient (neutral conditions), for comparison with the appropriate criteria. Assumed atmospheric conditions were 20 degrees Celsius and relative humidity of 80 per cent.

Topographical information together with plant locations and sound power levels and receiver locations were entered into ENM to produce noise contours around the quarry and single point calculations at the nearest ten residences to the quarry. The locations of these residences are shown in *Figure 2.1.*

The noise model estimates L_{eq} levels assuming all plant and equipment operates simultaneously. In practice, such an operating scenario would be unlikely to occur.

It is well known that under various wind and temperature gradient conditions, noise levels may be increased or decreased compared with neutral atmospheric conditions - that is, zero wind and temperature gradient. The INP requires assessment of non-neutral atmospheric conditions, which affect noise propagation.

These conditions include the effects of temperature inversions and wind velocity gradients that can both enhance or reduce noise propagation from source to receiver compared with still isothermal condition. This is due to refraction of sound propagating through the atmosphere, brought about by a change in sound speed with height. Sound levels are increased when the wind blows from source to receiver or under temperature inversion conditions, and decreased when the wind blows from receiver to the source or under temperature lapse conditions. Assessment of temperature inversions has not been conducted for Jandra Quarry as no night operations are planned.

Bureau of Meteorology data from an automatic weather station at Taree Airport was used to determine the prevailing wind vectors for the site. Noise levels for surrounding residences were calculated for a range of possible combinations of wind speed and wind direction. Using the proportion of time when each of these combinations applied, the probable distribution of noise levels was calculated.

Noise models, including ENM, are less accurate in predicting noise under adverse conditions than under neutral conditions. Hence, any noise level predictions presented under these conditions should be interpreted more carefully than traditional noise contours.

3.2 *NEUTRAL ATMOSPHERIC CONDITIONS*

Plant items were placed in worst case scenario locations including stripping topsoil, quarrying and drilling on the topmost benches of the quarry. All plant were operated simultaneously. Results of single point noise calculations for the closest 10 residences using ENM are shown in *Table 3.1*.

Table 3.1 ***L_{eq} Noise Results -Neutral Weather***

Residence	Criteria	Stage 1	Stage 3
Yala 1[3]	42	32	23
Yala 2[3]	42	34	24
Yala 3[3]	42	34.5	26.5
Jones	40	29	34
Groves	40	31	35
Loveday	42	33	35
Mowbray	42	32	31
Barnes	40	21	28
Middleton	42	32	28.5
Dubos	42	34	30.5

1. All values L_{eq} dB(A);
2. Non-adverse meteorological conditions,
3. Yala property under contract for purchase by CSR;
4. Adopted criteria for residences not subject to noise monitoring are based on location in regard to monitoring sites and the Pacific Highway.

The results given in *Table 3.1* indicate that there are no exceedances of the adopted criteria at any residence during any stage of quarry development during neutral atmospheric conditions.

L_{eq} noise contours for Stages 1 and 3 have been calculated and are shown in *Figure 3.1* and *Figure 3.2* respectively. All residences are below the project specific criteria.

3.3 *ADVERSE WEATHER CONDITIONS*

One year of weather data supplied by the Bureau of Meteorology for Taree Airport was used to represent general wind vectors for the area. Wind vector percentage occurrence data was combined with corresponding noise levels for the analysis of the complete set of meteorological conditions.

Modelling of noise levels for the range of atmospheric conditions has been conducted for Stage 1 and Stage 3. Criteria used in the EIS have been adopted for this assessment. The criterion used for these meteorological conditions is that noise levels should not exceed the standard intrusiveness criterion by more than 5 dB(A) for more than 10% of the specified time period during a year. That is, noise levels should not exceed 45 dB(A) or 47 dB(A) (depending on the location) for more than 10 per cent of the time, see *Table 3.2* for criteria applicable to individual residences.

Table 3.2 ***L_{eq} Noise Results – Adverse Weather***

Residence	Criteria	Stage 1	Stage 3
Yala 1[3]	47	35	26
Yala 2[3]	47	37	27
Yala 3[3]	47	36	30
Jones	45	**46**	45
Groves	45	**46**	45
Loveday	47	46	45
Mowbray	47	46	46
Barnes	45	36	39
Middleton	47	41	40
Dubos	47	40	37

1. All values 10th Percentile L_{eq} dB(A);
2. Adverse meteorological conditions,
3. Yala property under contract for purchase by CSR;
4. Adopted criteria for residences not subject to noise monitoring are based on location in regard to monitoring sites and the Pacific Highway.

Noise levels for Stage 1 exceeded recommended criterion at two locations to the east of the quarry. Stage 3 noise levels are at or below the recommended criteria.

The adopted criterion for these residences is 45 dB(A) which should not be exceeded for more than 10 percent of the time. The 45 dB(A) noise level occurs for 13 percent of the time with noise levels at 46 dB(A) occurring for approximately 9 per cent of the time. Therefore a reduction of 1 dB(A) would result in compliance.

Analysis of the relative contribution to total noise reveals that the crusher is dominant. Discussions with CSR indicate that the crusher is used periodically throughout the operation and some plant items used in overburden removal and dumping is often used to feed the crusher. Removal of the crusher results in noise levels approximately 2 dB(A) lower which will result in noise levels complying with the criteria. Use of the crusher will need to be co-ordinated not to coincide with adverse wind conditions (west or north west winds), which occur predominantly during winter and autumn.

It should be noted that higher noise levels are often associated with higher wind speeds, and in these cases background noise levels will also be elevated and this may tend to mask quarry noise.

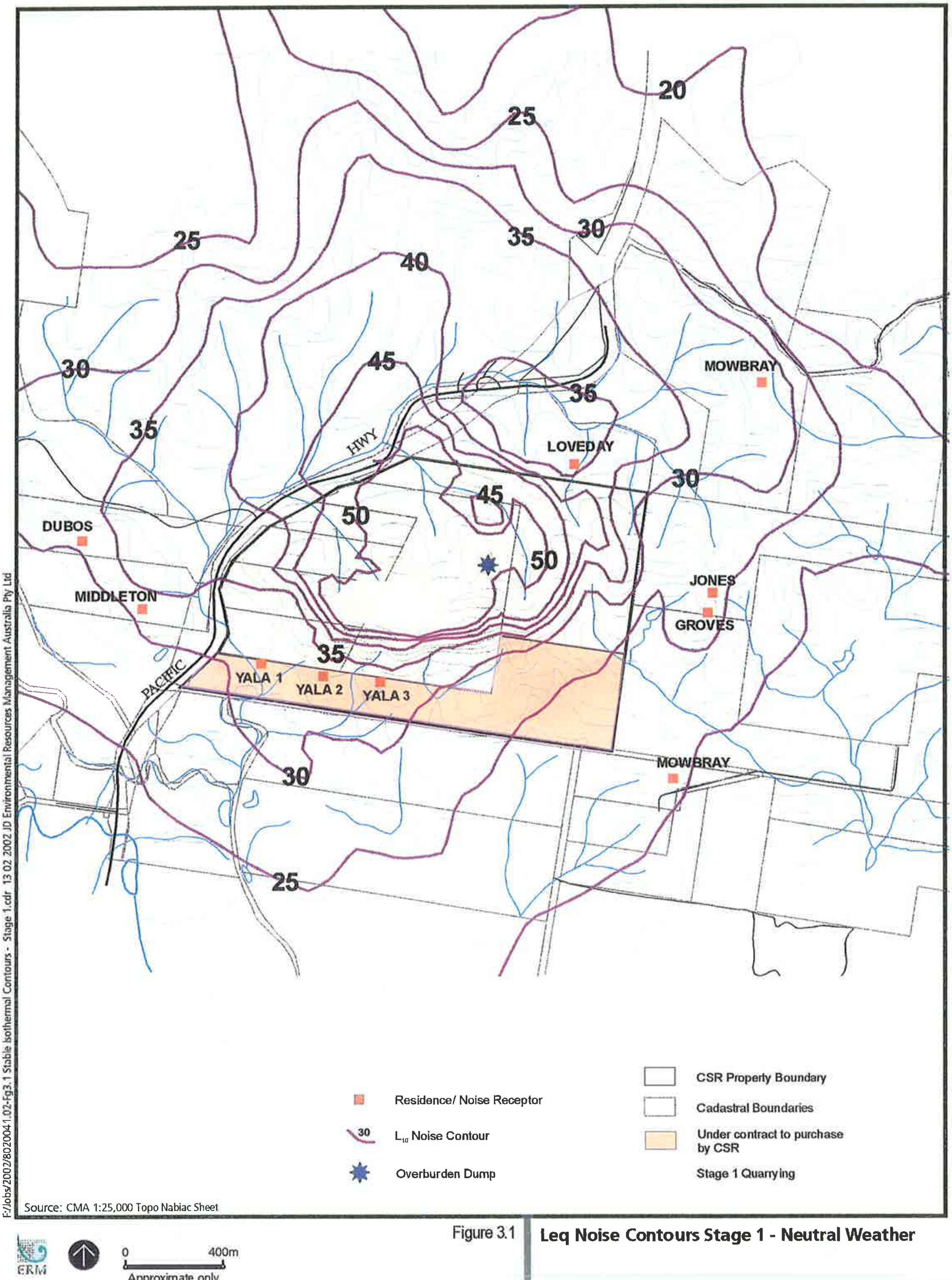

Figure 3.1 **Leq Noise Contours Stage 1 - Neutral Weather**

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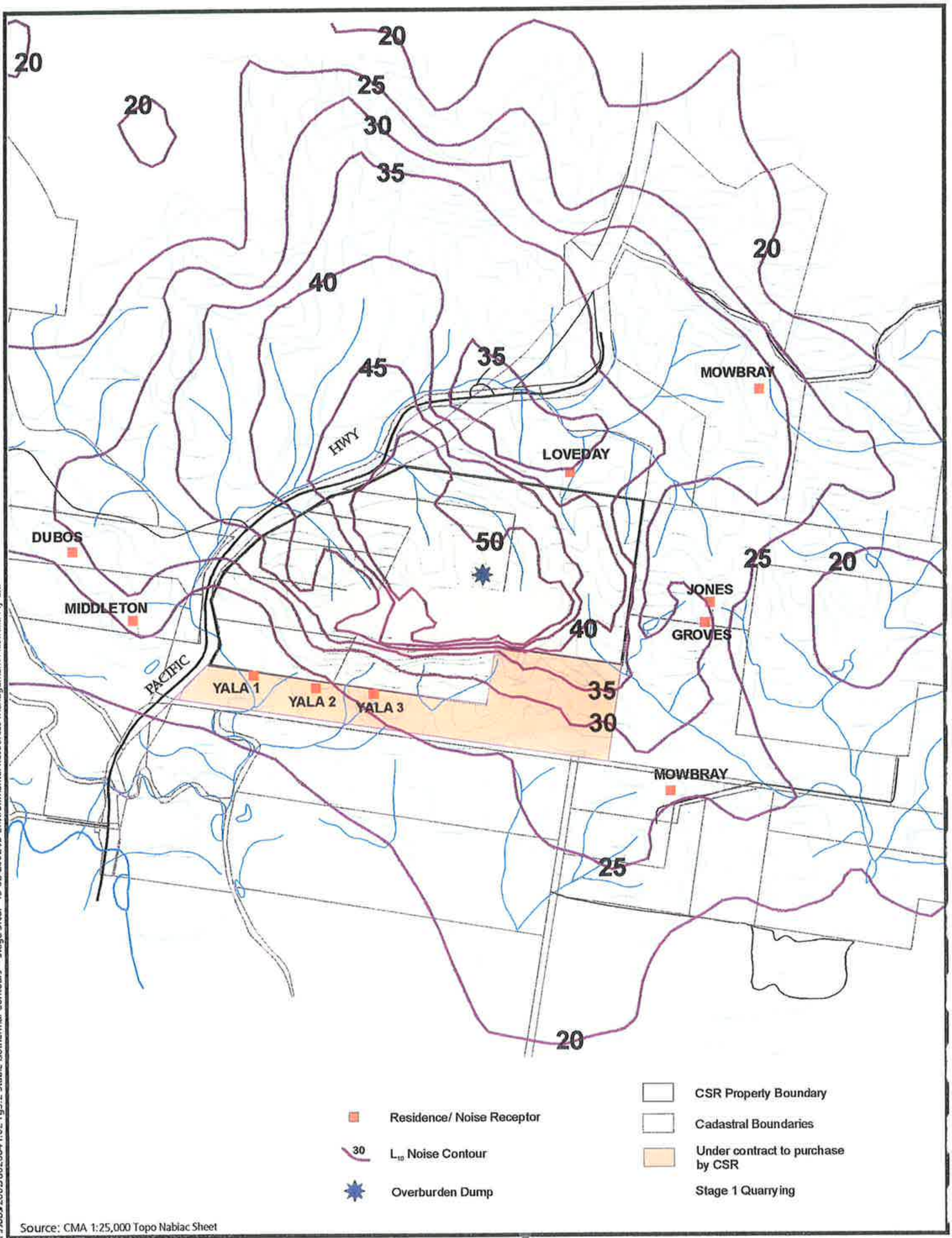

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ERM

0 400m
Approximate only

Figure 3.2 **Leq Noise Contours Stage 3 - Neutral Weather**

CSR Construction Materials - Jandra Quarry Pacific Highway Rainbow Flat, NSW

4 CONCLUSION

4.1 CONCLUSION

Noise modelling was conducted for existing, Stage 1 and Stage 3 phases of operation at Jandra Quarry. For each stage, plant items were located in worst case scenario locations and operated simultaneously. L_{eq} noise levels calculated under neutral conditions are below the adopted intrusiveness criteria for all surrounding residences for each stage of quarry development. Natural topographic shielding and distance attenuation result in noise levels below the intrusiveness noise criteria.

Modelling for the complete range of meteorological conditions was undertaken for Stage 1 and Stage 3. The analysis gives a comprehensive representation of the range of noise levels likely to occur throughout the year. Noise levels complied with the adopted criteria of non-adverse plus 5 dB for less than 10 per cent of the time under the worst case conditions modelled, except for residences to the east during Stage 1, where an exceedance of approximately 1 dB(A) was found.

Analysis of the relative contribution of plant items to noise levels for the Jones and Groves residences to the east revealed that noise levels were dominated by the crusher. This operation is intermittent and will be planned to coincide with neutral weather conditions wherever possible. Removing the crusher results in noise levels complying with the adopted criteria.

It should be noted that noise modelling for both non-adverse and adverse meteorological conditions has been conducted for absolute worst case operating scenarios, which are in reality unlikely to occur with any significant frequency. This has significant implications for the annual distribution of noise levels where it is assumed that absolute worst case plant locations occur for the entire year. This is not going to occur and the assessment is therefore quite conservative and represents the upper envelope of likely noise levels.

Potential noise impacts at residences surrounding the proposed expansion of Jandra quarry are within acceptable limits as defined by the EPA. It may be necessary to utilise noise control practices when using the crusher.

REFERENCES

Environment Protection Authority (1994)
Environmental Noise Control Manual, NSW Government.

Environment Protection Authority (2000)
Industrial Noise Policy, NSW Government.

ERM Mitchell McCotter (1999)
Jandra Quarry Extension Environmental Impact Statement, for CSR Construction Materials.