HEGLEY ACOUSTIC
CONSULTANTS

MACRAES PHASE III

PROPOSED MINE DEVELOPMENT

ASSESSMENT OF NOISE EFFECTS

Report No 8941

Prepared for:
Oceana Gold (New Zealand) LTD
DUNEDIN
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1 INTRODUCTION

Oceana Gold (New Zealand) Limited (Oceana Gold) is proposing an extension to the consented life of the Macraes Gold Project. The extension is known as the Macraes Phase III Project and includes the mine areas shown on Figure 1.

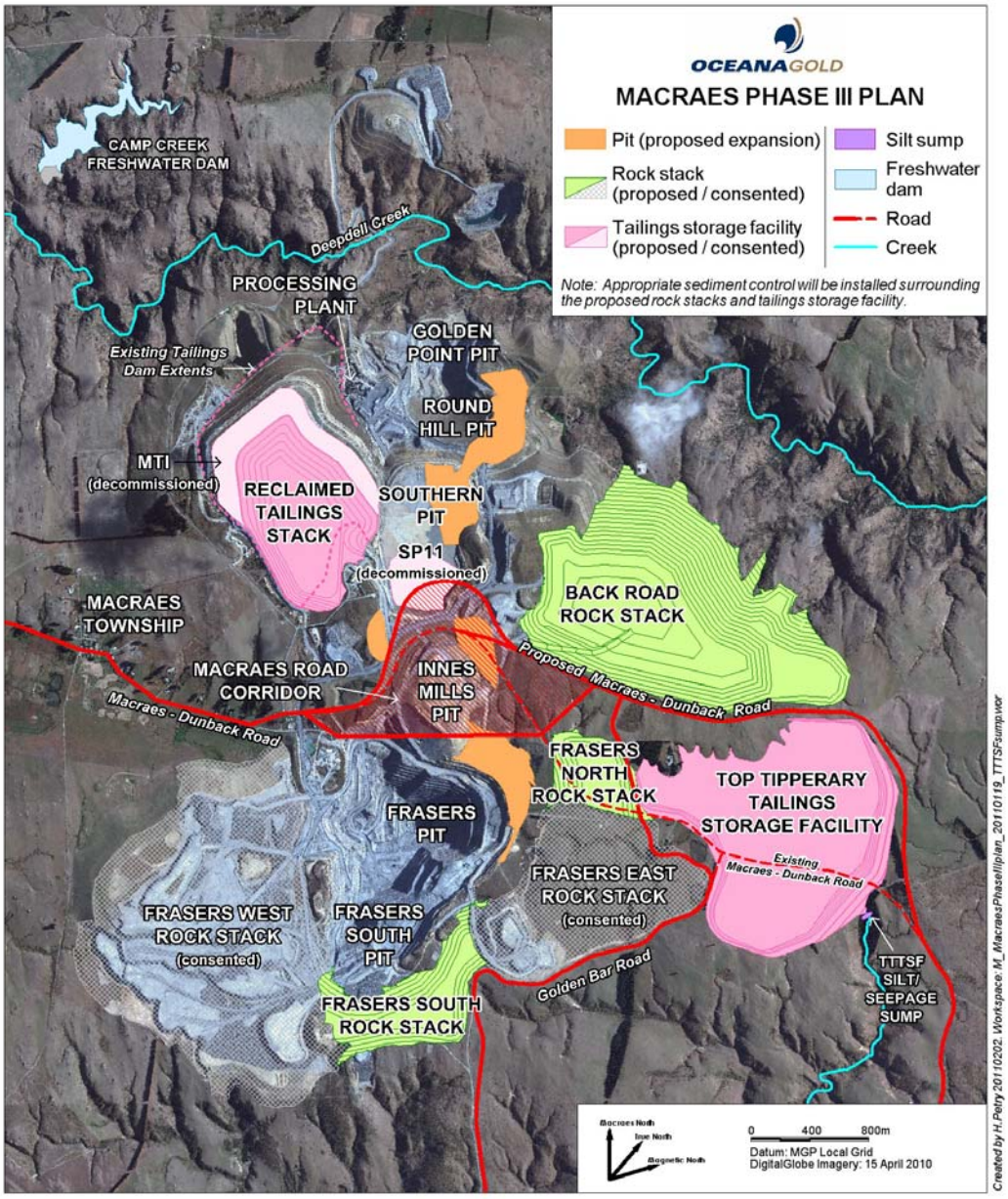


Figure 1. Macraes Phase III

This report considers the noise effects of the proposed work for the residential neighbours and how the work will be managed to ensure the noise[1] is controlled to within a reasonable level at all times.

[1] See Appendix A for a Glossary of noise terms used in this report.

2 DESIGN CRITERIA

To establish if noise from the activity will be within a reasonable level it needs to be determined what levels should be adopted. Condition 8, Noise, of the resource consent LRC 96/98 for the mine state:

a) The holder of this consent shall ensure that all activities associated with the mining operation are so designed and conducted that the following noise limits are not exceeded at the indicated sound measurement locations.

b) Noise limits:

- *On any day between 7 am to 9 pm (daytime): 50 dBA L_{10};*
- *On any day between 9.00 pm to 7.00am the following day (night-time): 40dBA L_{10}; and/or 70 dBA L_{max}.*

c) Measurement locations.
At any point within the boundary of the Township Zone of Macraes; or at, the notional boundary of any dwelling in the Rural Scenic Zone. The Township Zone and the Rural Scenic Zone is identified on the Planning Maps 72, 30, 31, 33 and 34, as set out in the Waitaki District Council's Proposed District Plan publicly notified on 14 December 1996.

Note: The notional boundary is defined as a line 20 metres from the exterior wall of any rural dwelling or the legal boundary where this is closer to the dwelling.

d) Measurement and assessment.
Subject to the express provisions of these conditions, sound levels shall be measured and assessed in accordance with the provisions NZS 6801:1991 Measurement of sound and NZS 6802:1991 Assessment of environmental sound.

There shall be no adjustment or averaging of measured sound levels in the manner provided in clauses 4.3, 4.4, or 4.5 of NSZ 6802:1991.

e) Construction noise.
Construction noise emanating from the site shall meet the limits recommended in, and be measured and assessed in accordance with NZS 6803P:1984. The measurement and assessment of noise from construction, maintenance, and demolition work. The term construction noise shall exclude noise from mining operations, waste rock stack construction, all rehabilitation and the decommissioning and removal of any building, or from blasting for construction purposes.

f) Construction noise shall be deemed to include "noise barrier" construction, including any "noise barriers" constructed in order to mitigate noise to Macraes township caused by the development of

Frasers West waste rock stack. The applicant shall notify the Waitaki District Council in writing of the location, size and proposed period of construction of any "noise barrier".

In addition, as shown on Figure 2 the site is zoned Macraes Mining Zone in the Waitaki District Plan.

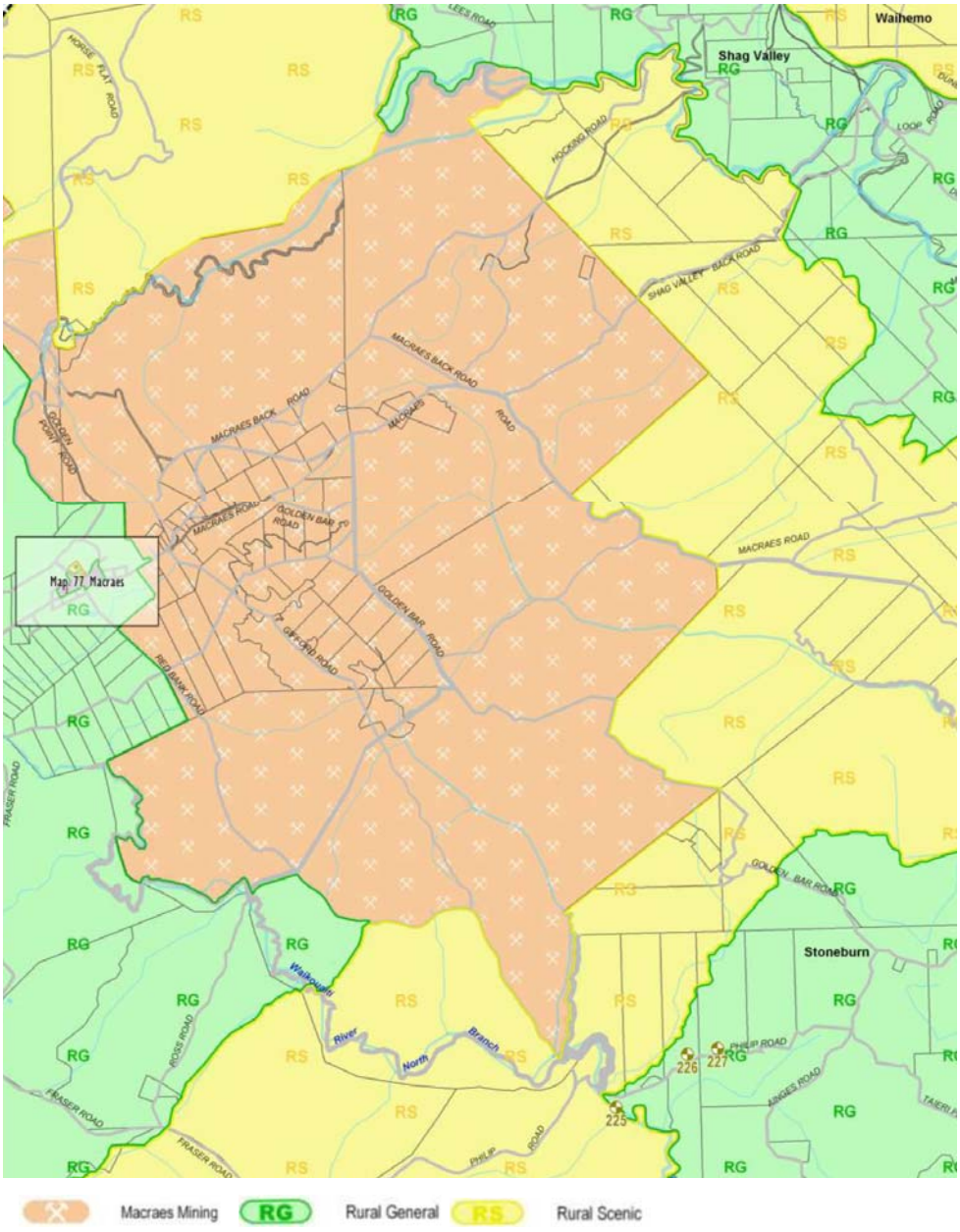


Figure 2. Zoning of the Site

From the Waitaki District Plan, Maps 31 & 34

The following are the relevant noise rules in the Waitaki District Plan for this site:

6.5.1 Noise

Activities shall be conducted such that the following noise levels are not exceeded at the Macraes Mining Mineral Zone Boundary:

- *during daytime 55dBA L_{10}*
- *during nighttime 40dBA L_{10}*
- *at all times 75dBA L_{max}*

There is a difference between the consent conditions and the District Plan requirements with the District Plan adopting the boundary of the Macraes Mining Zone and the consent conditions adopting the boundary of the Township Zone of Macraes, or at the notional boundary of any dwelling in the Rural Scenic Zone. Both criteria have been considered in this report.

6.5.3 Blasting

Activities shall be conducted such that the following air blast peak over sound pressure measured either at the Macraes Mining Zone Boundary or any building within the Golden Point Historic Reserve shall not exceed 128 dB linear unweighted. The hours of blasting shall be restricted to the following:

- *Monday-Friday 9am to 5.30pm*
- *Saturday and Sunday 10am to 4.30pm*

Section 1.1 of the District Plan defines noise as:

means the noise level from an activity is measured and assessed in accordance with NZS 6801:1991 Measurement of Sound and NZS6802:1991 Assessment of Environmental Sound. In circumstances where the noise from an activity has special audible characteristics, the L_{10} limits shall be reduced by 5dBA for comparison with the measured L_{10} noise level.

Where applicable the noise is assessed using:

NZS 6803P:1984 The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work

Day-time	*means 0700 to 2200 hours Monday to Friday and 0800 to 1700 hours Saturday*
Night-time	*means 0001 to 0700 and 2200 to 2400 hours Monday – Friday; 0001 to 0800 and 1700 to 2400 hours Saturday, all day Sunday and public holidays*

Resource Consent LRC 96/98 for the mine requires a level of 70dBA L_{max} to be complied with at night time 9.00 pm to 7.00am the following day and Rule 6.5.1 of the District Plan sets a level of 75dBA L_{max} for the full day.

The L_{max} is 30dBA above the night time L_{10} limit of the resource consent conditions and 20dBA above the District Plan L_{10} limit. Based on field measurements of the mining equipment, in both cases if the L_{10} limit is complied with then the Lmax limit will also be complied with. Thus, no further analysis has been undertaken on the single event sound (L_{max}).

3 THE PROPOSAL

Tailings relocation from SP11 to the mixed tailings drystack will be undertaken primarily by scrapers with secondary digger load and haul sequences. As this activity uses relatively small plant the noise effects will be well below the noise from mining itself. Thus, no noise analysis has been undertaken for this work for the reason that if the main mining activities comply with the noise criteria then this work will comply with a greater factor of safety. Similarly, the general road construction will use small plant in comparison with the mining plant so it is not necessary to undertake any detailed evaluation of this work.

The main features of the Project have been based on the sequence below. While there is expected to be variations in the sequence over the proposed work period the following provides a good basis to undertake representative noise assessments.

Pit Development Schedule

1. Frasers Stage 4 (Current stage – April 2011)
2. Frasers Stage 5 Cutback (Current stage – Quarter 3, 2013)
3. Frasers Stage 6 North East corner of Stage 5 (March 2012 – 2015)
4. Round Hill Stage 2 (Tailings removal and Dam deconstruction of SP11 Wall (January 2012 – Quarter 3, 2014)
5. Round Hill Stage 1 (Waste movement stage (Quarter 4, 2014 – 2015)
6. Round Hill Stage 3 (2015 - 2018)
7. Innes Mills (2016 - 2019)

Dump Destinations

1. Frasers Stage 4 – Frasers West Waste Rock Stack (FWWRS)
2. Frasers Stage 5 – Frasers East Waste Rock Stack (FEWRS), Frasers Backfill (SW Corner) (FRBF), Frasers West Waste Rock Stack
3. Frasers Stage 6 – Frasers East Waste Rock Stack, Frasers West Rock Stack, Back Road Waste Rock Stack (BRWD)
4. Round Hill Stage 2 – Mixed Tailings Dam Drystack (MTDS)

5. Round Hill Stage 1 – Back Road Waste Rock Stack

6. Round Hill Stage 3 – Back Road Waste Rock Stack

7. Innes Mills – Back Road Waste Rock Stack, Frasers West Waste Rock Stack, Frasers Backfill (SW),Frasers 6 Backfill (FR6BF)

Tailings Dam Construction

Would include building:

- 7m vertical lift on the Current SP11 dam to bring the dam crest to 544m RL between November 2010 – March 2011.

- 6m vertical lift of the Current MTI dam to bring the dam crest to 545m RL between November 2010 – September 2011

- Begin construction of the Top Tipperary Tailings Storage Facility environmental sump and Silt Dam September 2011 - April 2012

- Construction of subsequent Top Tipperary Tailings Storage Facility lifts during construction periods of most likely September 2012 – April 2013, September 2014 – April 2015, September 2017 – April 2018

Tailings Deposition (indicative dates only)

1. MTI 533RL - 539 RL (current through till April 2011)

2. SP11 537RL – 544RL (April 2011 – Oct 2011)

3. MTI 539RL – 545RL (Nov 2011 – January 2013)

4. Top Tipperary (May 2012 – LOM)

From this information five scenarios have been considered for the analyses that are regarded as representative of the noise likely to be experienced by the nearby properties. The locations of the mining areas to be worked are shown on Figure 1.

The scenarios evaluated are:

Frasers Stage 4

This phase includes taking waste rock from Frasers Pit to the FWWRS and ore from the Frasers Pit to the processing plant.

Frasers Stage 5

During this phase the work adopted in the noise predictions includes waste removal from the Frasers South Pit to the FEWRS, Frasers Pit to the FWWRS and the transport of ore from the Frasers Pit to the processing plant.

Round Hill Stages 1 & 2

Stage 1 is the waste removal from Round Hill to the Back Road Rock Stack with Stage 2 being the tailings removal to the Reclaimed Tailings Stack as shown on Figure 1. At the same time Round Hill Stage 6 has been considered, which simultaneously will have waste being transported to both the Frasers East and West Rock Stacks from the Frasers Pit area and ore being transported from the Frasers Pit Waste to the processing plant.

Round Hill Stage 3

This phase of the mining includes the transport of waste from Round Hill to the Back Road Waste Rock Stack plus the transport of ore from Round Hill to the processing plant.

Innes Mills Pit

The analysis for this phase includes the transfer of waste rock from the Frasers South Pit to the FWWRS and from the Innes Mills Pit to the Back Road Waste Rock Stack with ore from the Innes Mills Pit to the processing plant.

4 EQUIPMENT NOISE LEVELS

In order to predict noise from the various mining stages field measurements have been undertaken of the main plant operating on site.

Figure 3 shows a Cat 5230B excavator loading a Cat 789C dump truck. Figure 4 shows the level is 78dBA L_{10} when measured at 70m from the excavator.

Figure 3. Cat 5320C Excavator Loading a Cat 789C Dump Truck

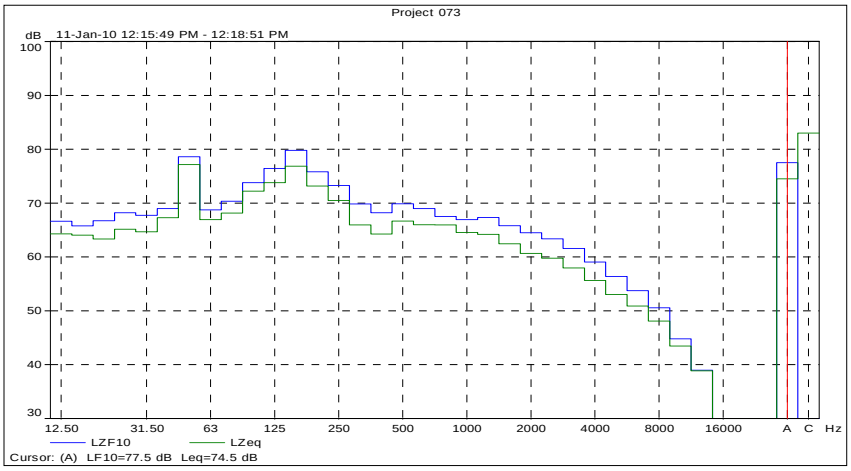


Figure 4. Sound of Cat 5320C Excavator & Cat 789C Dump Truck

Figure 5 shows a Hitachi EX3600 excavator loading a Cat 789C dump truck. Figure 6 shows the level is 68dBA L_{10} when measured at 130m from the excavator.

Figure 5. HitachiEX3600 Excavator Loading a Cat 789C Dump Truck

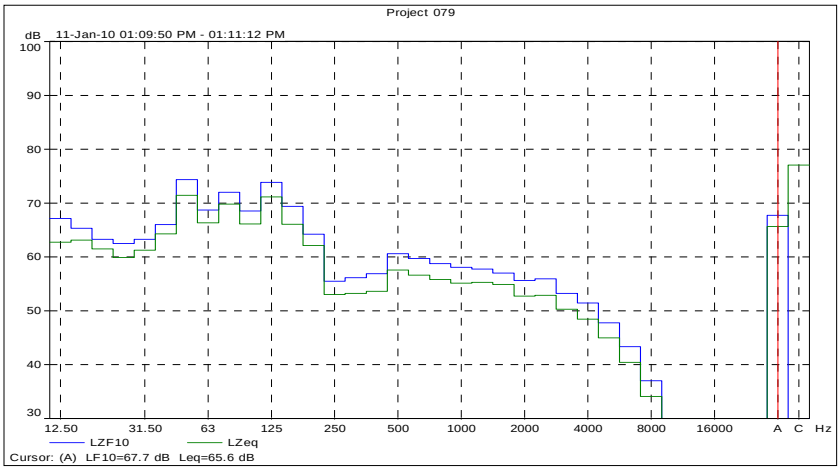


Figure 6. Sound of Cat 5320C Excavator & Cat 789C Dump Truck

Figure 7 shows a Cat 789C dump truck and Figure 8 shows the level of the dump truck is 79dBA L_{10} when measured at 26m from the truck.

Figure 7. Cat 789C Dump Truck

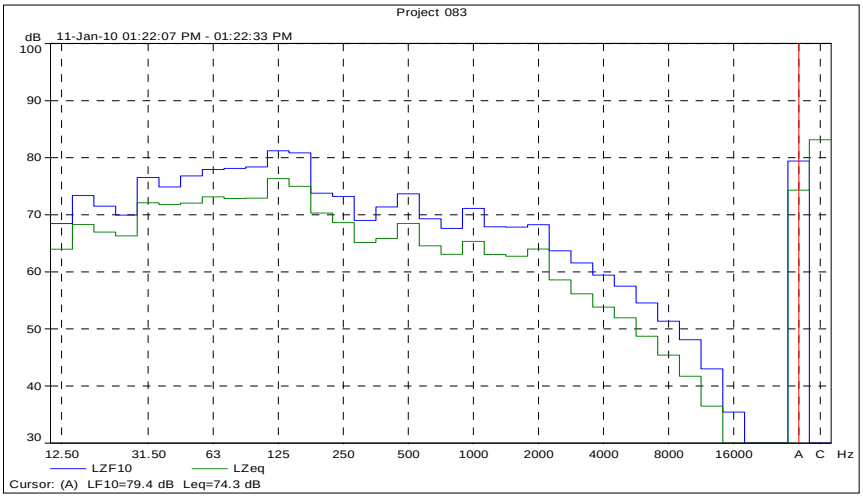


Figure 8. Sound of Cat 789C Dump Truck

Figure 9 shows an underground dump truck and Figure 10 shows the level from the dump truck is 78dBA L_{10} as it passes within 30m of the measurements point.

Figure 9. Underground Dump Truck

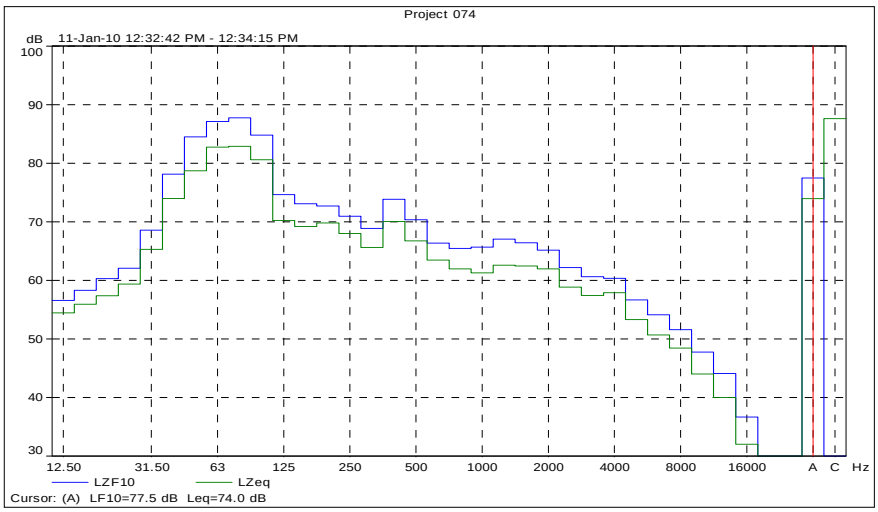


Figure 10. Sound of Underground Dump Truck

Figure 11 shows the rock drill used on site. However, this drill was not operating when I visited the site so the noise from this plant could not be measured. The noise predictions have therefore been based on a larger rock drill as measured at a hard rock quarry at a different site.

Figure 11. Rock Drill

5 PREDICTED NOISE LEVELS

In order to predict the noise from the proposed mine development the above noise sources have been located on a digital terrain model with mobile plant located at the most exposed positions to the notional boundary of the adjoining sites. The noise has then been predicted using the Brüel & Kjær Predictor computer model, which is an advanced noise prediction programme adopting advanced algorithms that will predict the noise levels to satisfy the requirements of NZS6802. The predictions have been based on slightly positive meteorological conditions using the prediction techniques as set out in ISO9613.1/2 and recommended in NZS 6802:2008 Acoustics – Environmental Noise. The predictions take into account the requirements of NZS6802, the existing ground contours and the screening effects of the terrain.

Where a sound has a special audible characteristic, such as tonality or impulsiveness it attracts a 5dBA penalty in the assessment of that sound. Similarly, if the sound is of limited duration then the sound may be averaged by up to 5dBA. Averaging is not permitted at night time. From field measurements the only equipment on site that has the potential to attract an adjustment due to the type of sound is from the rock drill (Figure 11). However, the noise from the rock drill does not exceed 12dBA at any notional boundary of any dwelling in the area. At this level there will not be any special audible characteristic to the sound and in the unlikely event this sound did have a special audible characteristic at this distance the level will be masked by the existing noise environment and hence no adjustment to the sound will be necessary.

The noise has been predicted on a 25m grid and from this noise contours have been developed by interpolating between these grid points to get the calculated location of the ground contour. In addition, spot levels have been calculated at 1.2m above the ground level at the most exposed boundary of each of the closer houses around the mine to provide a higher level of accuracy than is achieved from the contours, which is a smoothing of the levels determined by the selected grid.

Adopting the proposed stages of mining as set out above and the mining plant currently being used as shown above, the noise level has been predicted at each of

the closer houses not owned by the company plus some specific locations as shown on Figure 12. The results of these predictions are shown in Table 1.

House	Frasers Stage 4	Frasers Stage 5	Round Hill Stages 1 & 2	Round Hill Stage 3	Innes Mills Pit
C & E Howard Horse Flat Road	20	21	25	16	20
R & M O'Connell Macraes	25	26	30	19	24
Howard house Macraes	29	31	35	21	30
Beekeeper House Macraes	25	26	30	19	25
School House Macraes	25	26	30	19	25
P Neill Macraes- Dunback Rd	14	15	17	6	13
Golden Point Historic Reserve	24	25	34	23	25

Table 1. Predicted Noise Levels, dBA L_{10}

From Table 1 it can be seen that the highest noise level experienced a the notional boundary of the closer house is 35dBA L_{10}, which is well within the 50dBA L_{10} daytime limit and 40dBA L_{10} night time limit as set out in the consent conditions and the District Plan requirements.

Although these levels are well within both the District Plan limits and the mine consent conditions the effect on the existing noise environment have also been considered. No specific noise measurements have been undertaken in the area for this project and to do so would be difficult when near the mine as it is currently operating so potentially influencing the ambient environment. However, measurements were undertaken around the mine site in 1988 prior to any mining activities commencing.

Measurements undertaken in 1988 around the Macraes Flat township of the existing noise environment showed the background sound (L_{95}) in calm conditions dropped to a low of 27dBA in the afternoon with the lowest L_{10} level during the day at a measured 37dBA. At night time the background sound dropped to a low of 25dBA

with the L_{10} down to 28dBA in calm weather conditions. It is noted that the New Zealand Meteorological Service report, *'The Climate of the Macraes Flat Area with Respect to Gold Mining at Round Hill*' written by Ron McGann in May 1987, showed there was less than 1% calm conditions and as the wind increases the noise environment would quickly increase by 5 – 10dBA or more. That is, except for calm and close to calm conditions the predicted noise from the mine will be at or below the existing noise environment for the majority of the time.

In addition to the noise levels being predicted at the notional boundary of the closer houses in the area the noise contours of each stage set out in Table 1 have been plotted on an aerial photograph as shown on Figures 13 – 17.

The same noise contours for each stage have also been plotted on the District Plan map (Figures 18 - 22), which demonstrates that the night time noise limit of 40dBA L_{10} is complied with at the boundary of the Macraes Mining Mineral Zone with a good factor of safety at all times.

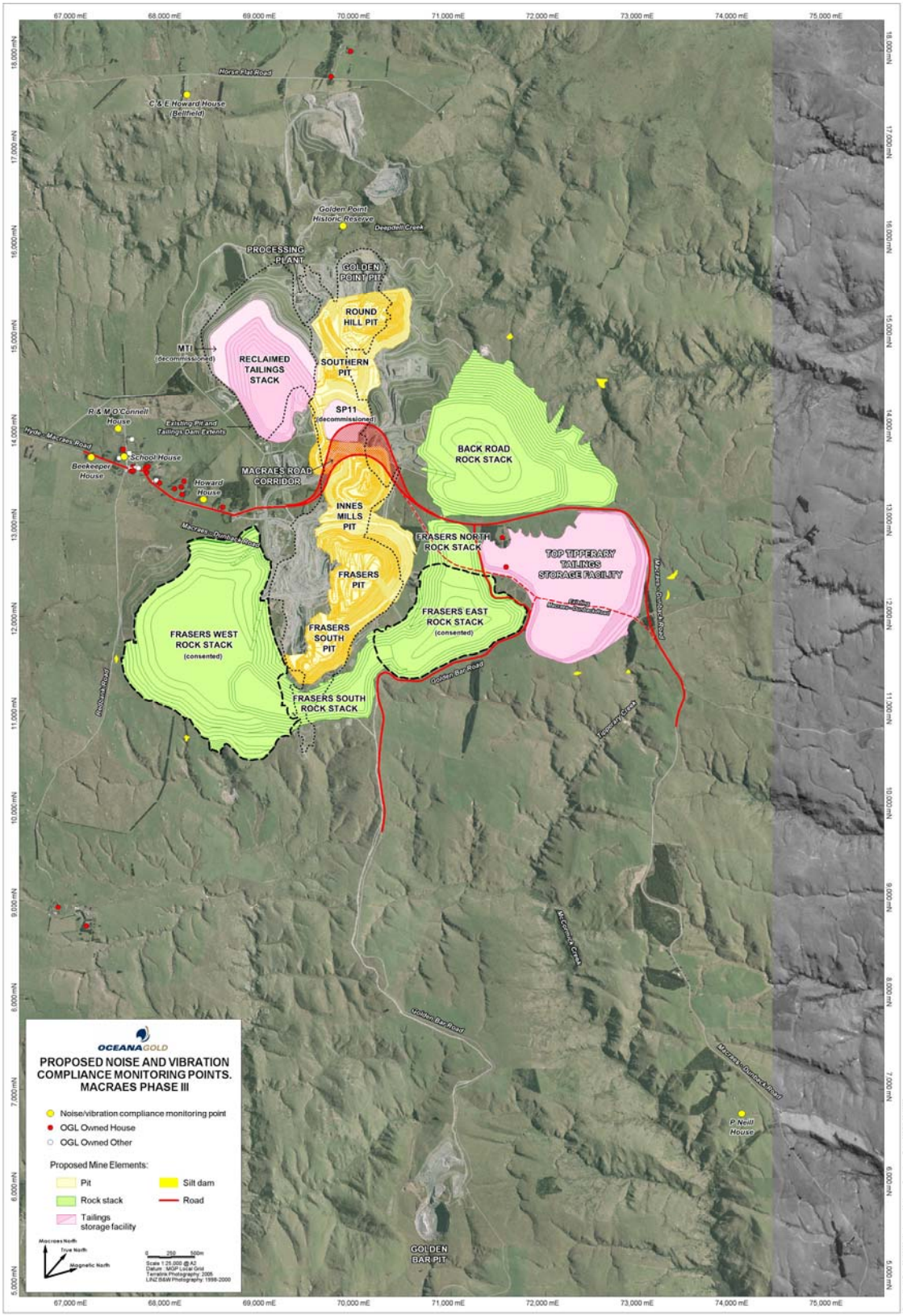


Figure 12. House Locations

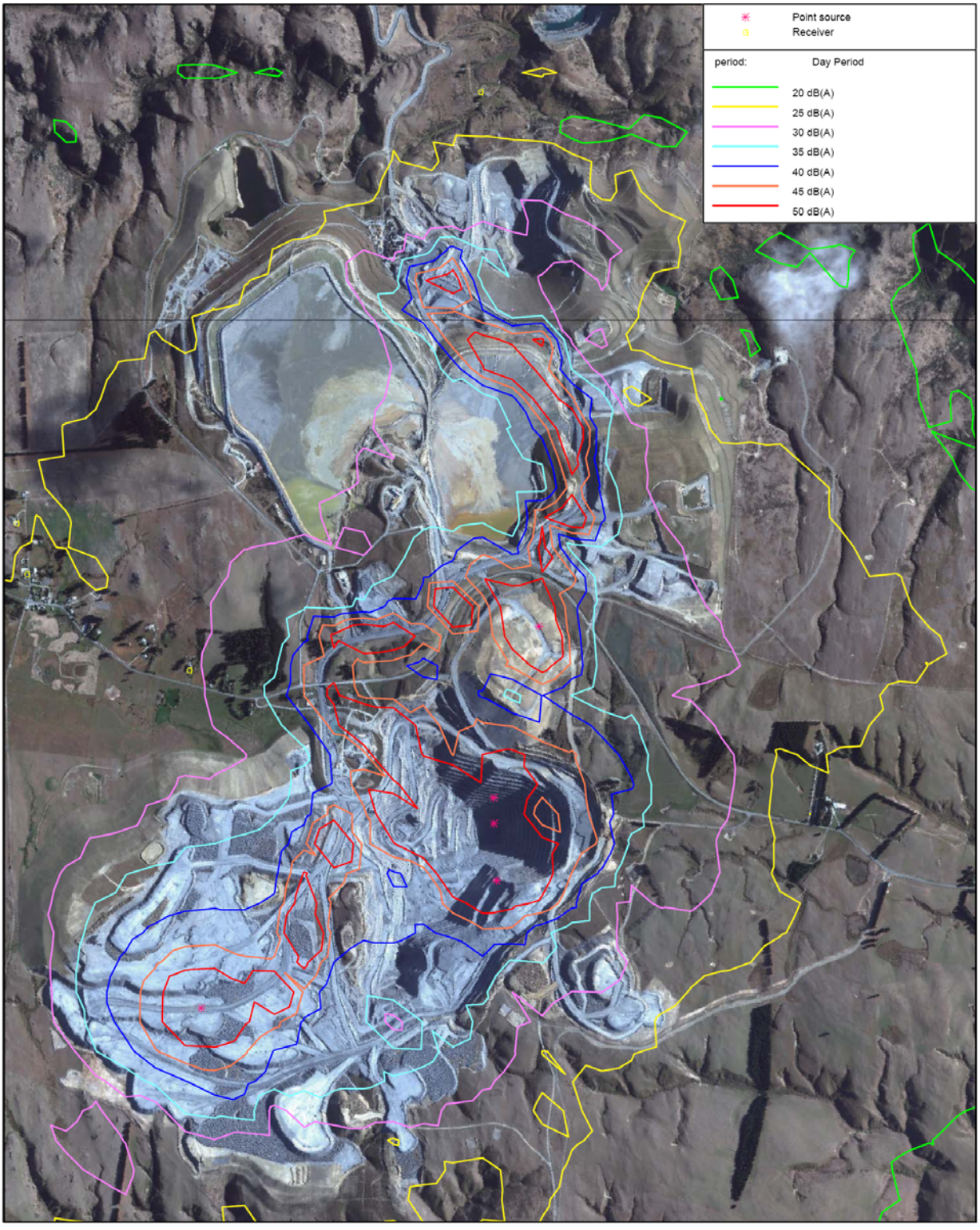


Figure 13. Noise Contours for Frasers Pit Stage 4

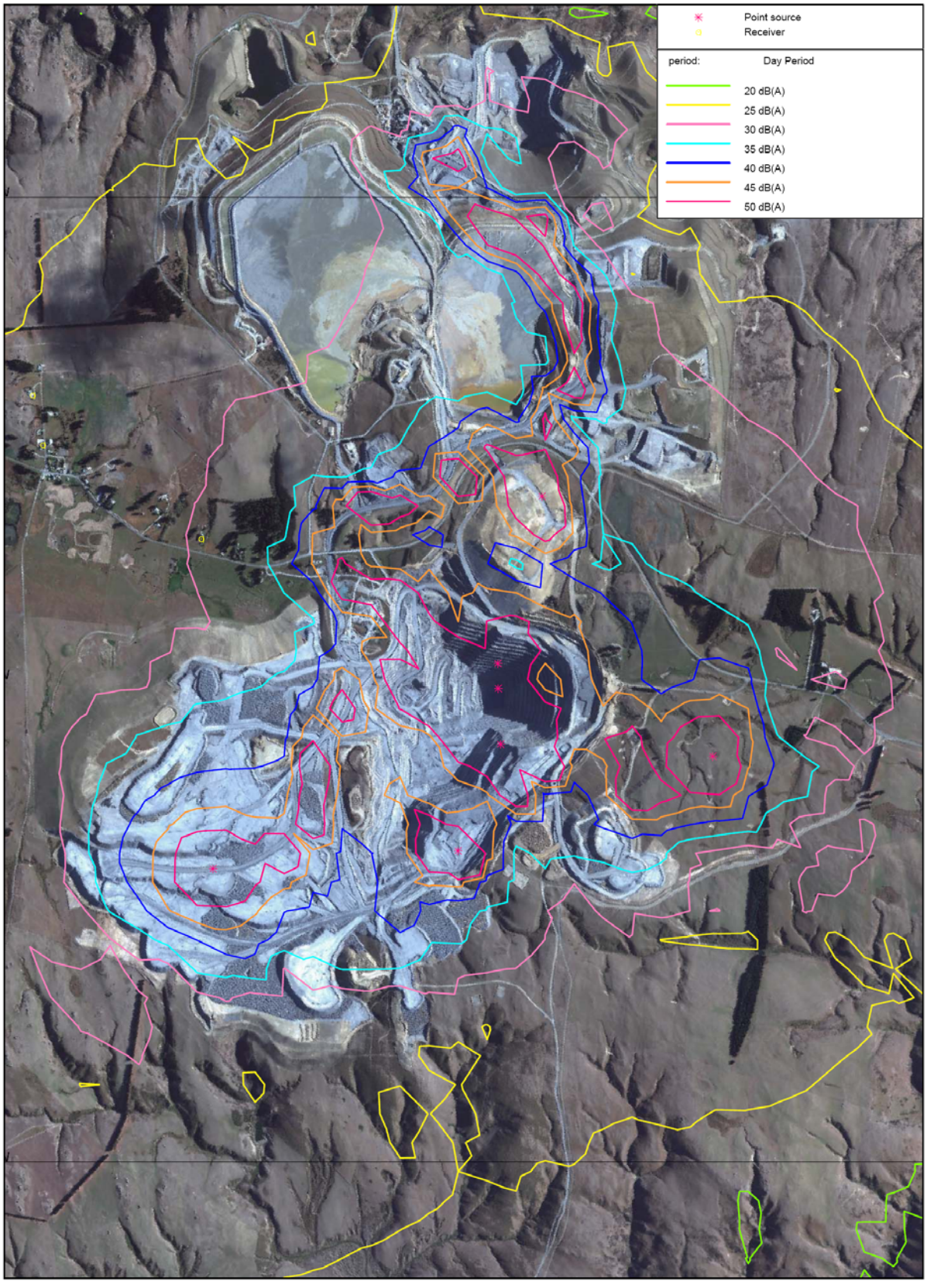
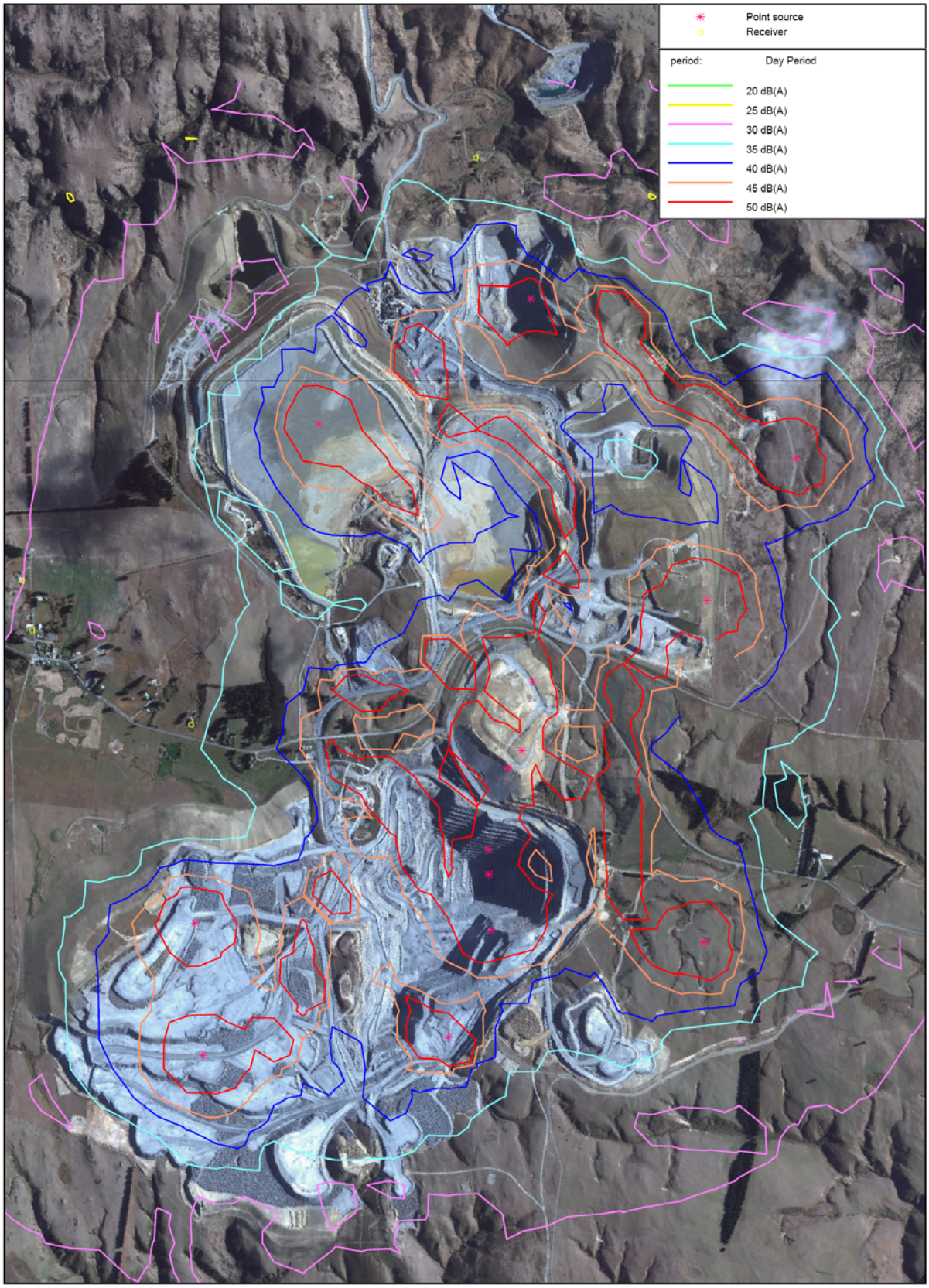


Figure 14. Noise Contours for Frasers Pit Stage 5



Industrial noise - ISO 9613.1/2, [Macreas Mine - Round Hill Stage 1 & 2] , Predictor V7.02

Figure 15. Noise Contours for Round Hill Stages 1 & 2

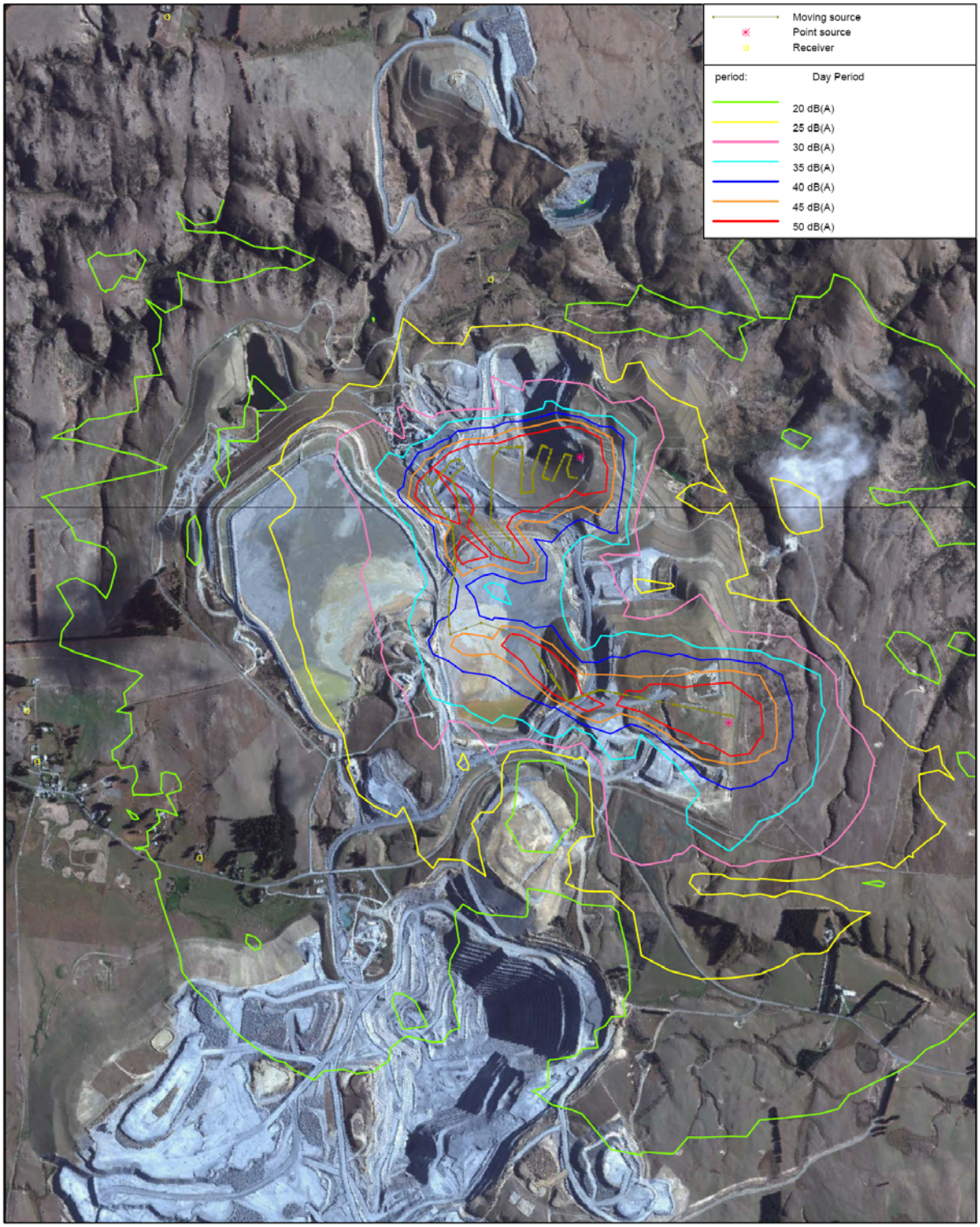


Figure 16. Noise Contours for Round Hill Stage 3

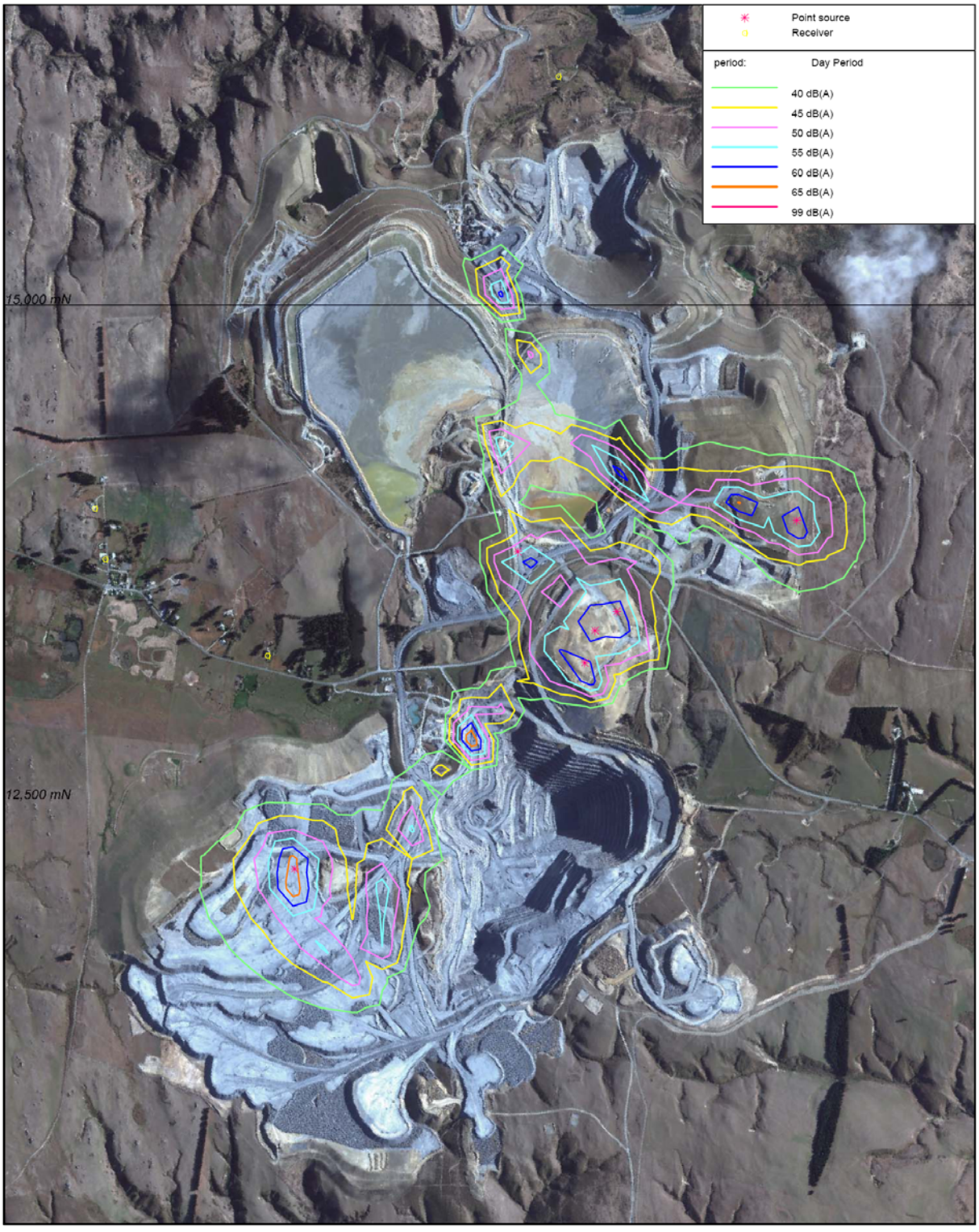
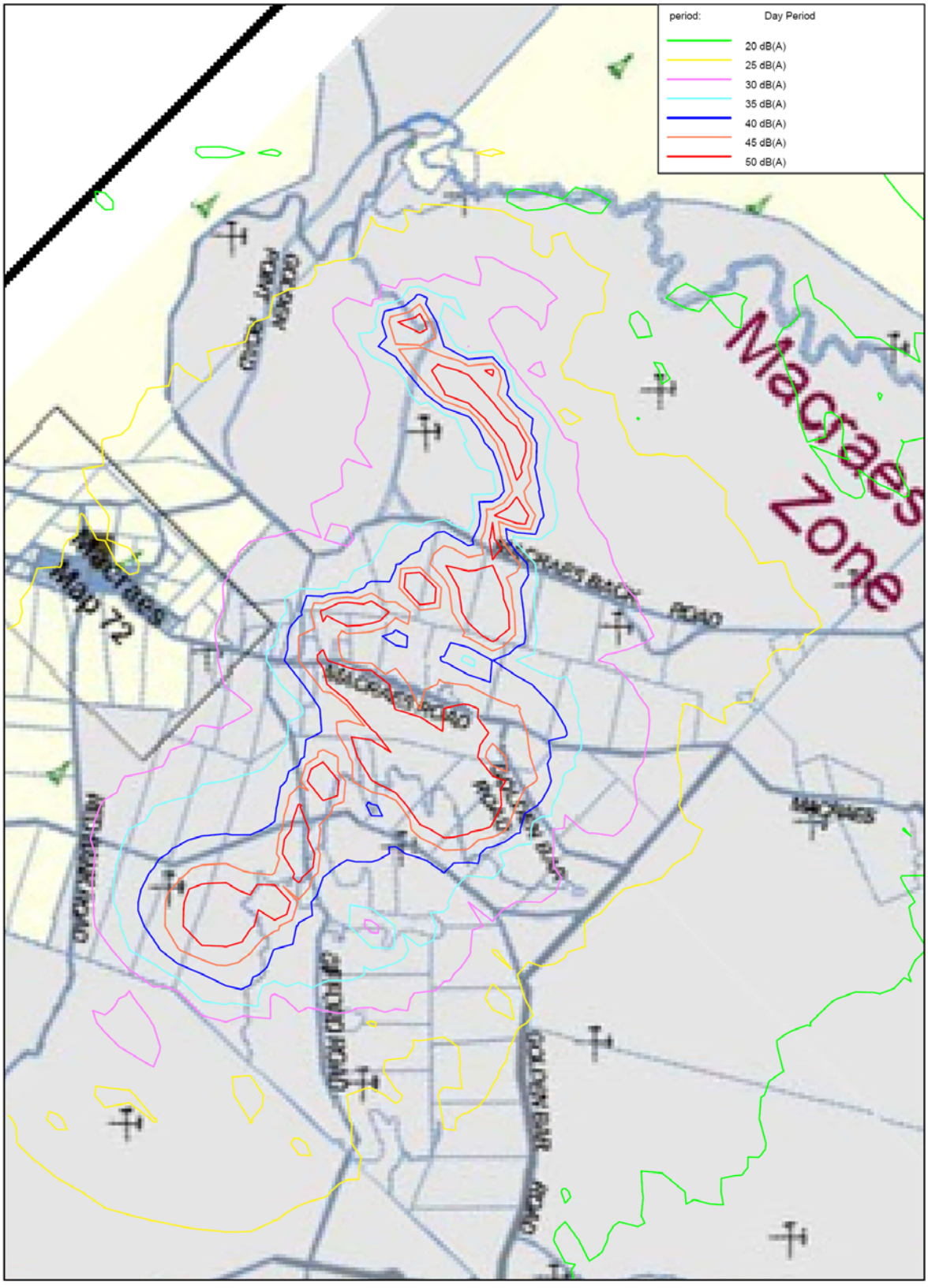


Figure 17. Noise Contours for Innes Mills Pit



Industrial noise - ISO 9613.1/2, [Macreas Mine - Frasers Stage 4] , Predictor V7.02

Figure 18. Noise Contours for Frasers Pit Stage 4

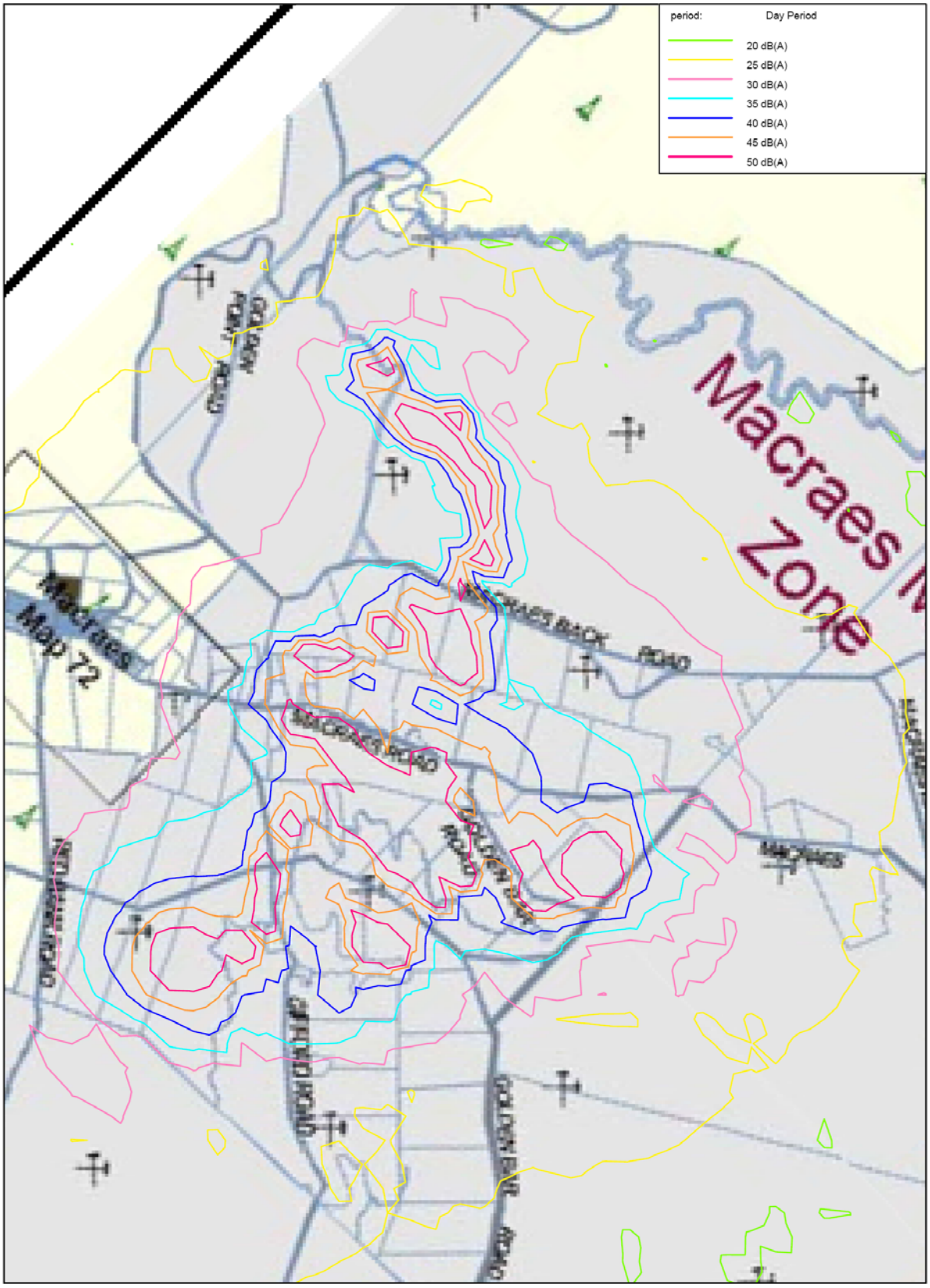


Figure 19. Noise Contours for Frasers Pit Stage 5

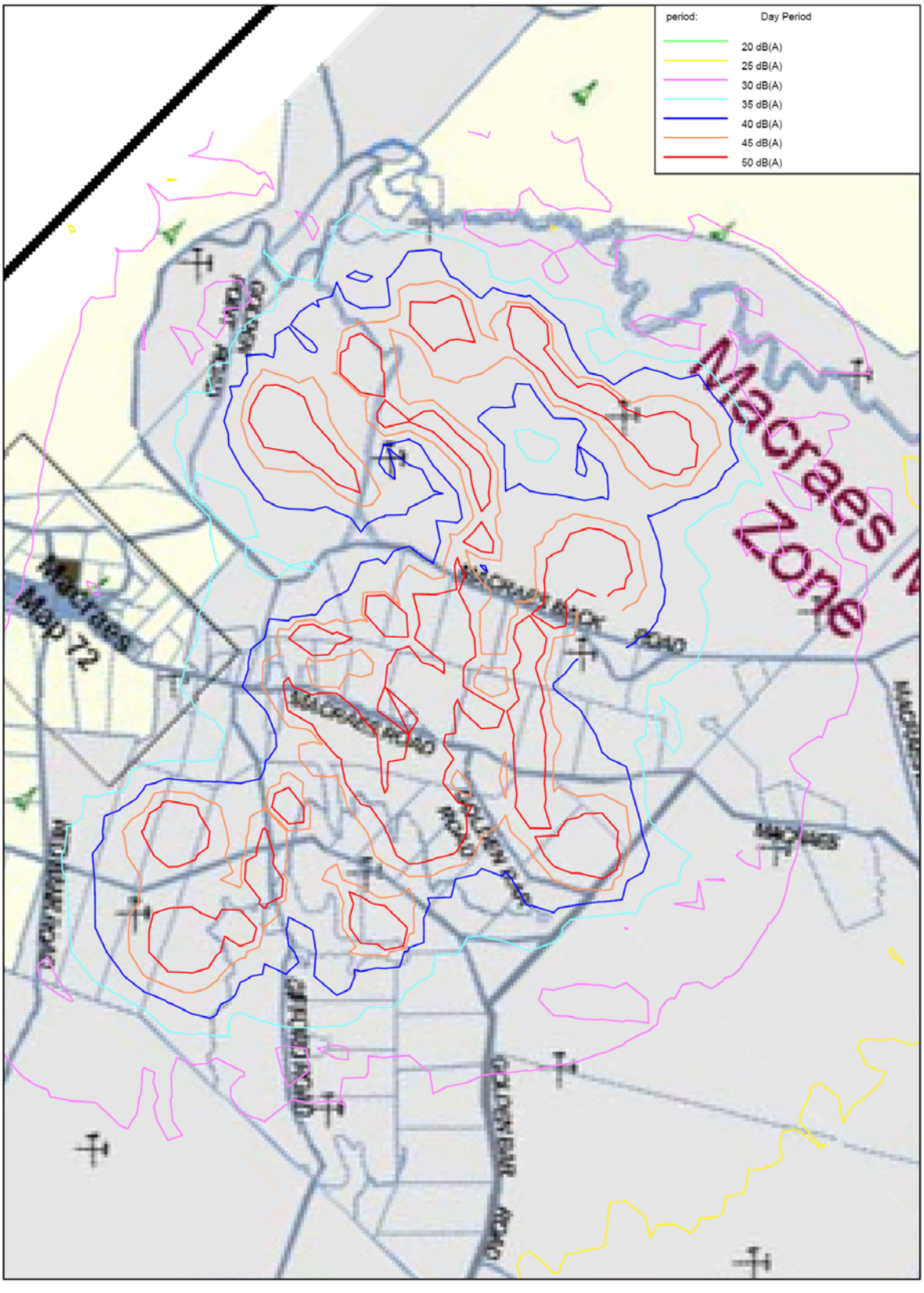


Figure 20. Noise Contours for Round Hill Stages 1 & 2

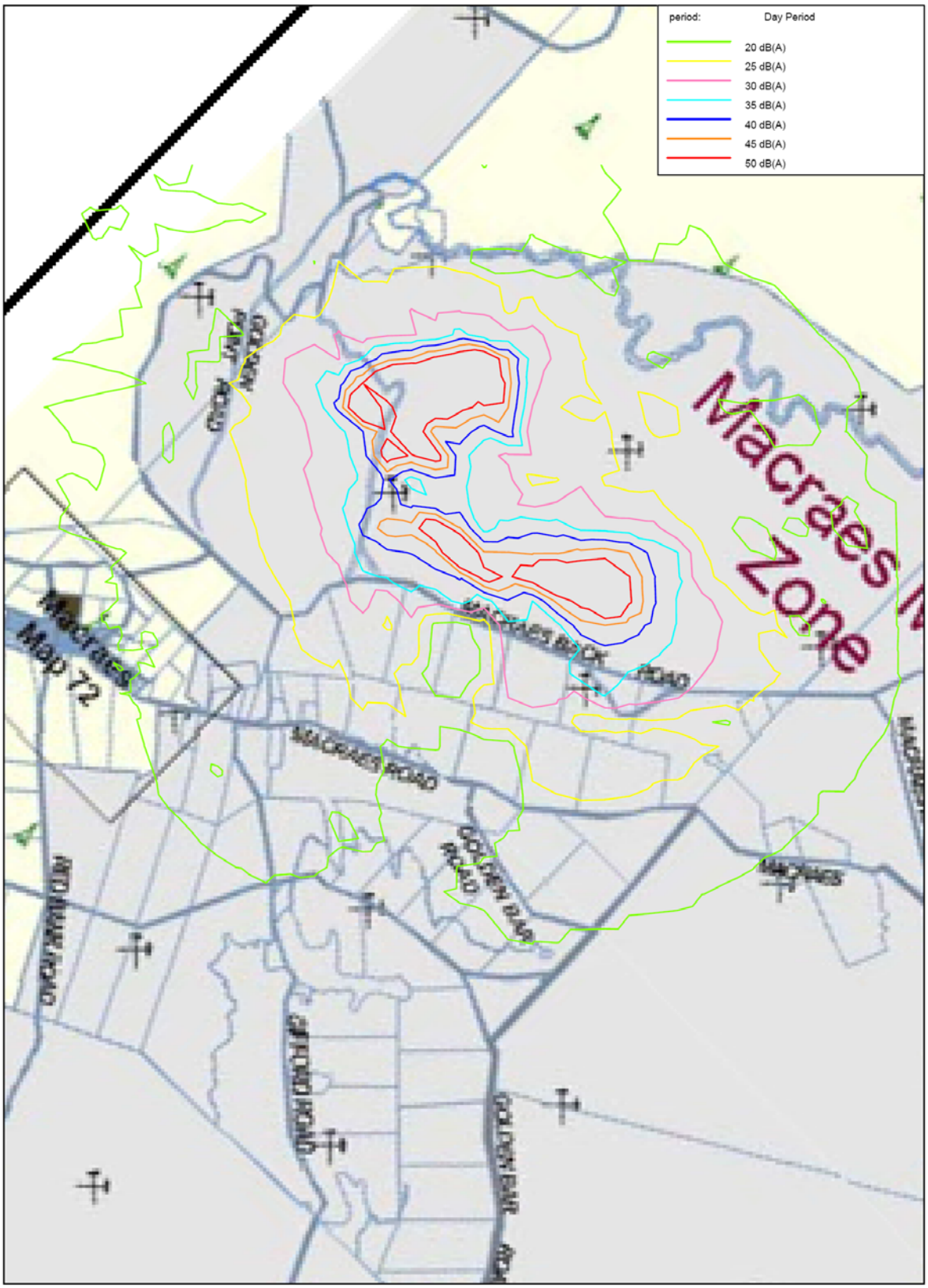


Figure 21. Noise Contours for Round Hill Stage 3

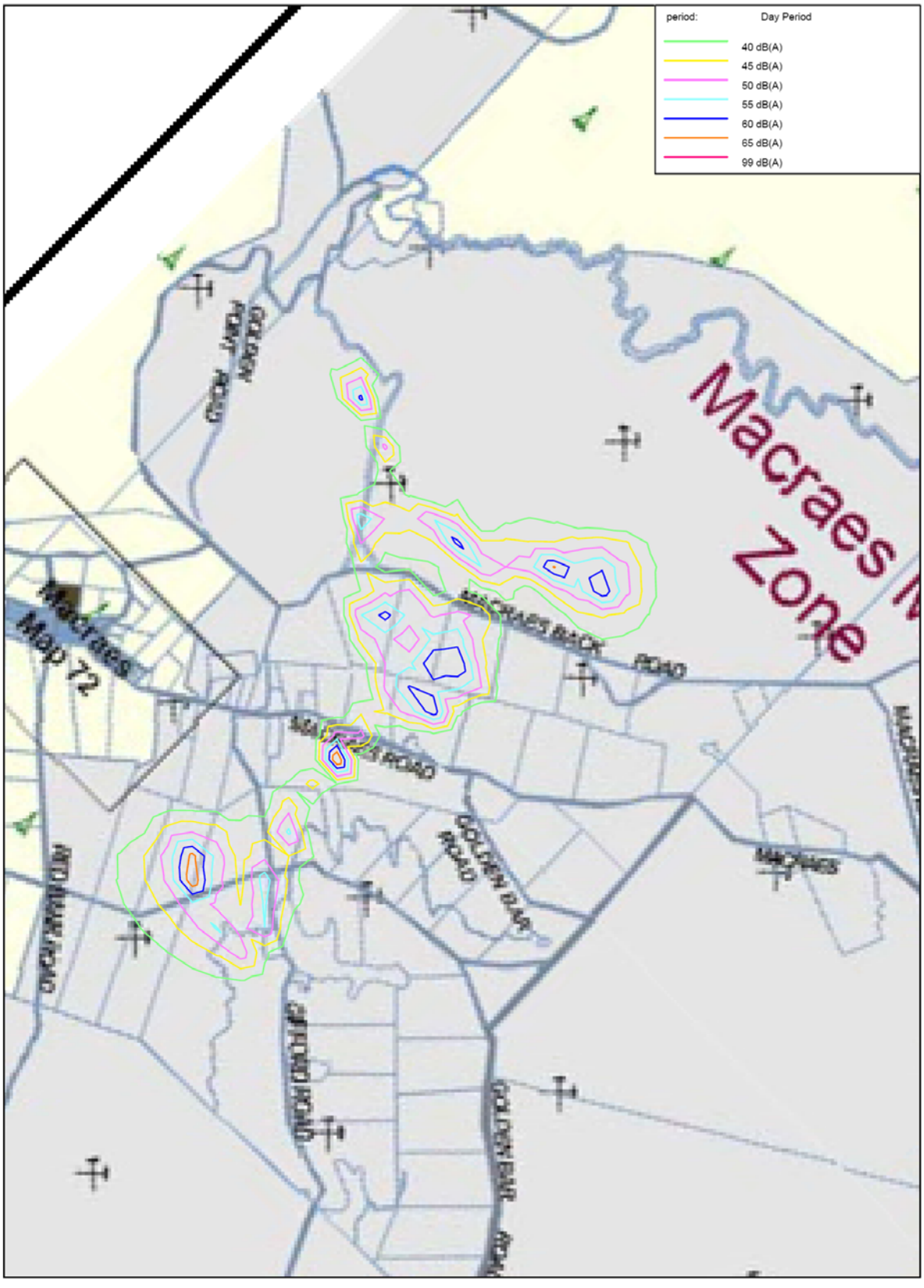


Figure 22. Noise Contours for Innes Mills Pit

6 CONCLUSIONS

Noise from the proposed extension of the consented life of the Macraes Gold Project has been predicted for five stages of the extension based on field measurements of the plant to be used during the mining.

During busy mining periods of each stage, the noise level at all of the closer houses will remain well within the mine consent conditions by a minimum of 5dBA L_{10} at:

- the boundary of the Township Zone of Macraes;
- the notional boundary of any dwelling in the Rural Scenic Zone where no written consent has been given.

As a guide, a reduction of 5dBA is a clearly noticeable reduction to the noise level.

In addition, the noise at the boundary of the Macraes Mining Mineral Zone has been considered in terms of the District Plan. As with the consent conditions, the District Plan requirements will be complied with, by a minimum of 7dBA.

As the same activities occur during the daytime as adopted in the above analysis, compliance with the night time noise criteria will ensure the daytime levels are complied with by a minimum of a 15dBA L_{10} factor of safety.

Although the existing noise environment is relatively low around the Macraes Township the predicted noise level is also low. Thus, while the mining may be heard in calm weather conditions and with wind speeds up to 1 – 2m/s even under these conditions there will be little to no noise impact for the neighbours. For the majority of the time with winds above approximately 3m/s mine noise will be below the existing noise environment.

Based on the above, and in terms of the requirements of the Resource Management Act, the noise effects of the proposed mine extension will be no more than minor.

* * *

APPENDIX A
Guide to Noise Terms

The following sets out an explanation of the acoustic terms that will be referred to throughout this report. The aim is not to necessarily provide technical definitions, but to enable a basic understanding of what is meant.

The setting of specific noise levels to control any adverse effects does not necessarily mean that noise will not be heard. Audibility depends on the level of a sound, the loudness of the background sound and any special frequency composition or characteristics that a sound may have.

Research suggests that a small number of people (approximately 10%) will find any noise not of their own making unacceptable. Conversely, there are approximately 25% of the population that are essentially immune to any noise. Neither of these two extremes is normally designed for. In establishing the appropriate noise levels the aim is to try and represent the typical expected community reaction, this will generally be approximately 90% of the people.

In order to reflect community response to noise it is necessary to establish a measure that reflects our attitude to the sounds that we hear. Due to the variability of many sounds (level, tone, duration, intrusiveness above the existing sound, etc) no single descriptor will totally describe the potential community reaction to a sound. For this reason there are a number of terms that need to be understood.

dBA

The basic unit to quantify a sound is the decibel. The A-weighted sound level, or dBA, is a good environmental noise descriptor because of the similarity between A-weighting and the frequency response of the human ear at moderate sound levels. It can also be measured easily. However, it provides no indication of tonal frequency components or unusual frequency distributions of sound that may be the cause of annoyance. Where appropriate, this must be assessed separately.

We can hear a change in sound pressure that varies from 1 (taken as the threshold of hearing) through to 1,000,000,000,000 (taken as the threshold of pain). In order to bring these numbers to a more manageable size a logarithmic scale is normally adopted. This reduces the above values to 0 and 12 respectively. The decibel is then described as 10 times the logarithm of the ratio of the pressure level of interest, to a reference pressure level. Thus the scale becomes 0 to 120dBA.

Some typical subjective changes in noise levels are:

A change of 3dBA is just perceptible
A change of 5dBA is clearly perceptible
A change of 10dBA is twice (or half) as loud

Because we use a logarithmic scale care must be taken when adding sound levels. Two equal noise sources raise the level of one source by 3dBA. It takes 10 equal noise sources to raise the level of one source by 10dBA. ie 60dBA + 60dBA = 63dBA and 60dBA x 10 = 70dBA.

Maximum Sound Level (L_{max})

This unit equates to the highest (maximum) sound level for a defined measurement period. It is adopted in NZS6802:1991 Assessment of Environmental Sound, mainly as a method of protecting sleep.

L_{10}

The sound level which is equaled or exceeded for 10% of the measurement time. This level is adopted in NZS6802:1991 Assessment of Environmental Sound to measure intrusive sound. This level may be considered as the average maximum sound level.

Background Sound L_{95}

The sound level which is equaled or exceeded for 95% of the measurement time. This level is adopted in NZS6802:1991 Assessment of Environmental Sound to measure the background sound. This level may be considered as the average

minimum sound level and is the component of sound that subjectively is perceived as continuously present.

Equivalent Sound Level (L_{eq})

The L_{eq} may be considered as the continuous steady noise level that would have the same total A-weighted acoustic energy as a fluctuating noise over the same time period.

Day Night Level, L_{dn}

The day/night level (L_{dn}) is defined as the time-average sound level in decibels (re 20μPa) over a 24 hour period from midnight to midnight) with the addition of 10dB to nighttime levels during the period from midnight to 07.00 hours and from 22.00 hours to midnight, to take account of the increased annoyance caused by noise at night.

Ambient Sound

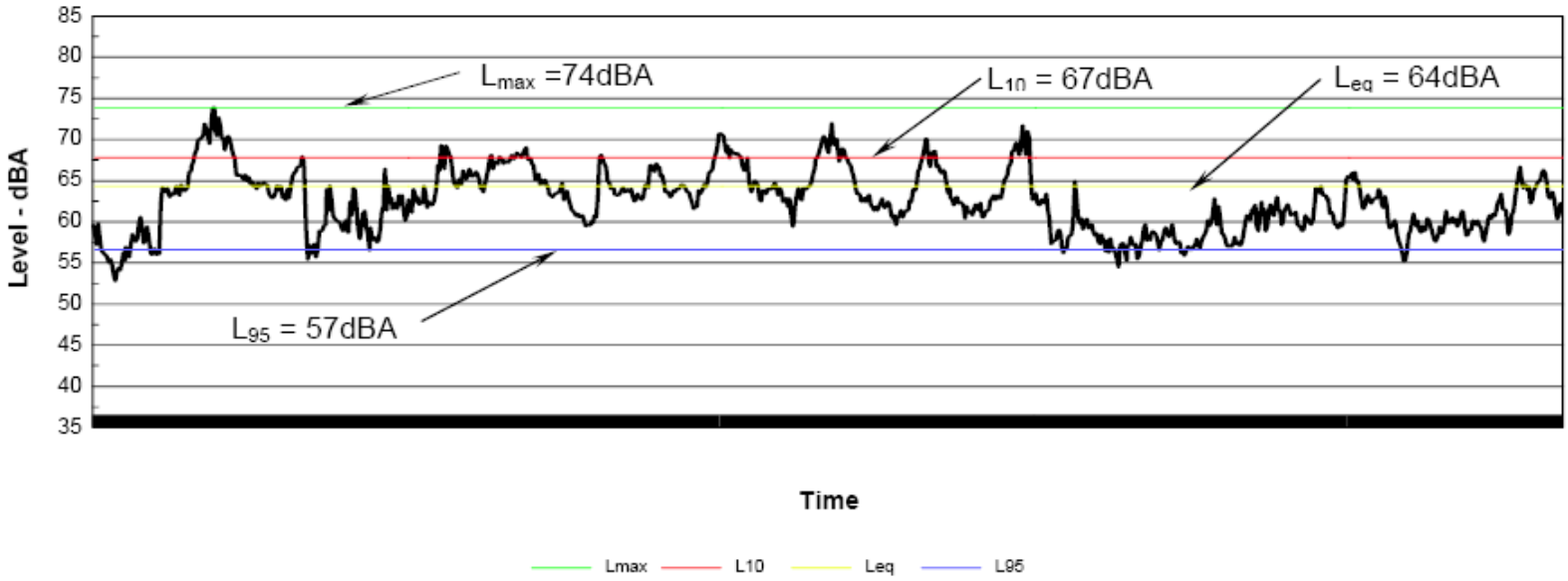
The ambient sound is normally used to describe the total noise environment. The ambient sound is often measured as the 24 hour $L_{eq,}$ which is an average value over the 24 hour period. Shorter times are often used, such as the daytime period

Notional Boundary

The notional boundary is defined as a line 20 metres from the facade of any rural dwelling or the legal boundary where this is closer to the dwelling.

Figure A1 shows a noise trace with the relationship of L_{max}, L_{10}, L_{95} and L_{eq} values when including all events over the 15 minute measurement period and Figure A2 some typical noise levels.

* * *



L_{max} is the maximum noise level
L_{10} is the noise level that is equaled or exceeded for 10% of the measurement period
L_{95} is the noise level that is equaled or exceeded for 95% of the measurement period
L_{eq} is the noise level that contains the same energy as the time varying noise

Figure A1

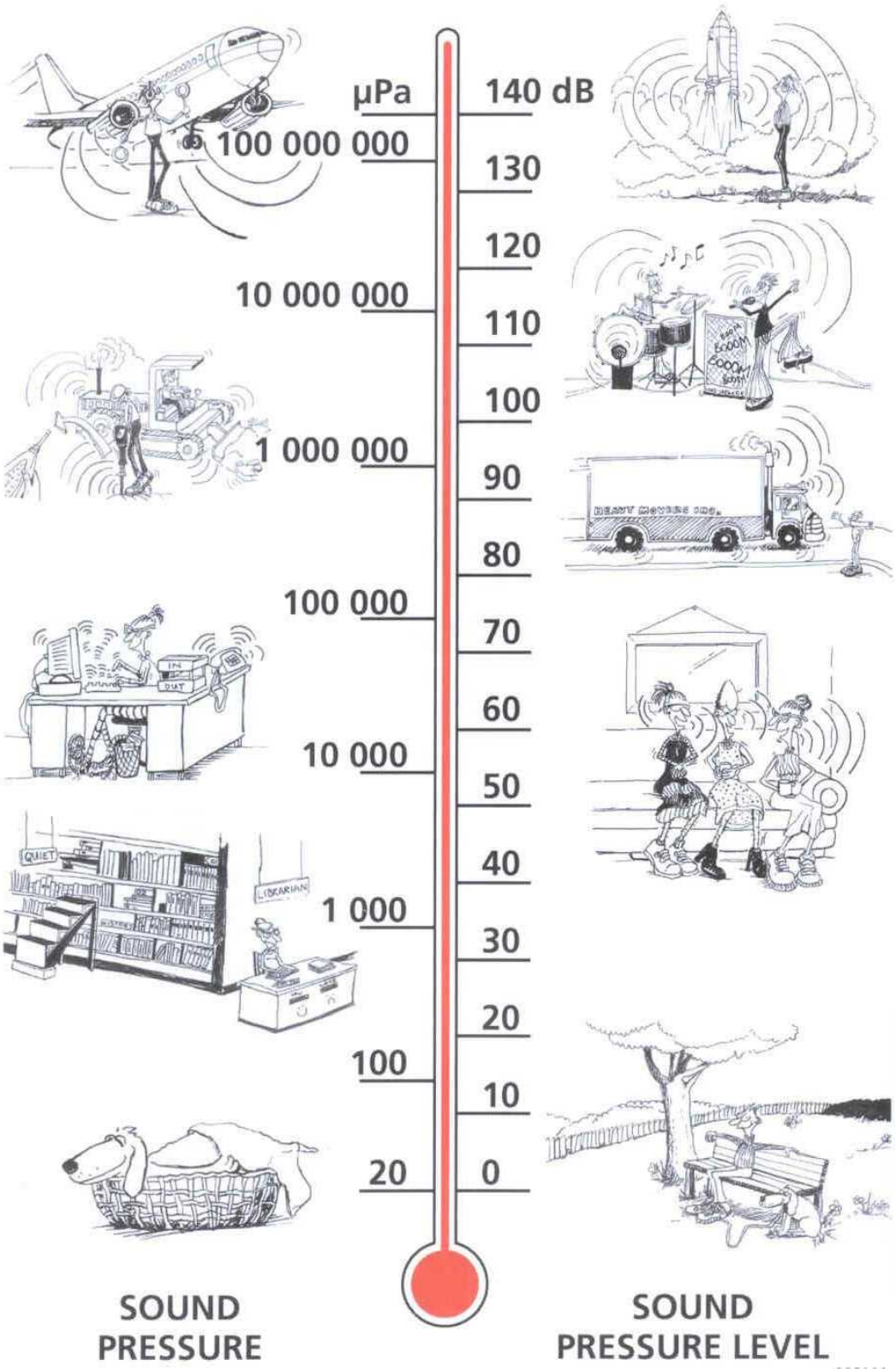

μPa
140 dB
100 000 000
130
120
10 000 000
110
100
1 000 000
90
80
100 000
70
60
10 000
50
40
1 000
30
20
100
10
20
0
QUIET
LIBRARIAN
SOUND PRESSURE
SOUND PRESSURE LEVEL

Figure A2