

Bundu Mining (Pty) Ltd

Impact Statement on Poultry Farms

PREPARED FOR: UMHLABA ENVIRONMENTAL CONSULTING CC

DATE: 24 February 2024

Compiled by:

Dr Nicolaas J van Niekerk, BVSc, SAVC: D23/15946

Reviewed by:

Dr Christopher C Henderson, BVSc, SAVC: D83/1851

Dr Neil M Duncan, BVSc (Hons), M Med Vet (Aves), Diplomat: American College of Veterinary Pathologists, SAVC: 95/78

Dr Vinoliah Makuwa, BVSc, SAVC: D22/14488

Table of Contents

Declaration of independence	3
Study team qualifications and background	4
Legal requirements	4
Background	4
Distances from the mine	6
Methodology	6
Areas of concern	7
Noise (air blast)	7
Vibration	11
Air quality	13
Mitigation	14
Executive summary	15
References	16
Document preparation and review	18

DECLARATION OF INDEPENDENCE

I, Dr Nicolaas J van Niekerk, Dr Christopher C Henderson, Dr Neil M Duncan and Dr Vinoliah Makuwa declare that:

We act as independent specialists in this application to UMHLABA ENVIRONMENTAL CONSULTING CC.

We performed the work in an objective manner.

We declare that there were no circumstances that may compromise our objectivity in performing such work.

We have no vested financial, personal, or any other interest in the application.

We have no, and will not engage in, conflicting interests in the undertaking of the activity.

All the particulars furnished by us in this form are true and correct.



Dr Nicolaas J van Niekerk (BVSc)
SAVC Reg No: D23/15946
SAVC Facility Reg No: FR15/13809



Dr. Chris Henderson BVSc
South African Veterinary Council Reg: D83/1851
Cell: 083 659 3603, E-mail: chris@c4africa.net
Practice Registration number: FR15/13809



Dr N M Duncan
BVSc (Hons), M Med Vet (Aves)
Diplomate: American College of Veterinary Pathologists
SAVC 95/78



Dr Vinoliah Makuwa (BVSc)
SAVC: D22/14488
SAVC Facility Reg No: FR15/13809

Study Team Qualifications and Background

The study team comprises Dr Nicolaas J van Niekerk, Dr Christopher C Henderson, Dr Neil M Duncan, and Dr Vinolia Makuwa of C4Africa Professional Consultants.

C4 Africa and its predecessor Irene Poultry Consultancy have been providing Veterinary services to the poultry industry for over 30 years, covering the fields of broiler breeder, broiler, layer, pullet, and hatchery.

Routine poultry consultancy is provided to clients in South Africa, Lesotho, Mozambique, Botswana, Swaziland (Eswatini), Namibia, Zimbabwe, Malawi, Zambia, and Mauritius, with requests for assistance from as far afield as Egypt, the UAE, Burundi, Ethiopia, Mali, Rwanda, Ghana, Gabon, Burkina Faso, Uganda, Kuwait, Angola and the DRC.

Legal Requirements

None

Background

Mining operation

Bundu Mining (Pty) Ltd (Bundu) wishes to restart operations at an old aggregate quarry west of Pretoria. The area is located approximately 11km east of Hartbeespoort and approximately 15km west of Pretoria West. The study area is located south of the R514 road and includes sections of the northern slopes of the Witwatersberg Mountain.

The proposed operation will include the drilling and blasting of competent material from within the mining right area that will then be transported to a processing plant. The aim is to start mining the existing pit and then slowly expand in a westerly direction (towards the poultry farm – Jura Poultry) at a rate of 20000tpm. Blasting will probably occur twice a month, perhaps more frequently in the beginning to open up the old pit.

The mining right will produce plaster sand, river sand, building sand, and aggregates of varying sizes.

Poultry farming

The poultry industry consists of five main sectors namely breeders (broiler breeders and layer breeders), broilers (meat), commercial layers (table eggs), POL (point of lay) hens produced on pullet rearing farms, and hatcheries (where

eggs from breeder farms get incubated for 21 days so that the developing embryo can hatch – to produce day old chicks).

These sectors are all farmed intensively to get maximum production. As with any intensive animal production system, the animals (in this case chickens) are already under stress to a certain degree. To minimize stress and maximize production, the chickens must have optimal feed, water, and environment.

Making this evaluation challenging is the fact that little to no scientific data is available on the various effects of a Mining operation on the different poultry farming sectors. Studies done on several animal species and farming systems will have to be taken into consideration.

The poultry farm closest to the mining operation is Jura Poultry, 119m from the boundary of the mining right area. Blasting and mining would start at the existing pit which is 1100m from the closest point of the poultry farm progressing in a westerly direction (towards Jura Poultry) and would get to about 900m after 10 years. Jura Poultry seems to be a breeder farm (probably broiler breeders) as nest boxes were noticed inside the poultry houses and a worker stated the breed of the chickens to be Ross 308. Nine (9) poultry houses seem to be on the farm (via Google Maps), however, no details regarding age, production, capacity, etc are known.

Other possible poultry operations are about 2500 - 3000m to the east. The writer has not seen or been to these operations. The type of poultry farming is important because their targets and management are completely different. One sector deals with adult (20 – 65 week old) chickens where behavior (mating) and egg production are important, another deals with day-old chicks that need maximum growth in 32 days before they get slaughtered, and the next deals with hens needing to produce maximum good quality eggs for human consumption, and lastly rearing farms where feed consumption and growth rates are crucial to producing a good quality point of lay (POL).

Grey Parrot Breeding Facility

A site visit to this facility was not conducted. The facility appears to be 1km east of the application area.

Due to the apparent lack of studies on the impact of impulse noise on caged exotic birds, we have to deduce potential impact scenarios from relevant literature.

Distances from the mine:

Jura Poultry: 119m from the mining right area.

Jura Poultry: 1100m from the existing mining pit where blasting will begin.

After ten (10) years:

It is estimated that the mining pit and blasting would be 900m from Jura Poultry.

CITES registered Grey Parrot Breeding facility: 1km east of the application area.

Other possible poultry operations: 2500 – 3000m to the east (no information, broilers, breeders, layers, capacity, etc?).

Methodology:

To assist in this evaluation a site visit was carried out on the 31st of January 2024. The Blast Impact Assessment (including ground vibrations, air blast, fly rock, and noxious fumes) was consulted. The available scientific literature was reviewed and colleagues were approached (C4 Africa) for their input and discussions on various aspects of the effects on poultry from the operation.

The main concerns raised with the restarting of the mining operations are the negative effects of noise (air blast), ground vibration, and air quality.

The ambient noise, vibration, airblast, and air quality levels in the area need to be determined. The effect of the mining operation on these parameters will be identified and evaluated and after taking suggested mitigating effects into consideration, an executive summary will be formulated.

Areas of concern:

- Noise (air blast)
- Vibration
- Air quality

Noise (air blast)

Noise is a type of sound and is defined as unwanted, annoying, unpleasant, or loud.

Air Blast (dB) is the calculated air blast level at a specific distance from the blast.

“Possible concerns” indicates if there is any concern for structural damage or human perception. The indicators used are:

- **“Problematic”** where there is a real concern for possible damage – at levels greater than 134 dB.
- **“Complaint”** where people will be complaining due to the experienced effect on structures at levels of 120 dB and higher (not necessarily damaging).
- **“Acceptable”** if levels are less than 120 dB.
- **“Low”** where there is a very limited possibility that the levels will give rise to any influence on people or structures. Levels below 115 dB could be considered to have low or negligible possibilities of influence.

There are four (4) types of noise

1. Continuous noise.
2. Intermittent noise: noise level that increases and decreases rapidly eg train passing by.
3. Impulsive noise: sudden bursts of noise e.g. explosions.
4. Low-frequency noise.

Different sources of noise associated with mining:

- a) Short duration – Blasting
- b) Longer duration, repetitive – Construction phase: machinery and equipment.
- c) Long duration, repetitive – Operational phase: machinery and equipment

Air Blast predicted values (dB), page 56.

No.	Distance (m)	Air blast (dB) for 56 kg Charge	Air blast (dB) for 446 kg Charge
1	50.0	143.7	149.5
2	100.0	140.2	146.1
3	150.0	134.4	140.2
4	200.0	132.0	137.8
5	250.0	130.1	135.9
6	300.0	128.6	134.4
7	400.0	126.1	132.0
8	500.0	124.3	130.1
9	600.0	122.7	128.6
10	700.0	121.5	127.3
11	800.0	120.3	126.1
12	900.0	119.3	125.2
13	1000.0	118.4	124.3
14	1250.0	116.6	122.4
15	1500.0	115.1	120.9
16	1750.0	113.8	119.6
17	2000.0	112.6	118.4
18	2500.0	110.7	116.5
19	3000.0	109.2	115.1
20	3500.0	107.9	113.8

Blast Management & Consulting, 2023

Short duration:

The table above indicates that air blast (dB) will be initially +/- 117.5 dB and +/- 123.5 dB at 1100m from the poultry farm (Jura Poultry), respectively for a 56kg charge and for a 446kg charge.

With time, mining and blasting will expand toward to west (towards the poultry farm) and would come to about 900m from the poultry farm in ten (10) years. Air blast would be 119.3 dB and 125.2 dB respectively for a 56kg charge and for a 446kg charge.

For the first +/-10 years, noise levels will be “acceptable” (<120 dB) for a minimum charge of 56kg when the distance of the blasting is more than 900m from the poultry farm.

After +/-10 years, >120 dB will be experienced on the poultry farm and it will fall in the range of “complaint” with a 56kg charge.

Air blast (dB) will fall in the range of “complaint” if blasting is done with a 446kg charge from the beginning of the operation (123.5 dB).

Increased noise of longer duration, which may be repetitive:

Using machinery and equipment on a mining site / processing area will result in an increase in ambient noise.

These changes in Noise (dB) caused by machinery and equipment will be smaller compared to blasting, however, it will be more continuous and on a daily basis.

An Environmental Noise Impact Assessment is recommended once the operation is underway, to determine noise generated by various types of equipment used at the mine.

Noise levels on poultry and poultry production:

Thunderstorms, accompanied by claps of thunder, have not been known to cause death in poultry, even though they produce noise at a level of 120 dB (personal observations).

The noise intensity to which poultry is exposed during production life is relatively high, varying in the range of 80 – 90 dB (Brouček, 2014).

Mechanical equipment within the chicken house can generate noise, with ventilation fans producing 73 dB and chain feeders 92 dB (Brouček, 2014; Oh et al., 2011).

Repeated longer periods of noise of 80 – 115 dB had no effect on the growth of birds or their weights in a broiler study (Stadelman, 1958).

Noise up to 90 dB did not affect the productivity and egg quality of laying hens (Oh et al., 2011).

Continual noise levels that pass the 85 dB level have been reported to cause a decreased feed intake of between 15-25%, stunting the growth of the chicken (Poultry World, Oct. 2016).

The proximity to a busy road (75 dB – 80 dB) had no effect on the production of broiler breeder farm (Personal communication, Dr S Wisdom, St David's Poultry team).

(Stadelman, 1958) investigated the effects of sounds of varying intensities on the hatchability of chicken eggs. He found that 11 out of 12 hens exposed to sound intensities of about 115 dB discontinued brooding within 2 hours.

(Stadelman, 1958) also found that daily exposure of chicken eggs in incubators to sound intensities up to 96 dB and 131 dB – using recordings of “back-ground airfield noises, propeller-driven aircraft low-level flight, or jet planes in low-level flight under full power” – had no measurable effect on the hatchability or quality of the chicks produced.

Conclusion:

Loud noise of short duration, to a level of 120 dB, does not negatively affect broilers. Louder noises of greater than 120 dB will result in complaints.

There does not appear to be negative effects on broiler and layer performance with continuous load noise levels of 73 – 80 dB (ventilation fans, busy roads) or repetitive loud noise of longer duration measured with chain feeders in a poultry house at 92 dB.

It would appear that birds, after showing signs of stress, habituate to the noise and return to their normal behavior (Chloupek et al., 2009).

The anatomy of the chicken lung also influences the possible negative effects air blasts may have. The avian lung does not have alveoli, i.e. the airways do not end in a blind-ending sack where oxygen transfer to the blood occurs. Birds draw air through the lungs and into large thin-walled cavities called air sacks. When they exhale, the air is pushed through the lung tissue again and oxygen transfer then occurs. Looking at the negative effect of air blast, i.e. that of lung injury with rupture of the alveoli accompanied by hemorrhage – without blind ending alveoli the lung tissue will not be damaged.

The greatest concern with the blasting noise is the effect on bird behavior – affecting breeding / mating, brooding, and subsequently fertile / infertile eggs produced. Given the infrequent blastings (approximately twice per month) and its short duration, this effect should be minimal, if not negated entirely.

Vibration

Ground vibration is experienced at different levels, human tolerance @ 30Hz:

- **“Perceptible”** and acceptable : 0.8mm/s – 6mm/s
- **“Unpleasant”** but acceptable : 6mm/s – 12.5mm/s
- **“Intolerable”** and problematic : >12.5mm/s
- Humans are sensitive to ground vibrations and perceive vibration levels of 0.8mm/s

Expected ground vibration at various distances from charges applied, page 54.

No.	Distance (m)	Expected PPV (mm/s) for 56 kg Charge	Expected PPV (mm/s) for 446 kg Charge
1	50.0	49.8	275.7
2	100.0	25.5	141.2
3	150.0	8.1	45.0
4	200.0	5.1	28.0
5	250.0	3.5	19.4
6	300.0	2.6	14.3
7	400.0	1.6	8.9
8	500.0	1.1	6.2
9	600.0	0.8	4.6
10	700.0	0.6	3.5
11	800.0	0.5	2.8
12	900.0	0.4	2.3
13	1000.0	0.4	2.0
14	1250.0	0.2	1.4
15	1500.0	0.2	1.0
16	1750.0	0.1	0.8
17	2000.0	0.1	0.6
18	2500.0	0.1	0.4
19	3000.0	0.1	0.3
20	3500.0	0.0	0.2

Blast Management & Consulting, 2023

At 1100m away from the pit, the poultry farm will experience ground vibrations of 0.3mm/s and 1.7mm/s respectively for a 56kg charge and a 446kg charge. At minimum charge it will be too low to be perceived and at maximum it will be perceptible and acceptable.

After ten (10) years of mining and being at 900m from the poultry farm, ground vibrations will be at 0.4mm/s and 2.3mm/s respectively for a 56kg charge and a 446kg charge. At minimum charge it will be too low to be perceived and at maximum charge it will be perceptible and acceptable.

Most of the vibration studies done on vibration in broilers are related to transportation stress on the way to slaughter and its effects on meat quality (Brouček, 2014), but its effects on broiler production have not been researched.

Studies regarding ground vibration on breeder farm performance have not been found.

In the case of layers, vibrations greater than 10mm/s did have a negative effect on egg production (Oh et al., 2011).

Conclusion

At 900m away from the pit, the vibration produced by the minimum (56kg) and maximum (446kg) charges is well below the level of 10mm/s, reported in the literature, above which production issues in layers were observed.

While there is no data on broiler and breeder performance, with the levels well below 10mm/s, a negative effect is unlikely.

Air quality

Air quality for birds is no different than that for humans. They need clean, fresh air for optimal production.

Dustfall and other pollutants should be monitored once production starts and compared to the required recommended acceptable levels.

Increased dust will decrease the air quality. Poor air quality affects the respiratory tract of the birds, damaging the cilia in the trachea, with this being the most common entry point for secondary bacterial infections. Hence good air quality is crucial for a healthy flock and optimal production.

Breeders are long-lived birds, meaning they reach 60 – 70 weeks of age. Thus chronic exposure to low levels of pollutants becomes additive.

Conclusion

The proposed mining activity is not operational as of yet, therefore no baseline air quality parameters can be used to measure possible effects on the health and production of the birds. It is advised and recommended that air quality assessments are conducted frequently once the operation commences.

The results should be below the health criteria standards for ambient air quality.

Mitigation

- Mitigations would be to limit blasting as much as possible.
- Especially during the breeding season of the birds (Grey Parrot).
- Deploy noise suppression features (plants) around the bird enclosure (Grey Parrot breeding facility).
- Mitigation interventions have been proposed regarding blasting to reduce air blast and ground vibrations. They are set out in detail in the respective assessment document (Blast Management & Consulting, 2023).
- It is advised and recommended that air quality assessments are conducted once the operation commences.
- The results should be below the health criteria standards for ambient air quality.
- Dustfall and other pollutants should be monitored once production starts and compared to the required recommended acceptable levels.
- Continuous monitoring once operational is recommended at the poultry farms and these values should be below recommended acceptable levels.
 - Noise (air blast)
 - Ground vibration
 - Air quality

Executive Summary

One site visit has been conducted at the proposed mining operation. Primarily we were concerned with the poultry operation (Jura poultry) being 119m from the mining right area. The grey parrot breeding facility has not been inspected nor other farms in the area.

The areas of concern are noise (air blasts), ground vibration, and air quality. These effects from blasting at the Bundu Mining operation suggest that there is a potential for a negative impact on the caged birds / poultry, however, the nature of this impact is unclear. Interference with breeding / mating, infertile eggs, reluctance to lay eggs during blasting, or neglected eggs / chicks are worst-case scenarios.

Monitoring and farm visitation during blasting must be done to evaluate the effect on the birds due to the paucity of information in these fields and the lack of studies on impulse noise, air blast, and ground vibration on poultry / caged birds.

It is recommended that the management of the mining operation works closely together with the community (especially the poultry farmers and grey parrot breeders). Dates, times, and frequency of blasting should be communicated to the respective farmers in the area.

A complimentary strategy would be for the mining management and the poultry farmers / grey parrot breeders to work together on a research project addressing the current knowledge gap with regard to the impact of impulse noise, ground vibration, air blast, and air quality on these chickens / birds' behavior, breeding, production, etc.

The proposed mining activity is not operational as of yet, therefore no baseline air quality parameters can be used to measure possible effects on the health and production of the birds. It is advised and recommended that Air Quality -, and Environmental Noise Impact assessments (continuous loud noise) are conducted frequently once the operation commences. Also, continuous monitoring of air blasts (dB) and ground vibrations (mm/s) is recommended at the POI.

Having to use various data sources and due to the paucity and sometimes conflicting research results from projects carried out on poultry, we cannot say for certain that the mitigation recommendations will negate all the possible negative effects on poultry. Should there be negative effects on performance, then pre-performance data must be used to establish the financial losses on production due to the mining operations.

References

1. Brewer, W.E., 1974. Effects of Noise Pollution on Animal Behavior. *Clinical toxicology*, 7(2), pp.179-189.
2. Brouček, J., 2014. Effect of noise on performance, stress, and behaviour of animals. *Slovak journal of animal science*, 47(2), pp.111-123.
3. Chloupek, P., Voslářová, E., Chloupek, J., Bedáňová, I., Pištěková, V. and Večerek, V., 2009. Stress in broiler chickens due to acute noise exposure. *Acta Veterinaria Brno*, 78(1), pp.93-98.
4. Cons, R. Chicken productivity sensitive to light and sound. *Poultry World*, Oct 2016.
5. Donofre, A.C., da Silva, I.J.O., Nazareno, A.C. and de Paula Ferreira, I.E., 2017. Mechanical vibrations in the transport of hatching eggs and the losses caused in the hatch and quality of broiler chicks. *Journal of Agricultural Engineering*, 48(1), pp.36-41.
6. Folinas, H., 1969. *Effects of ultrasonic vibrations on the development and respiratory metabolism of the egg of Tenebrio molitor*. Fordham University.
7. <https://www.cirrusresearch.co.uk/blog/2020/04/4-different-types-noise/>
8. <https://www.poultryworld.net/health-nutrition/chicken-productivity-sensitive-to-light-and-sound/>
9. Kemps, B.J., De Ketelaere, B., Bamelis, F.R., Decuypere, E.M. and De Baerdemaeker, J.G., 2003. Vibration analysis on incubating eggs and its relation to embryonic development. *Biotechnology progress*, 19(3), pp.1022-1025.
10. King'Ori, A.M., 2011. Review of the factors that influence egg fertility and hatchability in poultry. *International Journal of poultry science*, 10(6), pp.483-492.
11. McFARLANE, J.M. and CURTIS, S.E., 1989. Multiple concurrent stressors in chicks.: 3. Effects on plasma corticosterone and the heterophil: lymphocyte ratio. *Poultry Science*, 68(4), pp.522-527.
12. O'connor, E.A., Parker, M.O., Davey, E.L., Grist, H., Owen, R.C., Szladovits, B., Demmers, T.G.M., Wathes, C.M. and Abeyesinghe, S.M., 2011. Effect of low light and high noise on behavioural activity, physiological indicators of stress and production in laying hens. *British Poultry Science*, 52(6), pp.666-674.
13. Oh, T.K., Lee, S.J., Chang, D.I., Jiro, C. and Hong-Hee, C., 2011. The effects of noise and vibration generated by mechanized equipment in laying hen houses on Productivity.

14. Rosales, A.G., 1994. Managing stress in broiler breeders: a review. *Journal of Applied Poultry Research*, 3(2), pp.199-207.
15. Shannon, S.G., Moran, A.W. and Mason, K.T., 1994. Effect of vibration frequency and amplitude on developing chicken embryos. *UAAARL Report*, 95, pp.39-45.
16. Šistková, M. and Peterka, A., 2009. The exposure of working environment noise in the agricultural service workplaces. *Research in Agricultural Engineering*, 55(2), pp.69-75.
17. Stadelman, W.J., 1958. Observations with growing chickens on the effects of sounds of varying intensities. *Poultry Science*, 37(4), pp.776-779.
18. Stadelman, W.J., 1958. The effect of sounds of varying intensity on hatchability of chicken egg. *Poultry Science*, 37(1), pp.166-169.
19. Trigg, J., Naweed, A. and Kinnear, S., 2022. A scoping review of freight rail noise and vibration impacts on domestic animal health and welfare. *Animal Welfare*, 31(1), pp.69-77.
20. van Niekerk, D.J., 2021. The effect of human-caused noise on birds, with specific reference to the potential impact of blasting on caged exotic birds.
21. Zeeman, J.D., 2023. Report: Blast Impact Assessment, Bundu Mining (Pty) Ltd, Rietvalei Mining Right Application Project. Blast Management & Consulting.

Document preparation and review

Prepared by:



Dr Nicolaas J van Niekerk (BVSc)
SAVC Reg No: D23/15946
SAVC Facility Reg No: FR15/13809
Veterinary Consultant
C4 Africa Holdings
nico@c4africa.net
+27 60 526 1625
www.c4africa.net

Reviewed by:



Dr. Chris Henderson BVSc
South African Veterinary Council Reg:D83/1851
Cell: 083 659 3603, E-mail: chris@c4africa.net
Practice Registration number: FR15/13809



Dr N M Duncan
BVSc (Hons), M Med Vet (Aves)
Diplomate: American College of Veterinary Pathologists
Registered Specialist: Poultry and Veterinary Pathology SAVC 95/78
Senior Consultant: C4 Africa Consultants



Dr Vinoliah Makuwa (BVSc)
SAVC: D22/14488
SAVC Facility Reg No: FR15/13809
Veterinary Consultant
C4 Africa Holdings
vinoliah@c4-africa.co.za
+27 62 971 0754
www.c4africa.net