

**Before Independent Hearings Commissioners Appointed by Canterbury
Regional Council and Christchurch City Council**

In the Matter of the Resource Management Act 1991

And

In the Matter of Applications by SOL Quarries Ltd to extend the existing SOL
quarry onto land at 93 and 133 Conservators Road,
Christchurch (RMA 2019 373, CRC193563, CRC193564,
CRC193773)

**Statement of evidence of Michael James Smith
on behalf of SOL Quarries Ltd**

Acoustics

Dated: 20 November 2020

INTRODUCTION

1. My full name is Michael James Smith. I am a Principal Acoustics Engineer and director of Altissimo Consulting Ltd. I have previously been employed by multi-disciplinary firms AECOM and URS, and specialist acoustics firm Marshall Day Acoustics. I hold the degrees of Bachelor of Engineering (Mechanical) and Bachelor of Mathematical and Computer Sciences from the University of Adelaide. I live in Christchurch.
2. I have practised in the field of acoustics since 2006. I am a full member of Engineering New Zealand (MEngNZ), the Acoustical Society of New Zealand (MASNZ) and the Australian Acoustical Society (MAAS).
3. I have extensive experience assessing the effects of major infrastructure such as roads and windfarms, often located near rural dwellings. I regularly provide advice for applicants, submitters and regulators.
4. I recently provided advice to the Templeton Residents Association Incorporated regarding the proposed Roydon Quarry. The commissioners accepted my evidence, and included my recommended controls on the use of mobile crushers on site, and restrictions for vehicle movements in conditions.
5. I confirm that I have read the Environment Court's Code of Conduct for Expert Witnesses, contained within the Environment Court Practice Note 2014, and that I agree to comply with it. I confirm that the issues addressed in this will say statement are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.
6. In preparing my evidence, I have reviewed the following documents:
 - 6.1. The Assessment of Environmental Effects (**AEE**) that accompanied the application
 - 6.2. The **Acoustics Assessment** by NovoGroup (February 2019) that was included in the application as notified,
 - 6.3. The **Supplementary Acoustics Assessment** (November 2019) also by NovoGroup, that was prepared in response to the s92 request from CCC
 - 6.4. Submissions received in response to limited notification
 - 6.5. The s95 report from Christchurch City Council, including the EHO report from Isobel Stout

- 6.6. The s42A report from Christchurch City Council, including report (**Acoustics Review**) from AES (Dr. Trevathan)
- 6.7. Quarry Management Plan (v3) including site inductions
7. I have limited my evidence to the effects on properties identified in the s95 report as affected parties. The Acoustics Assessment addressed wider effects on the environment.
8. A glossary of acoustics terminology and standards is presented in Appendix A.

EXECUTIVE SUMMARY

9. SOL Quarries Ltd is seeking to extend the geographic extent of the extraction and processing operations further east towards Conservators Road. A 350m setback has been applied between crusher locations and any dwellings. Sound levels from operations have been predicted to comply with the noise limits from the existing SOL consent, which are consistent with the permitted activity standards from the Christchurch District Plan
10. The nature and intensity of truck movements on public roads will be unchanged by this proposal.

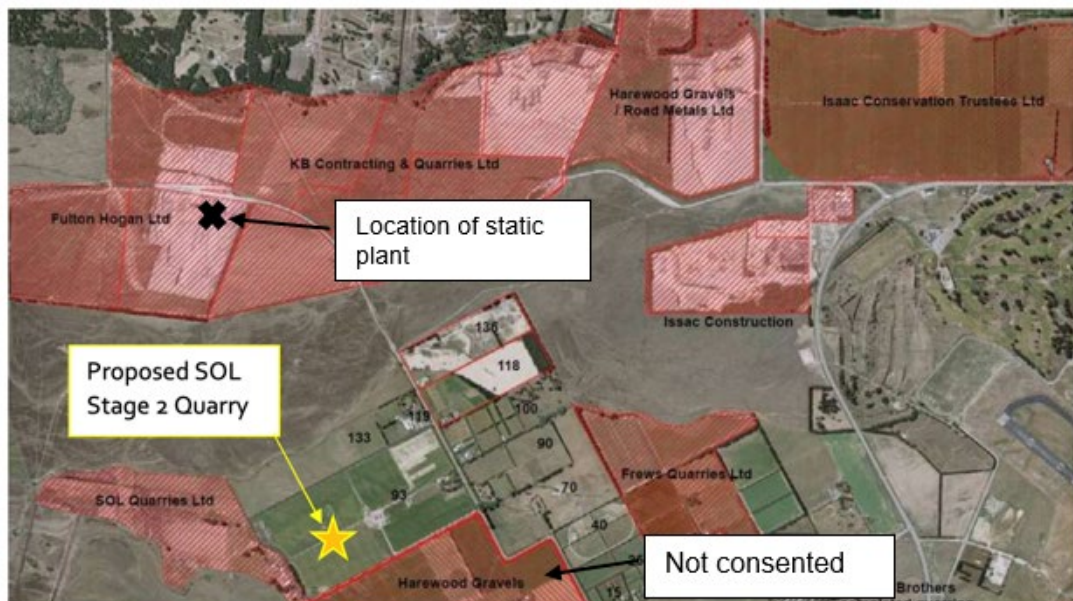
DESCRIPTION OF ACTIVITY

11. The proposed expansion will largely operate the same as existing operation. This is discussed in detail in Section 3 of the AEE, however a summary of the activity relevant to noise is provided below.
12. Topsoil will be removal to form the pit, and the perimeter bund using a dozer, scraper, and excavator. The pit will be 7-10m deep, and the perimeter bund will be 3m high and 15m wide.
13. The crushing plant will be located within the Quarry Pit and all aggregate processing and the stockpile of aggregate will occur between 7 and 10 metres below natural ground level.
14. The raw gravel is extracted using either an excavator or a loader, depending upon the compaction of the raw gravel and stored in a 'surge pile'. The raw gravel is fed into the crushing plants using a loader. The aggregate product is stockpiled according to product type. The stockpiles will not exceed 7 metres in height. Crushing will occur on average for 6-7 hours per day.
15. Most products can be produced using a cone crusher and a power screen, without the need for a jaw crusher. This is due to quarry gravel being generally small (<120mm). A jaw crusher will only be required 1-2 times annually when a specific product (TNZ M4-40) is to be produced. Jaw crushers have a more impulsive character to cone crushers.

16. The processed aggregate is loaded from the stockpiles into Client trucks for transport to a range of work sites. Consent is sought for up to 150 heavy vehicle per day, resulting in 300 combined movements. Trucks access the site from the public road network via the Guys Road entrance onto the access way which is sealed up until the weigh bridge.
17. The site will be rehabilitated upon completion of extraction, which will involve the use of a dozer, scraper and excavator.
18. SOL Quarries Ltd seeks a consent duration of 20 years with a lapse period of 8 years.

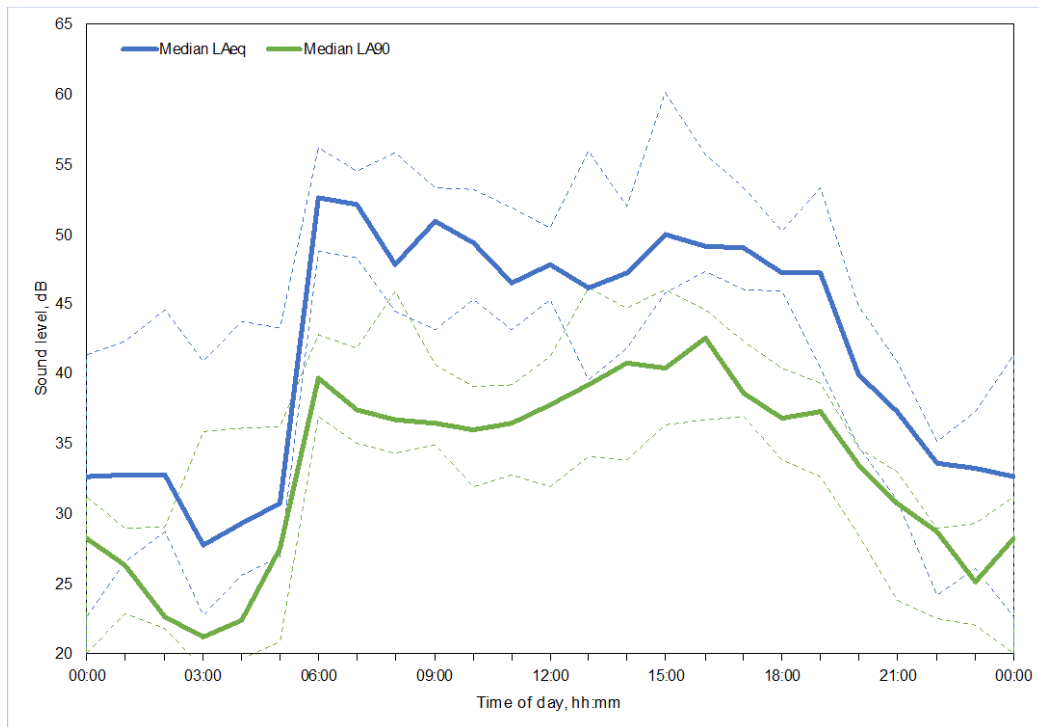
EXISTING ENVIRONMENT

19. The existing environment is complex and has changed over the recent years with multiple quarries being consented and established in the area. Submitters have identified that crushers and trucks are often heard throughout the day.
20. Other quarries in the area are shown below. I note that the KB Quarry is consented to allow crushing from 0600h, which may be the early morning activity noted by some submitters. They also have larger static plant which operates at the natural ground level and is visible above the bunds surrounding the KQ Quarry site.



21. To assist in quantifying the existing environment, I performed sound level measurements over a five-day period from 22-27 October 2020, using a fixed noise logger towards the eastern site boundary, approximately 200m from Conservators Road. Details of noise monitoring equipment are provided in Appendix B.
22. The monitoring period included a Sunday and the Labour Day public holiday where SOL and likely other quarry operations were closed. A graph of the daily profile is shown below. The

solid lines represent the median values, with the range of measured values indicated by the shaded regions.



23. Sound levels start to rise at approximately 0500h at the onset of dawn and are relatively stable during the period where SOL operated (0700-1700h). Typical daytime ambient sound levels were observed to be between 45-50 dB $L_{Aeq(15min)}$ and background sound levels between 35-40 dB $L_{A90(15min)}$. In winter, the shorter days are likely to result in the morning peak often associated with birdsong shifting later in the morning.

POTENTIAL EFFECTS

Extraction activities

24. Noise modelling was performed using the methodology set out in Acoustics Assessment. The ISO 9613-2 propagation algorithm assumes a light down-wind or a moderate ground-based temperature inversion, both conditions resulting in higher noise levels. Temperature inversions occur frequently in the area, particularly in winter when there is little or no wind, and the sky is clear.
25. The modelled scenario is for when pit is at its full extent to the north east, and the pit at its shallowed level (7m BGL). When the pit is extracted further, there will be increased screening by the pit edge, and sound levels will be lower at nearby properties. A 3m high bund is included along the north eastern boundary. This is expected to be conservative for earlier phases of the quarry when there will be more screening from the quarry face.

26. The predicted sound levels at the notional boundaries of the Conservators Road properties range between 45-50 dB $L_{Aeq(15min)}$ during combined extraction, crushing, and delivery.
27. The District Plan includes permitted activity standards for noise. In this case, the relevant daytime standards (0700-2200h) are 50 dB $L_{Aeq(15min)}$ at notional boundaries within the rural zone, and additionally 55 dB $L_{Aeq(15min)}$ at the site boundary. A 40 dB $L_{Aeq(15min)}$ limit applies at night. These standards are designed to provide a reasonable level of amenity, and protection from sleep disturbance at night. As consent is required for a discretionary activity, an assessment of effects is required taking into consideration all relevant factors.
28. NZS 6802:2008 provides a recommended upper limit of 55 dB $L_{Aeq(15min)}$ during the day. Clause C8.6.2 of the Standard provides further discussion on these guidelines:

‘The recommended daytime limit of 55 dB $L_{Aeq(15 min)}$ is consistent with the guideline values for community noise in specific environments published by the World Health Organization. The World Health Organization identifies that during the daytime, few people are seriously annoyed by activities with levels below 55 dB L_{Aeq} ’

29. The relevant extract from WHO community noise guidelines¹ is provided below. These criteria relate to the onset of the critical health effect, whereby only a proportion of the population will experience the effect.

Location	Critical health effect(s)	Time average sound level	Maximum sound level
Outdoor living area	Serious annoyance, daytime & evening.	55 dB $L_{Aeq(16h)}$	N/A
	Moderate annoyance, daytime & evening.	50 dB $L_{Aeq(16h)}$	N/A
Dwellings, indoors Inside bedrooms	Speech Intelligibility and moderate annoyance, daytime & evening.	35 dB $L_{Aeq(16h)}$	N/A
	Sleep disturbance, night-time.	30 dB $L_{Aeq(8h)}$	45 dB L_{AFmax}
Outside bedrooms	Sleep disturbance, window open (outdoor values) night-time.	45 dB $L_{Aeq(8h)}$	60 dB L_{AFmax}

30. In terms of comparison to the existing environment, quarry noise will be of a similar magnitude to the ambient environment. The ambient environment is composed of transient sources, and as such crusher noise may be audible over the background during lulls. This is consistent with submitter observations from other quarry operations. Even at relatively low sound levels, quarry noise may cause annoyance, but should not interfere with domestic activities.

On-site trucks / load out

31. Client trucks will access the site via a sealed access from Guys Road to the weigh bridge. They will then undertake a clockwise loop on gravel roads to the quarry pit, where they will

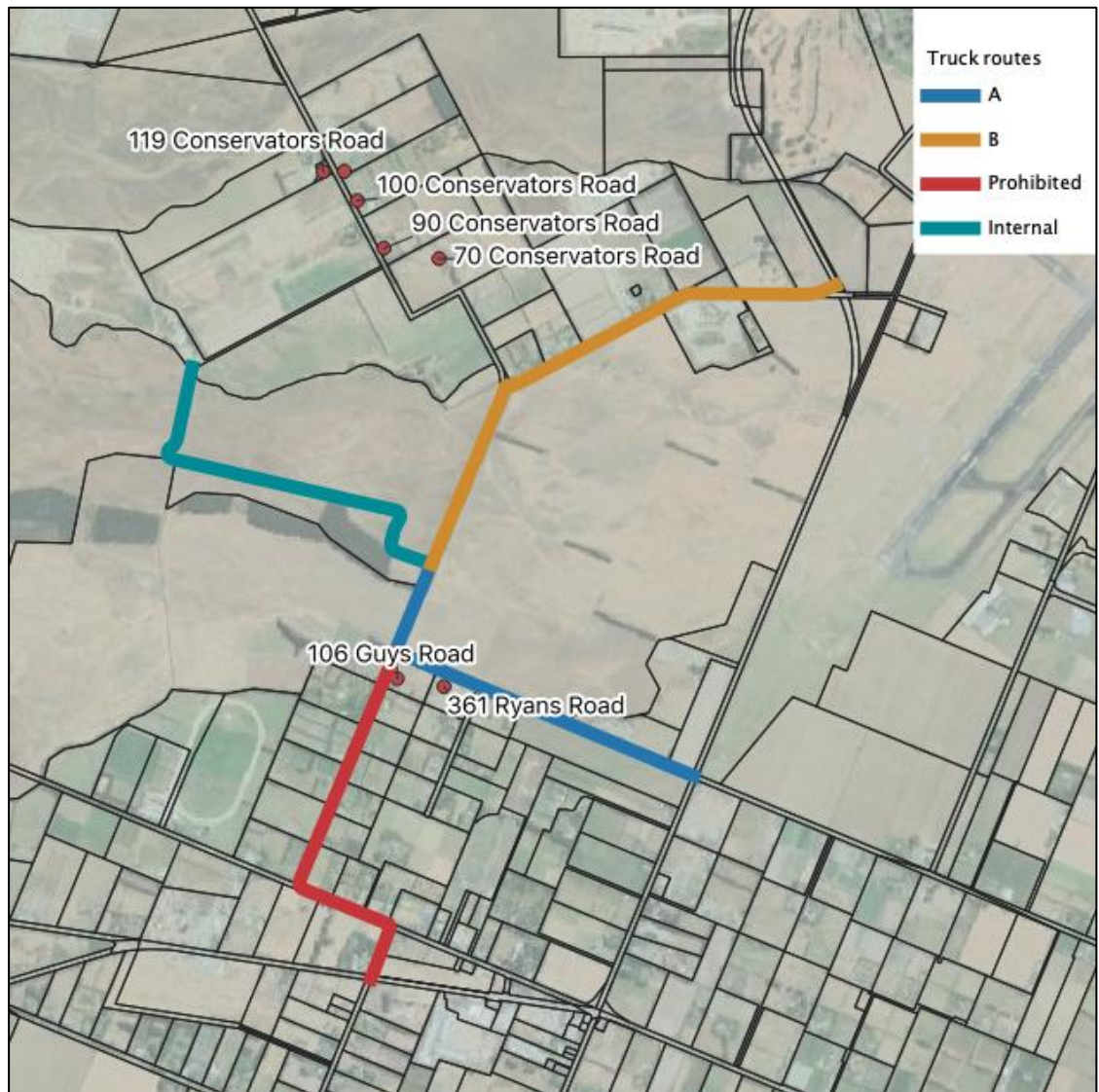
¹ Berglund, B. et al, Guidelines for Community Noise. World Health Organisation (1999).

receive their load from a front-end loader. Trucks will then complete the loop and exit the site via the same access road.

32. There is a posted speed limit of 15 km/h on the access road, which is also documented in the *Policy & Procedure Handbook: Quarry Visitors – V3* dated March 2019 (**Visitor Policy**), including the induction form. There is currently a speed check with a visual display. This does not record truck speeds.
33. Sound from on-site trucks has been included in the model for extraction activities.

Off-site trucks

34. The operation of off-site trucks would remain essentially the same as the consented operation, with up to 150 trucks per day results in 300 movements total. The effect of this consent is to extend the duration.
35. There are two designated routes from Guys Road entrance: North along Guys Road and onto Savilles Road, and then Pound Road; or South along Guys Road, turning into Ryans Road, which also intersects with Pound Road. Traffic will either head north towards SH1 or south to SH73.
36. Trucks are prohibited from using the southern section of Guys Road and School Road. I understand that trucks have used this route in the past, and ongoing management is required to enforce this prohibition. SOL is supportive of the proposal to introduce a bylaw prohibiting heavy vehicles along this route, i.e. the introduction of a weight limit (say 6,000 kg) on the southern section of Guys Road (past Ryans Road), by way of a CCC By Law, which is enforceable by NZ Police..
37. The relationship between the affected parties and the access road / designated routes is shown below:



38. Trucks must turn left onto Guys Road when leaving the site between 0700-0900h and 1600-1800h. This is due to the safety issues at the Ryans Road / Pound Road intersection. It is enforced with a locked directional control gate the entrance, and a 3-strike warning system, as detailed in an amendment to the Conditions of Consent (RMA/2018/2777).
39. The noise from vehicles on public roads (within a Transport Zone) is excluded from District Plan zone standard noise limits. This is common across New Zealand. Nevertheless, it is appropriate to consider effects from trucks in the immediate vicinity of the site.
40. For new and altered roads, the New Zealand Standard NZS 6806:2010 is typically applied. This seeks to achieve sound levels of 57 dB $L_{Aeq(24h)}$ outside dwellings and provides a structured method for evaluating mitigation options. This standard, however, is designed to be applied to roads over 2000 vpd, where the character of sound is not from individual vehicles.

41. For this project, I am supporting 55 dB $L_{Aeq(1h)}$ as an appropriate criterion for truck noise, at the façade of affected dwellings. This is consistent with the recommended upper limit in NZS 6802:2008. This should be calculated for a typical 'busy' hour, without any duration corrections to determine a 'rating level' across the day. This is consistent with the approach recommended by Dr Trevathan.
42. The closest property to the designated route is 361 Ryans Road, which is set back 30m from the road edge. I understand that the owners of the property have not expressed concern with truck noise, and have not submitted on the application. The other property identified by CCC as potentially affected is 106 Guys Road, which is set back 85m from the road.
43. NovoGroup measured sound levels of a number of individual truck movements as described in the Supplementary Acoustics Assessment. Some of these measurements included acceleration and breaking the vicinity of the Ryans Road / Guys Road corner. The measurements indicated that truck noise would be 65 dB $L_{Aeq(15min)}$ at 10m from the road edge, assuming 7 truck movements in a 15-minute period (i.e. 28 movements in an hour).
44. In the Acoustics Review Dr Trevathan notes that this is louder than truck noise he has previously measured in the Conservators Road / Savilles Road intersection. I have reviewed the measurement results and photographs included in the Supplementary Acoustics Report and have concluded that the measurements were taken closer at 5m from the road edge, and therefore a level of 57 dB $L_{Aeq(15min)}$ at 10m would be experienced.
45. On this basis, I predict the following sound levels:
 - 361 Ryans Rd – 57 dB $L_{Aeq(1h)}$ at notional boundary, and 47 dB $L_{Aeq(1h)}$ at the façade.
 - 106 Guys Rd – 41 dB $L_{Aeq(1h)}$ at notional boundary, and 38 dB $L_{Aeq(1h)}$ at the façade.
46. The above sound levels achieve the recommended criterion of 55 dB $L_{Aeq(1h)}$ at the façade. Despite this, truck noise will still be clearly audible and may cause annoyance to the occupants.
47. Noise and vibration from trucks on the prohibited route south of Ryans Road would result in unacceptable noise effects.

NOISE MANAGEMENT

48. SOL is proposing a Quarry Management Plan (QMP) which will detail operational processes that SOL will adopt to minimise environmental effects, including noise, from the operation of the quarry.
49. Through the submissions, there is the perception that SOL is not compliant with several conditions. To assist the community to understand the level of activity at any time and how it may compare to the maximum consented output, I recommend SOL is proactive with the release of information, and that the following information be made available on a website:

- Construction / rehabilitation progress
 - Locations that are currently being extracted / processed area
 - Daily numbers of trucks through the gate. This could be weekly averages.
50. Cameras installed at the entrance to the site and at the Guys / Ryans Road intersection should be considered to determine compliance with traffic restrictions. This would offer other benefits, including identifying dirt / debris on the road from trucks.
51. Tonal reversing alarms are known to cause annoyance even at low sound levels. All equipment on site should either have broadband reversing beepers or use flashing lights for safety. The advice note in section 6.1.4.2 of the District Plan acknowledges that broadband reversing alarms are preferable.

s42A report and Acoustics Review

52. The Acoustics Review some technical queries regarding the Acoustics Assessment and Supplementary Acoustics Assessment. The following information is presented to answer these questions.
- 52.1. The modelled scenario is for the pit at its final level, being 7m below natural ground, with sources located 3m above the pit floor.
- 52.2. The source levels are linear (unweighted) sound power levels. A complete table including total levels, and equivalent sound power levels, is presented in Appendix C to this evidence. I note that the crusher sound power level is based on measurements at site, and is for a cone crusher and power screen. As discussed in p12, a jaw crusher generally not used at this site.
- 52.3. The model includes both crushers operating, a front-end loader, as well as 7 truck movements per 15-minute period.
53. Dr Trevathan concludes that 50 dB L_{Aeq} is appropriate for noise emitted from the site, assessed at the notional boundary of neighbouring dwellings, and will provide adequate protection of residential amenity.
54. Ms Bealey concludes
- “The cumulative effects of multiple quarries operating in the area, all of which will have similar hours of operation and operated on many sides of the rural residential properties, would have a detrimental effect on the amenity of the nearby neighbouring properties.”*

55. The potential for cumulative effects is limited to the Conservators Road properties. Noise from the existing SOL quarry is part of the existing environment. There are no cumulative effects between the existing SOL operations, and the proposed expansion as the site will be quarried sequentially. Based on my assessment of the ambient noise environment, I consider that the proposed expansion is unlikely to materially alter the noise environment on Conservators Road, including contributions from other quarries.
56. No other quarries in the area result in truck movements on Ryans Road adjacent the two properties of interest.

CONDITIONS

Submitter suggestions

57. Most of the submissions that identified noise as a concern only did so in a general sense and hence have been addressed indirectly through my preceding comments.
58. The submitters have questioned whether a noise limit of “0 dB” more appropriate than the proposed limit of 40 dB $L_{Aeq(15min)}$. I note that the inclusion of a noise limit is a restricting standard, not an enabling one, and the prohibition of extraction activities and truck movements remains in place. I consider that it is appropriate to include a limit at notional boundaries, to cover ancillary activities that may occur between 0630-0700h. An example of activities that may occur between 0630-0700h is clearing air intakes of birds nests or other obstructions, and 24/7 dust suppression through use of the “automated dust suppression system”.
59. The submitters have requested changes to the operating hours as follows:
 - 59.1. No aggregate processing or truck movements between 0630-0800h Weekdays
 - 59.2. No aggregate processing on Saturdays (truck loud-out only), with activity commencing at 0800h rather than 0700h
60. While the District Plan has distinct day and night periods changing at 0700h, there is a transition period in the morning where people have an increased sensitivity to noise. However, my measurements have indicated that the ambient sound level is similar between 0700-0800h and the remainder of the day. My experience is that prohibiting truck movements from 0700-0800h would result in unacceptable constraints to quarry customers and their projects.
61. I understand that pre-start activities typically take at least an hour, and therefore crushers often are not operating until 0730 or 0800h. Mr Hedley is able to provide more details on a typical day.

62. I also understand that on Saturday there is a skeleton crew running, with maintenance activities being performed in preference to extraction and crushing, unless there is an immediate need for aggregate to be produced.

CONCLUSIONS

63. The proposed quarrying extension can comply with noise limits from the existing consent, which are consistent with daytime permitted activity standard. Noise at the Conservators Road properties will be comparable to the ambient sound levels, but will be often be audible during lulls in other sources.
64. Truck noise is likely to achieve reasonable noise levels at Guys and Ryans Road properties. Again, truck noise will be clearly audible over the ambient environment. Effective control is required to ensure that the designation route is adopted.
65. I support a robust Quarry Management Plan with transparent and regular reporting to Environment Canterbury and the Christchurch City Council, with information also available to residents.



Dated this 20th day of November 2020

Michael James Smith

Appendix A - Glossary of acoustics terms

Ambient	The sound measured in the absence of the intrusive noise or the noise source requiring control, and frequently measured to determine the situation prior to the addition of a new source. This includes other fluctuating noise sources, and is generally measured as an $L_{Aeq(15min)}$.
Background	The component of residual sound that subjectively is perceived as continuously present. This is level in decibels equalled or exceeded for 90% of the measurement interval. eg. $L_{A90(15min)}$
L_{AE}	Sound exposure level is the total noise energy produced from a single noise event. The Sound Exposure Level is a metric used to describe the amount of noise from an event such as an individual aircraft flyover or truck movement The Sound Exposure Level is the integration of all the acoustic energy contained within the event.
$L_{Aeq(t)}$	The 'time average' level is the energy average of the period 't'. It is expressed in A-weighted decibels
L_{AFmax}	The maximum sound level is the highest instantaneous level during a measurement. It correlates to a specific event like a truck hitting a pot hole, or a car door being closed. It is expressed in A-weighted decibels
Octave band	Frequency bands allow a representation of the spectrum associated with a particular noise. Each octave band is described by its centre frequency

Appendix B - Noise monitoring details

Location: NZTM 1559,241mE, 5184,913mN

Equipment NTi XL2-TA Type 1 Sound Level Meter
Serial A2A-17220-E0 calibrated 24/1/20



Aerial photograph showing monitoring location



North view



East view



South view

Appendix C – Equipment sound levels

	Sound power level, dB							A	L _{p,A} at 10m, dB
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz		
Construction sources									
Excavator	113	117	107	108	106	101	95	114	86
Dozer	110	112	104	103	106	104	98	112	84
Scraper	110	77	91	95	98	102	108	109	81
Operation sources									
Haul trucks	117	113	105	107	103	101	95	112	84
Front end loader	108	116	107	108	105	99	95	113	85
Crusher	117	114	107	109	103	99	94	113	85