Appendix B
Noise Impact Assessment

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ENVIRONMENTAL NOISE IMPACT ASSESSMENT OF THE PROPOSED MCARTHUR RIVER MINING OPEN CUT PROJECT

FOR

URS AUSTRALIA PTY LTD

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1 INTRODUCTION

SVT were requested by URS Australia Pty Ltd to undertake an environmental noise impact assessment of the proposed McArthur River Mining Open Cut Project.

The McArthur River Mine is located 45 kilometres south west of the township of Borroloola in the Gulf Region of the Northern Territory, approximately midway between Darwin and Mount Isa.

The mine is a major underground operation mining zinc ore at a rate of 1.5 Mtpa which is concentrated on site prior to being transported via road to the Port at Bing Bong. The proposed operation will increase production to 1.8 Mtpa using open pit mining methods.

There are no noise sensitive locations near the mine site with the exception of the accommodation camp located approximately 1.6km to the south west. Therefore, this report concentrates mainly on noise impacts at the camp.

1.1 Current Operations

In the current underground operations ore is blasted, loaded into trucks and hauled to the underground crushing and conveying system. The ore is transported via a conveyor in an access tunnel to the surface where it undergoes secondary crushing and screening before being passed to the mill stockpile. Coarse ore from the mill stockpile undergoes primary grinding in a sag mill and verti mill. The ore then passes through a re-grind circuit prior to being fed to conditioner and flotation tanks. The concentrated ore is filtered and pressed to remove water and then transferred via conveyor to the concentrate storage shed.

Power for the current operations is supplied by an on site gas fired power station rated at 22MW.

Concentrated ore is loaded onto road trains using a front-end loader. The road trains transport the ore to the port at Bing Bong where it is stored prior to being loaded onto a barge via a conveyor system. The ore is transported by the barge to anchorages in the Gulf of Carpenteria where it is transferred to cargo vessels.

Figure A1 in Appendix A is an aerial photograph showing the mine site and surrounding area.

1.2 Proposed Open Cut Operation

The McArthur River Mine Open Cut Project involves a staged open pit development with a mining rate of approximately 1.8Mtpa of ore. Mining will be undertaken by a fleet of mobile equipment comprising:

3 Ingersoll-Rand ECM700 drills,
1 Hitachi EX2500 excavator,

1 Hitachi EX1900 excavator,
1 Cat 922 wheel loader,
15 Cat 777D haul trucks,
3 Cat D8 track dozers,
2 Cat 777 water carts,
2 Cat 16H graders,
1 Cat 330 Ex rockbreaker.

The ore from the open pit will be transported to a new primary crusher via haul truck. There will be no additional ore concentration facilities and all of the surface infrastructure facilities will be essentially as they are now. The future pit workings will be protected from inundation during localised wet season flooding using a bund wall.

Transport of the concentrate will be by truck to Bing Bong along the existing sealed highway. Power generation capacity will not be increased.

1.3 Scope of Work

The following list outlines the major activities undertaken during the course of the study:

- Review of documentation provided by URS and McArthur River Mining including site plans, equipment lists, and topographical data.
- Measurement of existing ambient noise levels at the accommodation camp and at the port of Bing Bong.
- Determination of noise emission levels (sound power levels) for existing high noise equipment items and estimation of sound power levels for equipment associated with the proposed operation.
- Development of an acoustic model for the mine and surrounding area.
- Plotting of noise contours for a range of meteorological conditions for the current mining operations and for the proposed operation.
- Calculation of noise levels at the accommodation camp for a range of meteorological conditions.
- Review of noise limit criteria for the accommodation camp.
- Review of the noise impacts of the proposed mine open cut operation and assessment of noise emissions for compliance with noise limits.
- Identification of high noise equipment items that significantly contribute to increased noise impacts at the accommodation camp.
- Review of noise impacts associated with construction activities, blasting and road transport.
- Provision of noise mitigation and noise management recommendations.

2 METHODOLOGY

2.1 Ambient Noise Monitoring

Ambient noise levels were recorded for a period of 1 week at the eastern boundary of the accommodation camp and at the port of Bing Bong. Average noise levels were recorded every 15 minutes using automatic noise monitoring equipment.

2.2 Noise Modelling

A noise model was developed to assess the noise impacts of the open cut mine. Initially this model was used to plot noise contours and predict noise levels at the accommodation camp for the existing mining operations. The model was verified by taking noise readings at various locations and comparing these readings with predictions produced by the model under similar conditions.

The noise model was then revised to include noise sources associated with the proposed open cut. Further noise contours were prepared and noise level predictions were undertaken to determine the impact of the operation.

3 ASSESSMENT OF AMBIENT NOISE LEVELS

In order to assess ambient noise levels, continuous noise logging systems were deployed at the eastern boundary of the accommodation camp and at the manager's house at the port of Bing Bong. The monitoring was conducted for a period of one week, commencing on 9 April 2003. The monitors were set to collect L_{A1}, L_{A10} and L_{A90} noise levels every 15 minutes.

L_{A1} represents the noise level exceeded for 1% of the measurement period.
L_{A10} represents the noise level exceeded for 10% of the measurement period.
L_{A90} represents the noise level exceeded for 90% of the measurement period.

The monitors were field calibrated immediately before and after logging commenced with an acoustic calibrator. All measurement and field calibration equipment used had been calibrated at a NATA accredited calibration laboratory within the past 2 years. (Calibration certificates are available on request.)

3.1 Ambient Noise at McArthur River Mine Camp Site

The recorded noise levels are presented in the Figure C1 in Appendix C. The table below summarises the range of noise levels recorded at the camp site.

	Range of Recorded Noise Levels dBA		
Location	**L_{A1}**	**L_{A10}**	**L_{A90}**
Accommodation Camp	35 - 75	34 - 59	29 - 49

Recorded noise levels at this location were influenced by background noise from insects, birds, wind-generated noise, occasional traffic and activities at the camp. Therefore, the L_{A1} and L_{A10} noise levels are not likely to be representative of noise emissions from the mine site. However, the mine was clearly audible at the logging position when background noise levels were low and therefore the L_{A90} noise levels can be considered to be representative of noise emission from the mine site. The large variation in the L_{A90} noise levels is caused by changes in meteorological conditions, which affect sound propagation, and also by changes in the operating conditions at the mine.

3.2 Ambient Noise at Bing Bong

Only 3½ days of recordings were captured for Bing Bong because the microphone of the noise monitoring system was removed by the resident of the house at which the monitor was placed. However, the recordings are considered to be long enough to be representative of ambient noise at the port.

The recorded noise levels are presented in Figure C2 in Appendix C. The table overleaf summarises the range of noise levels recorded at the Bing Bong.

	Range of Recorded Noise Levels dBA		
Location	**L_{A1}**	**L_{A10}**	**L_{A90}**
Bing Bong	51 - 81	50 - 73	47 - 54

Recorded noise levels at this location were strongly influenced by activities at the port. In particular, the L_{A90} noise levels are representative of the noise received from the generator building. L_{A1} and L_{A10} noise levels are representative of noise from road trains entering and leaving the port facility.

4 NOISE MODELLING

4.1 Methodology

An acoustic model has been developed using the ENM noise modelling program developed by RTA Technology. The ENM program calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. The ENM noise modelling program was originally developed by RTA Technology for the Australian Noise Advisory Council. The inputs required are noise source data, ground topographical data, meteorological data and receiver locations.

The model has been used to generate noise contours for the area surrounding the mine site and also to predict noise levels at the accommodation camp.

The model covers an area of 84 km^2 (12km east – west x 7km north – south).
The model does not include noise emissions from any sources other than the mining operations. Therefore noise emissions from road traffic, aircraft, domestic sources, entertainment, etc are not accounted for.

The model produces noise contours or noise levels at specified receiving locations for specific meteorological conditions. Therefore, a range of noise levels can be predicted for any given location.

4.2 Input Data

4.2.1 Source Sound Power Levels

Existing Operations

For the existing operations at the McArthur River Mine, sound power levels were developed for the major plant areas that contribute to the noise received at the camp site. The sound power levels were calculated from sound pressure level measurements recorded on a closed contour around each plant area, taking into account the distance from the sound source and the area enclosed by the measurement contour. The table below presents the sound power levels for major plant areas.

	Octave Band Sound Power Levels - dB(lin)								Overall Levels	
Item	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Lin**	**A**
Regrind Circuit	113	113	115	119	111	106	98	93	124	118
Vertimill	108	106	107	103	99	94	86	78	114	105
SAG Mill	118	117	118	114	111	108	100	95	128	116
Flotation Blower	110	108	107	108	103	97	91	85	117	108
Crushing Circuit	117	117	119	111	110	109	104	98	124	116
Power Station	127	124	123	114	112	106	113	112	132	120

Note:- Other items of plant such as the flotation circuit, thickeners and the concentrate storage and loading operations produce insignificant noise emissions compared to the items in the table above and have, therefore, been excluded from the noise model.

The simultaneous operation of all the above plant items represents worst-case noise emission conditions.

Proposed Open Cut Project

The following outlines the high noise equipment likely to be associated with the proposed operation and the assumptions made when developing the source sound power levels.

The major noise emitting equipment is likely to include the following:

Mobile equipment operating in the open pit

The proposed mining fleet is outlined in section 1.2 of this report. The number of items of equipment operating at any given time and their locations will vary considerably. For the purposes of this study it has been assumed that the following equipment is operational:

- 11 haul trucks, 8 in the pit and 3 on the haul road to the waste rock dump to the north of the pit.
- 2 drill2
- 2 excavators
- 2 dozers
- 1 front-end loader
- 1 graders
- 2 water carts

The number of mobile equipment, as described above, represents approximately 70% of the total mobile fleet anticipated for the MRM open cut project. This is considered to be a realistic scenario for modelling purposes, as not all mobile equipment is likely to be operating simultaneously at any one time.

The sound power levels for these items of mobile equipment are presented in the table below and have been obtained from SVT's internal database of measurements recorded for similar items of equipment. The mobile equipment items have been distributed throughout the pit for the purposes of the noise model.

	Octave Band Sound Power Levels - dB(lin)								Overall Levels	
Item	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Lin**	**A**
Haul Truck	108	118	115	114	110	106	102	94	122	116
Drill	109	118	113	113	113	112	110	104	122	118
Excavator	113	117	107	108	106	101	95	89	119	110
Dozer	110	122	113	114	110	108	104	94	123	116
Loader	108	116	107	108	105	99	95	88	118	110
Grader	109	107	108	106	107	102	97	90	115	110
Water Cart	104	114	111	110	106	102	98	90	118	112

Note:- the sound power levels in the table above are estimates. Sound power levels can vary significantly, even for similar items of equipment, depending on the condition of the vehicles.

<u>New primary crusher</u>

The primary crusher has been assumed to have a similar overall sound power level to the existing secondary crushing circuit but with proportionally more noise being emitted in the lower frequency bands. The sound power levels assumed are:

	Octave Band Sound Power Levels - dB(lin)								Overall Levels	
Item	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Lin**	**A**
Primary Crusher	123	123	121	111	106	105	100	94	127	116

4.2.2 Topography Ground Types and Barriers

Topographical information for the noise model was obtained from McArthur River Mining in AutoCad format. Ground contours were converted into DXF file format for direct import into the noise model.

The ground type assumed for the model is “sandy silt, hard packed by vehicles”. This is the most appropriate ground type available in ENM for the majority of the area covered by the model.

The barrier effects of large buildings at the mine site have also been incorporated into the noise model.

The ground contours for the mine include the pit and the bund wall that is to be erected around the pit and processing areas. The ground level for the pit has been assumed to be 28m, representing the worst-case situation for sound propagation at the start of the pit life. As the pit develops the equipment in the pit will be located progressively lower and will receive greater noise shielding from the pit walls.

4.2.3 Receiving Locations

The noise model has been used to predict noise levels at two locations (A and B) at the accommodation camp site. These locations are shown in Figure B1 in Appendix B and represent the eastern and northern boundaries of the camp.

4.2.4 Meteorology

Certain meteorological conditions can increase noise levels at a receiving location by a process known as refraction. When refraction occurs, sound waves that would normally propagate directly outwards from a source can be bent downwards causing an increase in noise levels. Such refraction occurs during temperature inversions and where there is a wind gradient. These meteorological effects can increase noise levels by as much as 5 to 10 dB depending on the source – receiver geometry and intervening topography.

The ENM noise model calculates noise levels for user defined meteorological conditions. In particular, temperature, relative humidity, wind speed and direction data, and temperature inversion rates are required as input to the ENM model.

The noise model has been used to predict noise levels and produce noise contours for a range of meteorological conditions. In all cases the temperature and relative humidity values used were 30°C and 70% respectively. Calm conditions have been investigated as well as 3m/s winds from each of 8 cardinal directions combined with a 2°C/100m thermal inversion. (Wind speeds of 3m/s combined with a thermal inversion rate of 2°C/100m are representative of worst-case conditions for sound propagation.)

4.3 Noise Modelling Results

4.3.1 Results for Existing Operations

Noise contours have been produced for calm conditions and for 3m/s winds from the east and the north combined with a 2°C/100m temperature inversion. The following noise contours can be found in Appendix B:

NC1 – Existing operations – calm conditions
NC2 – Existing operations – 3m/s easterly wind with a 2°C/100m temperature inversion
NC3 – Existing operations – 3m/s northerly wind with a 2°C/100m temperature inversion

The table below presents the noise levels predicted at locations A and B for a range of meteorological conditions.

Wind Direction	**Wind Speed m/s**	**Inversion Rate °C/100m**	**Noise Level at Position A dB(A)**	**Noise Level at Position B dB(A)**
Calm	0	0	37	36
N	3	2	43	41
NE	3	2	47	45
E	3	2	48	46
SE	3	2	45	44
S	3	2	39	38
SW	3	2	35	34
W	3	2	35	33
NW	3	2	36	35

From the table above, it can be seen that noise levels vary between 35 dB(A) and 48 dB(A) at position A when there is a 3m/s wind combined with a thermal inversion. The worst-case wind direction for sound propagation is from the east. For the same meteorological conditions noise levels vary between 33 dB(A) and 46 dB(A) at position B.

4.3.2 Verification of Model

The noise model for the current mining operations was verified by recording noise levels at various locations and comparing these recordings with noise levels predicted by the noise model for the same operating conditions and meteorological conditions. Noise levels were recorded when background noise was low and when the mining operations were clearly audible. Three locations were investigated, one at the eastern camp site boundary, one near the airstrip, and one on the road approximately half-way between the mine site and the camp. Agreement to within +2, -3 dB(A) was reached at all locations.

4.3.3 Results for Proposed Open Cut Project

Noise contours have been produced for calm conditions and for 3m/s winds from the east and the north combined with a 2°C/100m temperature inversion. The following noise contours can be found in Appendix B:

NC4 – Open cut operations – calm conditions
NC5 – Open cut operations – 3m/s easterly wind with a 2°C/100m temperature inversion
NC6 – Open cut operations – 3m/s northerly wind with a 2°C/100m temperature inversion

The table below presents the noise levels predicted at locations A and B for a range of meteorological conditions.

Wind Direction	Wind Speed m/s	Inversion Rate °C/100m	Noise Level at Position A dB(A)	Noise Level at Position B dB(A)
Calm	0	0	40	39
N	3	2	47	46
NE	3	2	50	49
E	3	2	51	50
SE	3	2	49	48
S	3	2	43	43
SW	3	2	38	38
W	3	2	38	37
NW	3	2	40	39

From the table above, it can be seen that noise levels vary between 38 dB(A) and 51 dB(A) at position A when there is a 3m/s wind combined with a thermal inversion. The worst-case wind direction for sound propagation is from the east. For the same meteorological conditions noise levels vary between 37 dB(A) and 50 dB(A) at position B.

4.3.4 Noise Impacts of Proposed Open Cut Operation

The table overleaf presents the increase in noise levels that can be expected as a result of the mine open cut project.

Wind Direction	Wind Speed m/s	Inversion Rate °C/100m	Change in Level - Position A - dB(A)	Change in Level Position B - dB(A)
Calm	0	0	3	3
N	3	2	4	5
NE	3	2	3	4
E	3	2	3	4
SE	3	2	4	4
S	3	2	4	5
SW	3	2	3	4
W	3	2	3	4
NW	3	2	4	4

From the table above it can be seen that the proposed operation has the potential to cause an additional noise impact at the camp with noise levels rising between 3 and 5 dB compared to existing noise levels.

Mobile equipment is the main contributor to the predicted increase in noise levels. However, the impacts of noise from mobile equipment should reduce progressively as the pit develops and becomes deeper.

5 NOISE CRITERION

Currently there are no statutory regulations governing environmental noise emissions in the Northern Territory.

Consideration to noise impacts for the current mining operations was given in the original McArthur River Mine Environmental Impact Statement prepared by Hollingswood Dames & Moore in 1992. This study adopted an indoor night-time sleep criterion level of 35 dB(A). The study also assumed a noise reduction of 25 dB from outside to inside for air conditioned residences. This effectively sets the outdoor criterion level at 60 dB(A).

The indoor criterion level of 35 dB(A) is consistent with recommended design sound levels for sleeping areas provided in Australian/New Zealand Standard AS/NZS 2107:2000 – "*Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors*". Therefore, SVT concur that this is an appropriate criterion for noise received at the accommodation camp.

6 OTHER NOISE IMPACTS

6.1 Construction Noise

The major noise producing activities during construction will include plant construction, earthworks, and construction activities associated with the development of accommodation for construction workers. It is difficult to accurately assess the noise impacts associated with construction activities. However, it is unlikely that these activities will cause a significant increase in the noise received at the accommodation camp.

One exception may be noise associated with the temporary expansion of the camp site for construction workers. For this activity a noise management program may be required. The program should ensure that due consideration is given to the selection of construction equipment to ensure that noise emissions are as low as possible. For example, generators could be fitted with high performance exhaust silencers, and portable screens could be used to reduce noise impacts from high noise activities such as grinding. Other considerations would include limiting known noisy activities to certain times of day (eg shift changes) when sleep disturbance is likely to be minimal, and undertaking prefabrication activities at locations remote from the camp site.

6.2 Traffic Noise

Traffic noise impacts are limited to the township of Borroloola. Consideration was given to the potential for traffic noise impacts in the Supplement to the McArthur River Mine Environmental Impact Statement prepared in July 1992. This resulted in the establishment of a bypass corridor some 2.5km from the township. At this distance traffic should neither cause sleep disturbance nor interfere with the amenity of any residences.

6.3 Blasting Noise & Vibration

Peak noise levels from blasting are very difficult to predict but are obviously related to the size and location of the blast and the prevailing weather conditions. In order to control blasting noise it is recommended that a blast monitoring program is initiated to determine if there is any possibility of sleep disturbance as a result of blasting. If blasting noise does cause sleep disturbance then a maximum allowable blast size should be determined based on the noise levels recorded from the blast monitoring program. Other control measures (if required) could include restricting blasting to certain times of day (eg shift changes) when sleep disturbance is likely to be minimal, and only blasting when winds are from the south-western quadrant or when wind or rain noise is likely to mask the noise from blasting.

Given that the camp site is approximately 1.6km from the mine site, vibration associated with blasting should be insignificant.

6.4 Noise Impacts at Bing Bong

The transport of concentrate will be by truck to Bing Bong. The product tonnages are not significantly different to those that are currently being transported and therefore noise impacts from this activity should be minimal at Bing Bong.

7 DISCUSSION AND RECOMMENDATIONS

The proposed open cut operation at McArthur River Mine will have an impact on the noise levels received at the accommodation camp. Noise levels could potentially increase by between 3 and 5 dB over existing noise levels depending on the prevailing weather conditions.

Although the predicted noise levels increase, the resultant noise levels are not high enough to result in sleep disturbance within the accommodation units at the camp. In fact, the worst-case noise levels predicted for the camp are very similar to those predicted during the impact assessment undertaken for the existing mine operations. (The actual measured noise levels for the existing mine site are significantly lower than originally predicted.) There are no other noise sensitive premises within the vicinity of the mine site.

Noise from mobile equipment operating in the pit contributes towards the increase in predicted noise levels at the camp. However, as the pit develops, noise from mobile equipment should become progressively less significant. The biggest impact from mobile equipment is likely to be from haul trucks travelling to and from the waste rock dump.

The following noise mitigation measures are available to reduce noise impacts at the camp site:

- Ensure all items of mobile equipment are fitted with high performance mufflers and low noise cooling fans.

In addition to environmental noise considerations, any new equipment should be selected so as to reduce occupational noise exposure to a minimum. Where possible, every effort should be made to ensure that noise levels do not exceed 85 dB(A) within the work area, (i.e. within 1m from operating equipment). Noise level information should be requested from equipment suppliers prior to making final equipment selections. This information should be reviewed to ensure that occupational noise exposure standards are not exceeded, and to ensure that the sound power levels assumed for the noise model of the mine open cut are not exceeded.

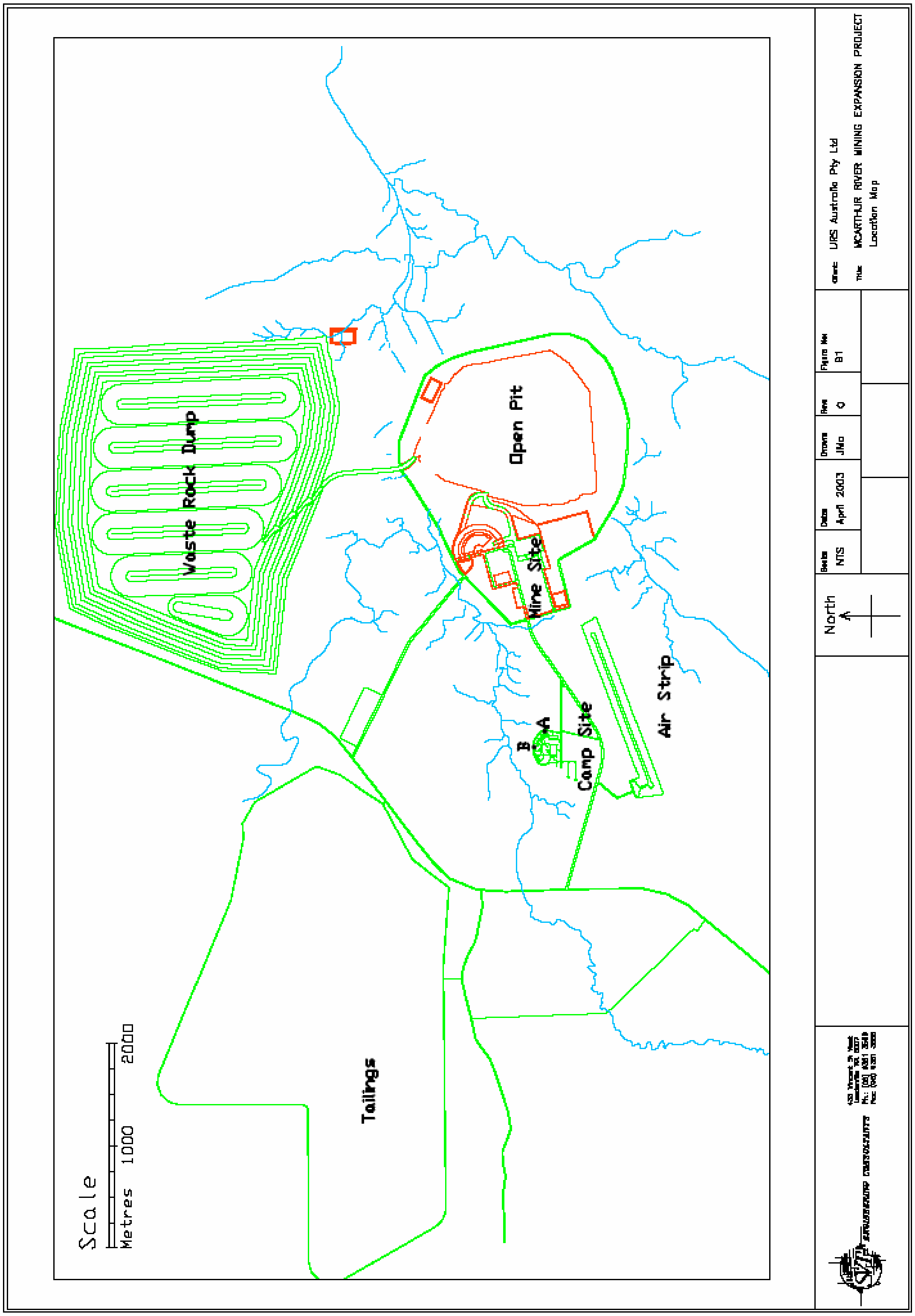
8 APPENDIX A – Aerial Photograph of Area Surrounding Mine Site

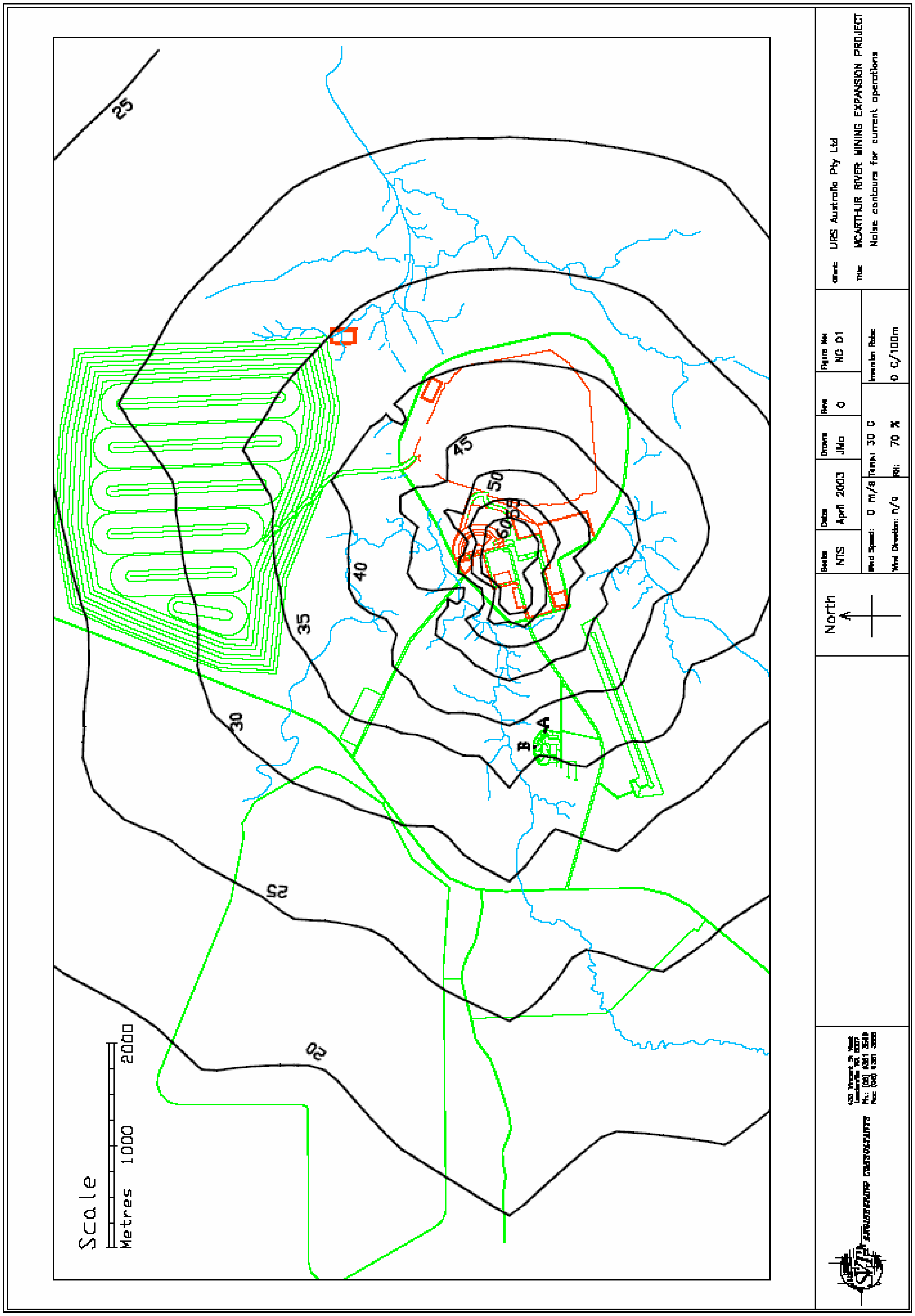
Aerial Photograph of Existing Area Surrounding McArthur River Mine

Figure A1

SVT Engineering Consultants

9 APPENDIX B – Location Map and Noise Contours

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MCARTHUR RIVER MINING EXPANSION PROJECT
Noise contours for current operations
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JMo
April 2003
NTS
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70 %
n/a
0 C/100m
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Scale
Metres
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2000
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30
35
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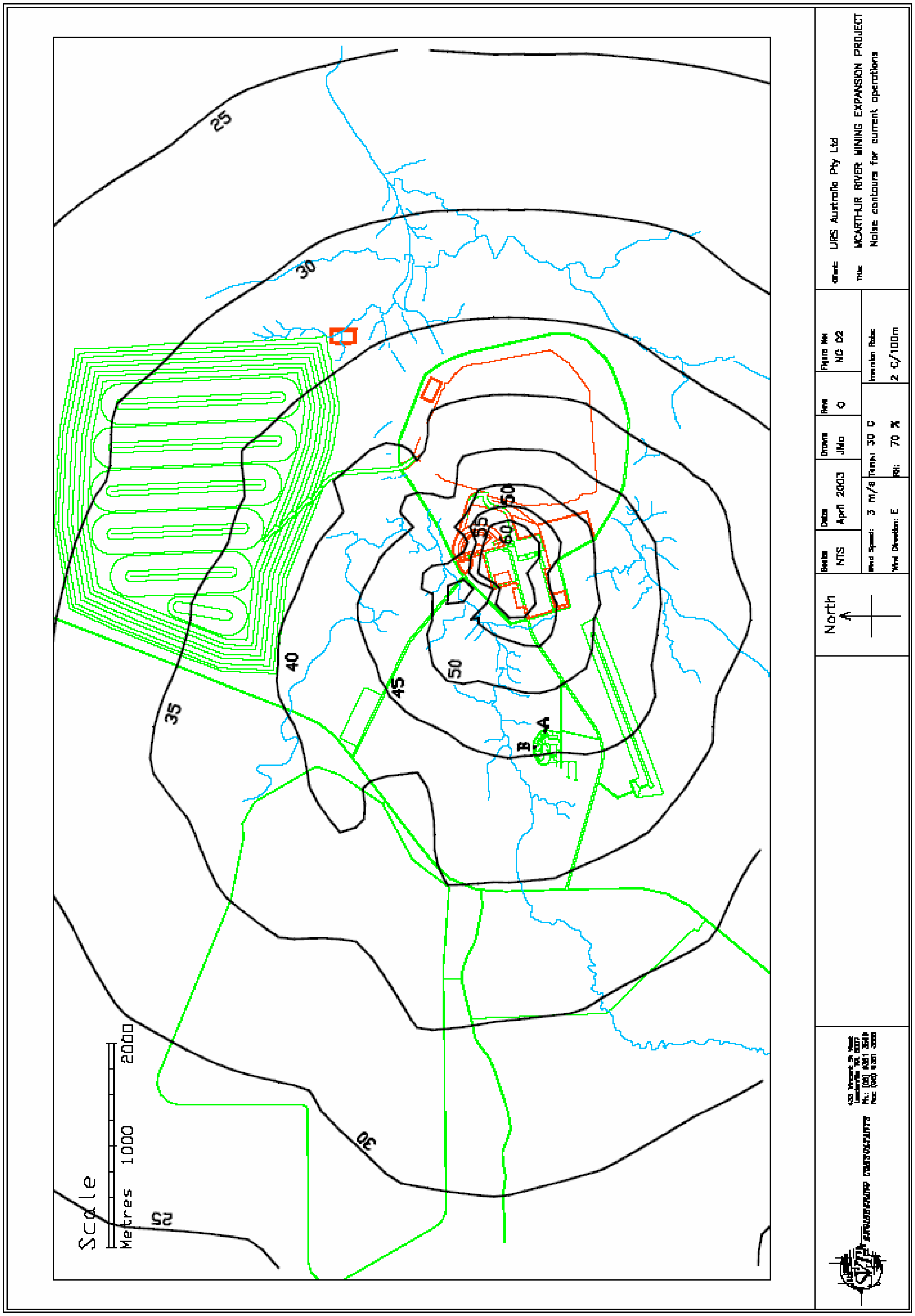
A
B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Rev 0
Drawn JMc
Date April 2003
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Metres 1000 2000
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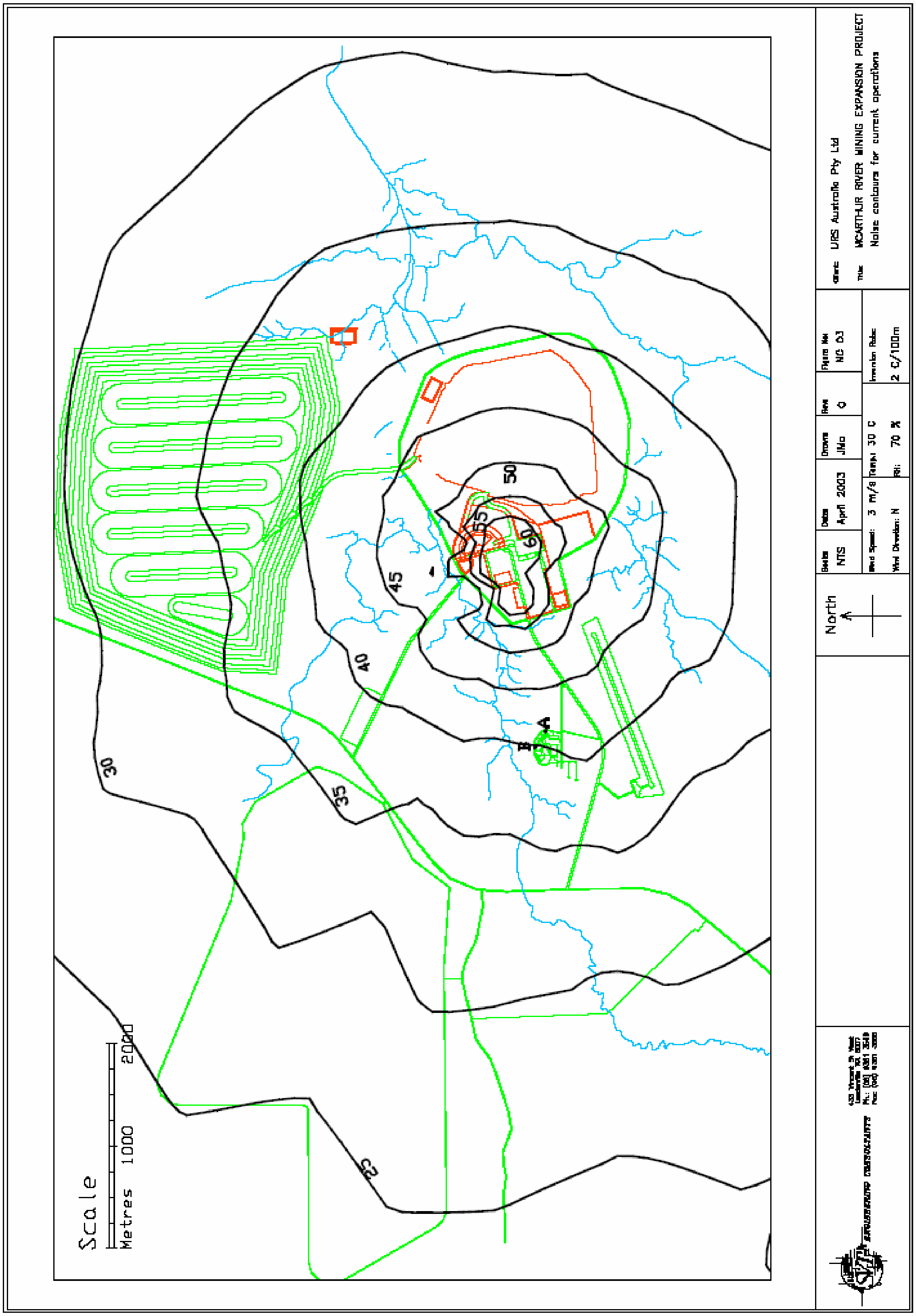
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RH: 70 %
Date: April 2003
Wind Speed: 3 m/s
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North
Scale
Metres 1000 2000
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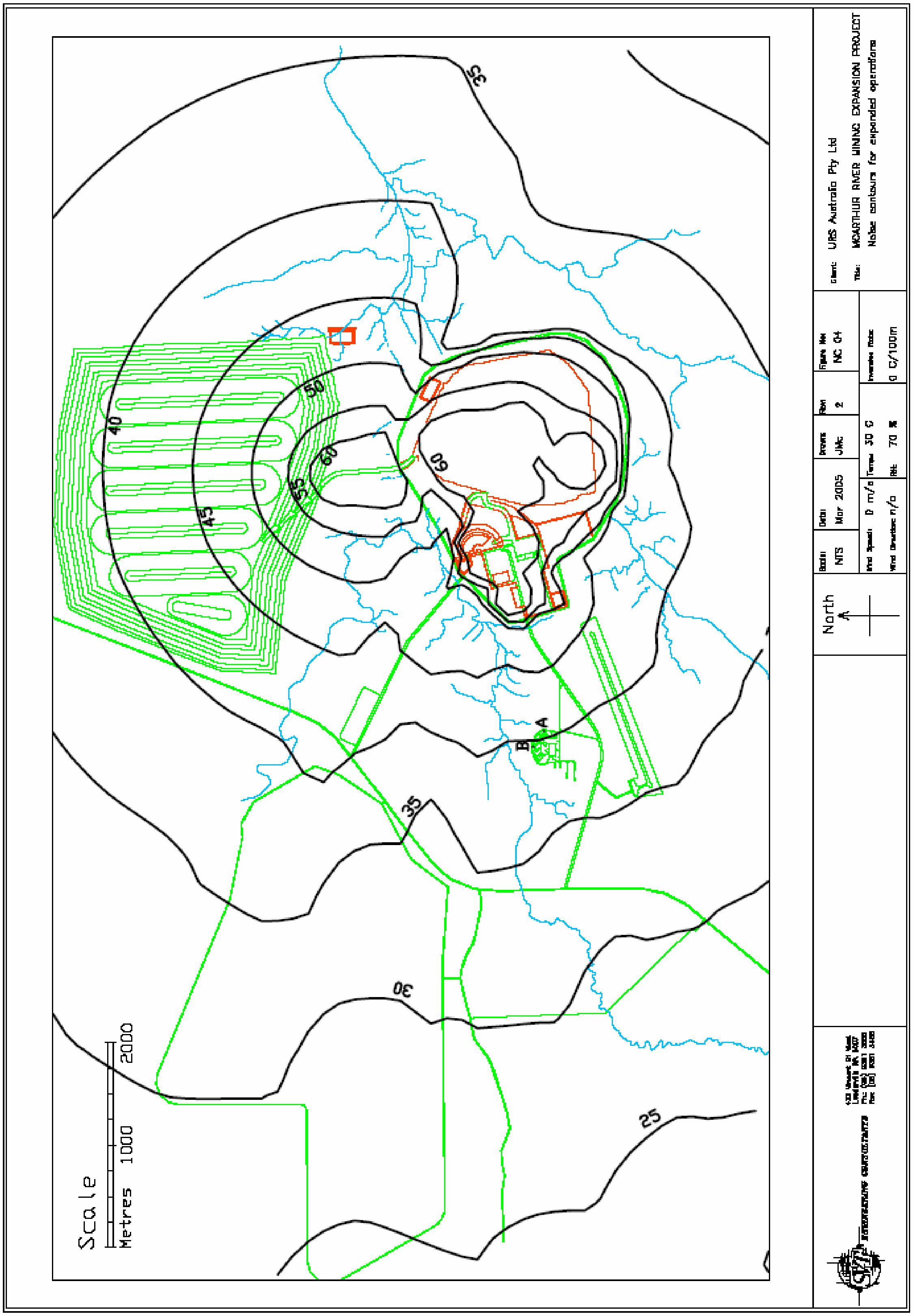
60
A
B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Noise contours for expanded operations
Figure No NC 04
Rev 2
Drawn JMc
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RH 70 %
Wind Speed 0 m/s
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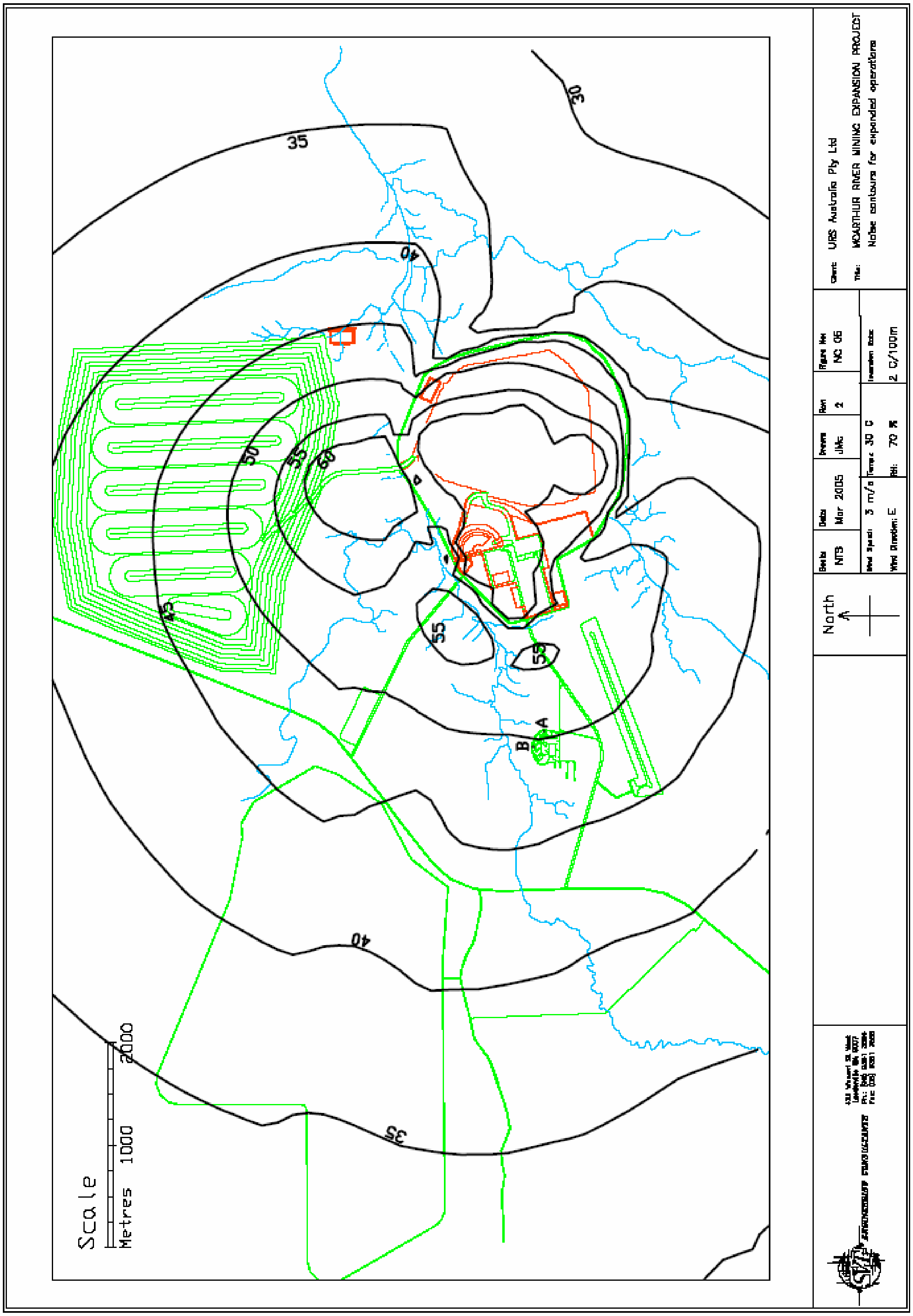
URS Australia Pty Ltd
McARTHUR RIVER MINING EXPANSION PROJECT
Noise contours for expanded operations
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Scale
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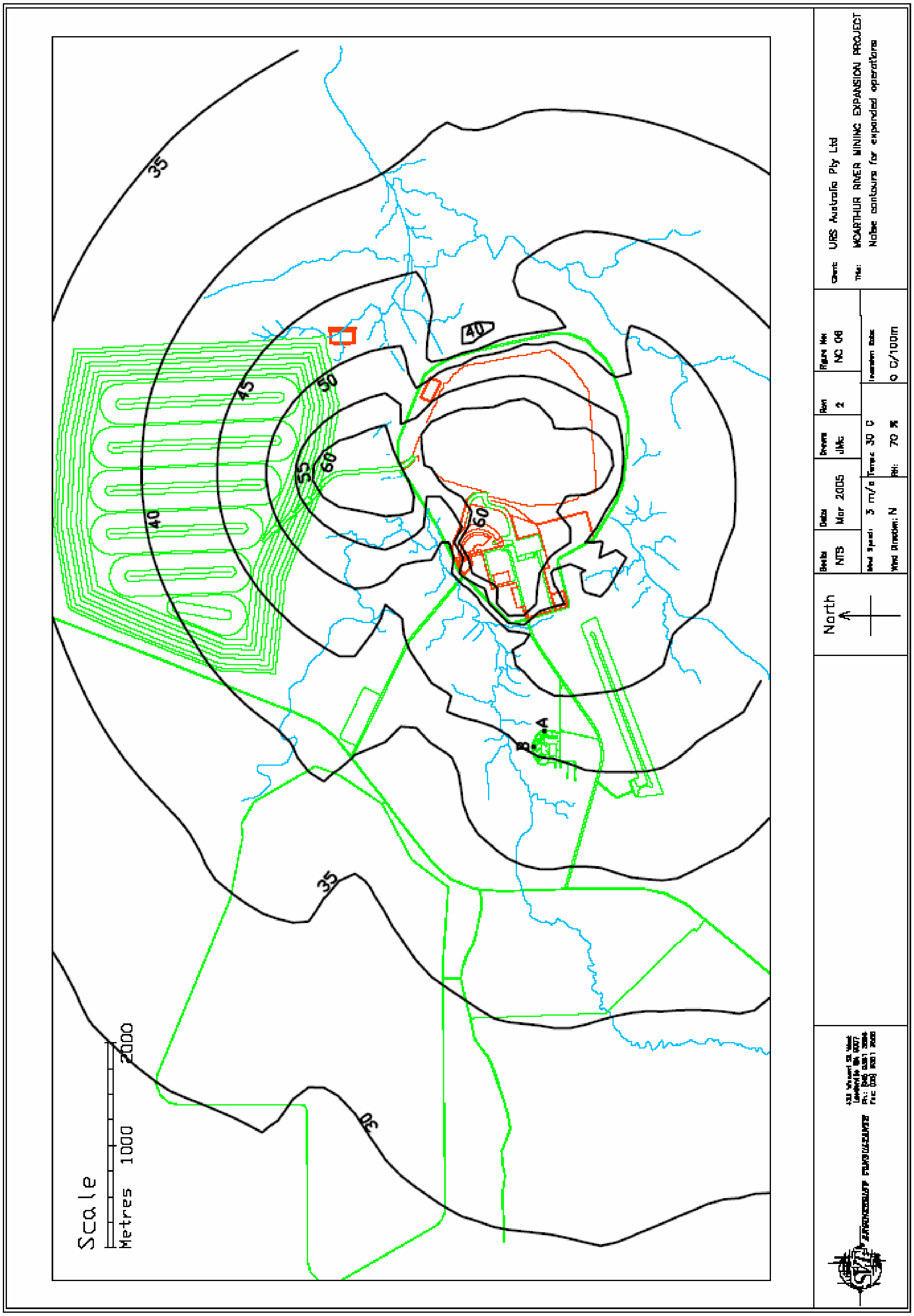
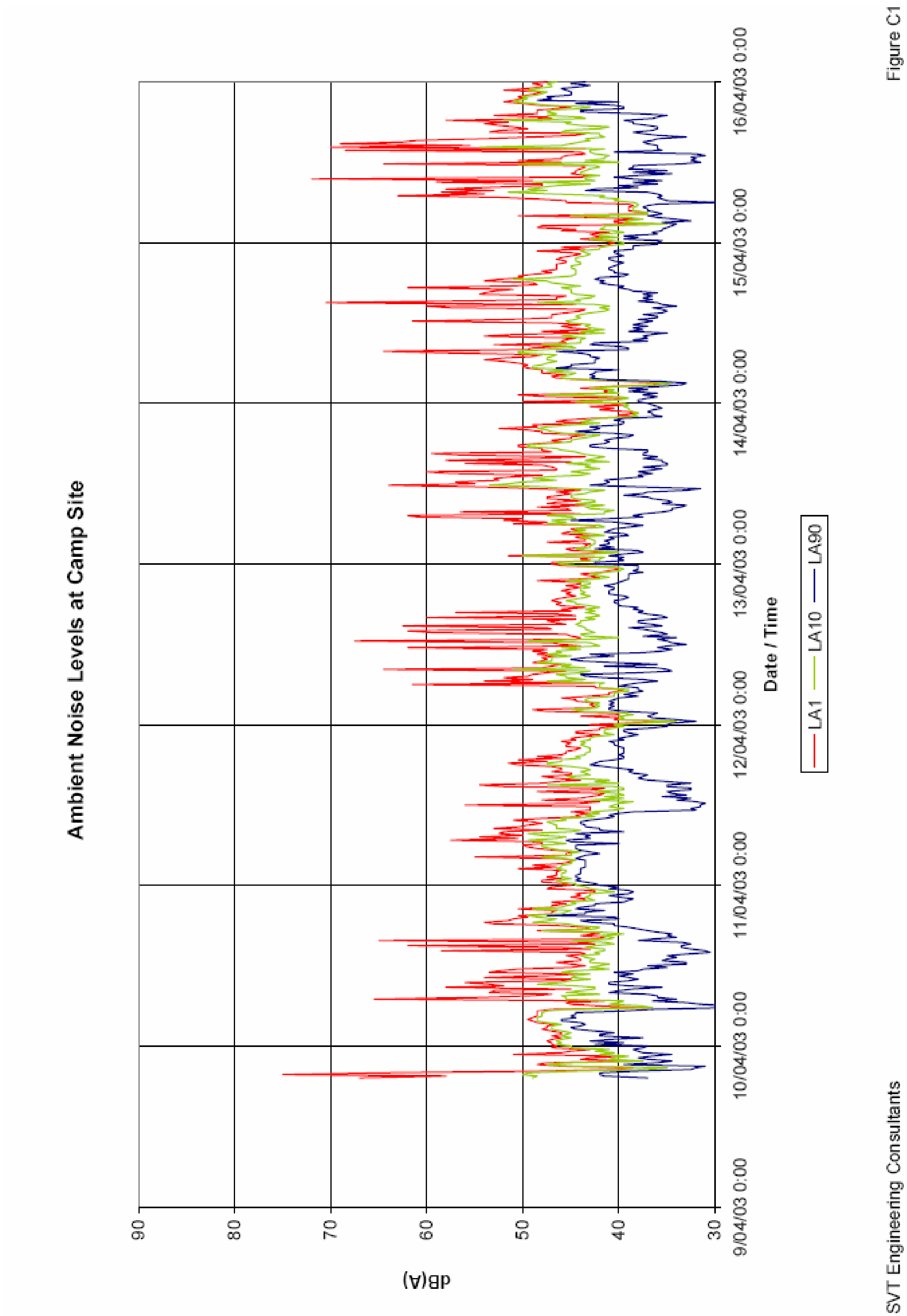
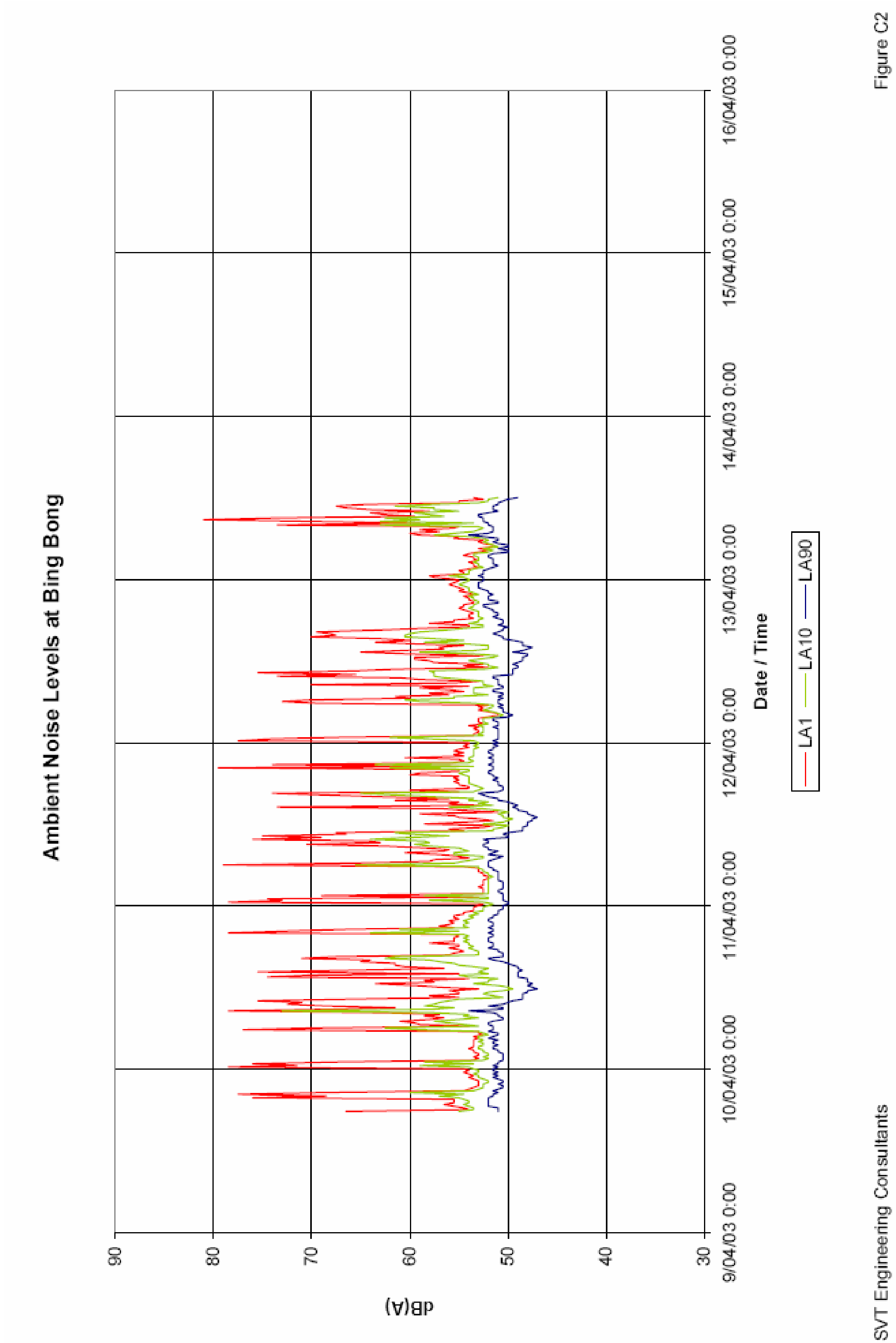


URS Australia Pty Ltd
MCARTHUR RIVER MINING EXPANSION PROJECT
Noise contours for expanded operations
NC 08
2
JMc
Mar 2005
NTS
3 m/s
30 C
70 %
Wind Direction: N
0 C/100m
North
Scale
Metres
1000
2000
35
40
45
50
55
60
30

10 APPENDIX C – Noise Monitoring Results




Ambient Noise Levels at Bing Bong
dB(A)
90
80
70
60
50
40
30
9/04/03 0:00
10/04/03 0:00
11/04/03 0:00
12/04/03 0:00
13/04/03 0:00
14/04/03 0:00
15/04/03 0:00
16/04/03 0:00
Date / Time
LA1
LA10
LA90
SVT Engineering Consultants
Figure C2