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Dunmore Quarry
NOISE AND VIBRATION MANAGEMENT PLAN

May 2025

DOCUMENT CONTROL

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Rev No.	Date	Prepared	Reviewed	Approved By	Comments
1	September 2024	Rod Linnett	Oliver Muller	Boral	MAC180747-12RP1
2	January 2025	Rod Linnett	Oliver Muller	Boral	MAC180747-12RP1V2 updated to include responses to DPHI comments
3	May 2025	Rod Linnett	Oliver Muller	Boral	MAC180747-12RP1V3

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1 INTRODUCTION

1.1 BACKGROUND

Boral Resources New South Wales (NSW) Pty Ltd (Boral) own and operate Dunmore Quarry (the 'Quarry') located on Tabbita Road, in the Shellharbour local government area (LGA). The quarry is approximately 12 kilometres (km) north-west of Kiama and 20km south of Wollongong, NSW.

Quarrying operations have been undertaken on the site for over 100 years under a series of historical development consents issued by Shellharbour City Council. On 30 September 2004, the Dunmore Quarry Expansion Project (the project) (DA470-11-2003) was approved by the then Minister Assisting the Minister for Infrastructure and Planning (Planning Administration) and all prior development consents were surrendered.

The current consent has been previously modified on 12 occasions (see Table 1), and allows Boral to extract, process and transport up to 2.5 million tonnes per annum (Mtpa) of quarry product until 30 September 2034.

In January 2023, Boral lodged an application (Modification 13) to modify the consent (DA470-11-2003) under section 4.55(2) of the Environmental Planning and Assessment Act 1979 (EP&A Act). The proposed modification includes:

- an increase to the approved extraction area to the north of the existing pit by approximately 7.8 hectares (ha) (herein referred to as the 'RIC pit extension'), resulting in a total extraction area of 84ha;
- an increase the depth of the approved RIC pit (and including the proposed extension area) by approximately 46 - 64 metres (m) to 43 metres Australian Height Datum (m AHD);
- an increase the depth of the approved Croome Farm Pit by 38 m to 55 m AHD and the Croome West Pit by a maximum of 8 m to 60 m AHD; and
- the extension to the quarry life by 9 years to 2043.

An environmental impact statement (EIS) was prepared to accompany the application for 470-11-2003 Mod 13 titled Modification Report – Dunmore Hard Rock Quarry Modification 13, prepared by EMM, dated 20 January 2023, and the following supporting documents - Submissions Report – Dunmore Quarry Mod 13, dated January 2024, and additional information titled Response to Further RFI from BCS – Dunmore Quarry Mod 13, dated 18 April 2024 and 2nd Response to Further RFI from BCS – Dunmore Quarry Mod 13, dated 14 June 2024.

Modification 13 was approved in June 2024 with an updated consolidated consent. The updated consent does not change the hours of operation, or noise and blasting limits. The significant aspect of the modification is the increase to extraction depth in the RIC, Croome Farm and Croome West pits (refer **Figure 1**).

This NMP has been prepared by Muller Acoustic Consulting (MAC) on behalf of Boral. MAC are a member firm of the Association of Australasian Acoustic Consultants (AAAC). The author and reviewer are both members of the Australian Acoustical Society and hence, are considered suitably qualified and experienced and have been endorsed by the Planning Secretary.

1.2 Purpose and Scope

This Noise and Vibration Management Plan (NVMP) describes how Boral will manage and control noise and blasting emissions (airblast overpressure and ground vibration) when operating the quarry and applies to all activities undertaken by the quarry including extraction (drilling and blasting), loading and haulage of materials, stockpiling, processing (crushing, screening and conveying).

Specific objectives of the NVMP are to:

- provide Dunmore the quarry's employees and contractors with a description of their responsibilities, regarding noise and blasting management;
- address the relevant conditions/requirements in the development consent and other guidelines relevant to this NVMP;
- describe the noise and blasting management system and the measures that will be implemented to ensure noise from quarrying operations comply with the relevant regulatory criteria;
- outline the noise and vibration monitoring requirements and methodology for determining the noise levels emitted by the quarry;
- outline the blast monitoring requirements;
- evaluate noise and blasting emissions and reporting on compliance with the relevant regulatory criteria;
- outline procedures associated with the management of noise and blasting emissions and associated community consultation; and
- provide data suitable to demonstrate compliance with the consent criteria and conditions.

The NVMP is prepared for a mixed audience of consent authorities, environmental regulators and site personnel; the latter of which are responsible for implementing this plan as part of day-to-day operations.

The site implements the Noise and Blast Management Plan as approved from time to time by the Planning Secretary.

1.3 CONSULTATION

As required by Condition 1.4a consultation is required with the EPA in regard to the preparation of the Noise Management Plan.

The EPA were consulted with the initial preparation of the plan in December 2017 however no response was provided.

Boral have discussed noise management aspects with the EPA in 2023 as a review of the Dunmore Quarry Licence.

A copy of the 2024 Noise and Blast Management plan will be provided to the EPA for comment.

1.4 Responsibility for Implementation

The Quarry Manager carries ultimate responsibility for the ongoing development and implementation of this NVMP and providing the necessary resources as required.

The site Environmental and Stakeholder Advisor is responsible for ensuring that the management and control measures outlined in this plan are implemented on site, investigating and responding to complaints associated with noise and blasting emissions, and carrying out and/or coordinating the monitoring and reporting requirements of this plan.

The site Environmental and Stakeholder Advisor is responsible for reporting exceedances of the noise criteria and complaints to the site Technical and Production Managers.

Operations personnel (Quarry Supervisors) are responsible for adjusting operations as appropriate to minimise noise impacts on neighbouring properties.

Table 1 provides the quarry's employees and contractors with a description of their responsibilities regarding management of noise and blasting emissions .

Table 1 Employee and Contractor Responsibilities

Role	Responsibilities
Environmental and Stakeholder Advisor	• Assist in the development of the NVMP. • Ensuring that the management and control measures outlined in this plan are implemented on site. • Co-ordinate all noise and blast monitoring. • Liaison with specialists to understand compliance. • Key point of contact for all NVMP related communications and reporting. • Investigating and responding to complaints associated with noise emissions. • Reporting exceedances of the noise and blasting criteria and complaints to the Site, Technical and Production managers. • Assist implementing training, auditing and review of the NVMP.
Quarry Supervisors	• Implement the NVMP. • Adjusting mine operations as appropriate to minimise noise and blasting impacts on site and neighbouring properties. • Implementing the NVMP. • Modifying operations to ensure compliance with the consent criteria • Ensure all monitoring required under regulatory and environmental licences is undertaken.
Site Manager	• Accountability for compliance with the noise and blast criteria and this NVMP.

1.5 Alignment with Other Plans

This NVMP document is part of the overall Environment Management Strategy which outlines the overarching environmental strategy of the Quarry.

FIGURE 1

SITE LAYOUT

MAC180747

Dunmore Quarry

KEY

- Receivers
- RIC Extension
- Cadastral Boundary

0 100 200 300 400 500 m

N

MAC
Muller Acoustic Consulting

1.6 DOCUMENT STRUCTURE

The structure of the Management plan is outlined in Table 1.

Table 2 Structure of the Management Plan

Section	Content
1	Provides an overview of the project and objectives of the plan.
2	Outlines statutory requirements associated with the consent, Environmental Protection Licence (EPL) and consultation undertaken to develop the plan.
3	Describes the existing acoustic environment (baseline).
4	Outlines the noise and blasting criteria the mine is required to meet, and the performance criteria used to assess the success of the management actions.
5	Outlines the noise management protocols in place for mining operations throughout the life of the consent.
6	Outlines the procedures and requirements of the noise monitoring program.
7	Outlines the blast management protocols in place for mining operations throughout the life of the consent
8	Outlines the procedures and requirements of the blast monitoring program
9	Outlines the procedures for evaluating the performance of the NMP review of procedures, and to facilitate improvement where required.
10	Outlines the procedures for responding to incidents or impacts identified by the monitoring program, investigation of incidents, possible responsive actions. Outlines the procedures for reporting, notification and complaints handling
11	Reference Documents

2 STATUTORY REQUIREMENTS

This NVMP has been prepared in accordance with the consent as follows

Table 3 presents the administrative conditions;

Table 4 presents conditions relating to acquisition and mitigation;

Table 5 presents specific conditions relating to noise;

Table 6 presents specific conditions relating to Noise Management Plans;

Table 7 presents specific conditions relating blasting; and

Table 8 presents specific conditions relating to Blast Management Plans.

Table 3 Administrative Conditions

Condition	Requirement	Section
Schedule 3 13	**Compliance** 13. The Applicant must ensure that all employees, contractors and sub-contractors are aware of, and comply with, the conditions of this approval relevant to their respective activities.	

Table 4 Mitigation and Acquisition Related Conditions

<table>
<tr><th>Condition</th><th>Requirement</th><th>Section</th></tr>
<tr><td>Schedule 4
6A</td><td>ADDITONAL MITIGATION ON REQUEST
Upon receiving a written request from the landowner of any residence on the land listed in Table 1 or Table 1A, the Applicant must implement additional mitigation measures at or in the vicinity of the residence, in consultation with the landowner. These measures must be consistent with the measures outlined in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Development (NSW Government, 2014) (as may be updated or replaced from time to time). They must also be reasonable and feasible and proportionate with the level of predicted impact.
If within 3 months of receiving this request from the landowner, the Applicant and the owner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Secretary for resolution.
Table 1: Land Subject to Acquisition on Request
<table>
<tr><th>Land Owner</th><th>Land Identification</th></tr>
<tr><td>Creagan</td><td>Lot 5 DP 1001931</td></tr>
<tr><td>Stocker</td><td>Lot 1 DP 745632</td></tr>
<tr><td>McParland/Fogarty</td><td>Lot 10 DP 977931</td></tr>
<tr><td>Kimmorley Property</td><td>Lot 1 DP9998321</td></tr>
</table>
Table 1A: Land Subject to Mitigation on Request
<table>
<tr><th>Receiver Locations</th><th>Mitigation Basis</th></tr>
<tr><td>Locations AA, D, F, G and Z</td><td>Noise</td></tr>
</table>
ACQUISITION UPON REQUEST</td><td>Section 10.5</td></tr>
</table>

Condition	Requirement	Section
	2. Upon receiving a written request for acquisition from the landowner of the land listed in Table 1, the Applicant must acquire the land in accordance with conditions 3 and 4 below. Land Owner(s) Land Identification Creagan Lot 5 DP1001931 Stocker Lot 1 DP745632 McParland/ Fogarty Lot 10 DP977931 Kimmorley Property Lot 1 DP998321 Table 1: Land Subject to Acquisition on Request Note: Land titled 'McParland/Fogarty' has been acquired and is now quarry-owned. 3. Within 6 months of receiving a written request from the landowner, the Applicant must pay the landowner: (a) the current market value of the landowner's interest in the land at the date of this written request, as if the land was unaffected by the development the subject of this DA, having regard to the: • existing and permissible use of the land, in accordance with the applicable environmental planning instruments at the date of the written request; and • presence of improvements on the land and/or any approved building or structure which has been physically commenced at the date of the landowner's written request, and is due to be completed subsequent to that date; and (b) the reasonable costs associated with: • relocating within the Shellharbour or Kiama local government areas, or to any other local government area determined by the Planning Secretary; and • obtaining legal and expert advice for determining the acquisition price of the land and the terms upon which it is to be acquired; and (c) reasonable compensation for any disturbance caused by the land acquisition process. However, if within 6 months of receiving this written request, the Applicant and landowner cannot agree on the acquisition price of the land and/or the terms upon which the land is to be acquired, then either party may refer the matter to the Planning Secretary for resolution. Upon receiving such a request, the Planning Secretary shall request the NSW President of the Australian Property Institute to appoint a qualified independent valuer to consider submissions from both parties, and determine a fair and reasonable acquisition price for the land, and/or the terms upon which the land is to be acquired. If either party disputes the independent valuer's determination, the independent valuer must refer the matter back to the Planning Secretary for resolution. If the landowner refuses to accept this offer within 6 months of the date of the Applicant's offer, the Applicant's obligations to acquire the land cease, unless otherwise agreed by the Planning Secretary.	

Condition	Requirement	Section
	4. The Applicant must bear the costs of any valuation or survey assessment requested by the independent valuer or the Planning Secretary, and the costs of determination referred to in Condition 3 above. 5. If the Applicant and landowner agree that only part of the land should be acquired, then the Applicant must pay all reasonable costs associated with obtaining Council approval for any plan of subdivision, and registration of the plan at the Office of the Registrar-General.	

Table 5 Noise Related Conditions

<table>
<tr><th>Condition</th><th>Requirement</th><th>Reference</th></tr>
<tr><td>Schedule 4
7</td><td>
NOISE LIMITS
The Applicant must ensure that the noise generated by the development does not exceed the criteria specified in Table 2.
Table 2: Noise Impact Assessment Criteria for the Development.
<table>
<tr><th rowspan="3">Receiver locations</th><th colspan="6">Noise limits dB(A)</th></tr>
<tr><th colspan="4">$L_{Aeq,15\ minute}$</th><th colspan="2">$L_{A1,1\ minute}$</th></tr>
<tr><th>Day</th><th>Evening</th><th>Night</th><th>Shoulder</th><th>Night</th><th>Shoulder</th></tr>
<tr><td>Location K
Stocker Residence</td><td>49</td><td>44</td><td>38</td><td>47</td><td>48</td><td>55</td></tr>
<tr><td>Location O
Dunmore Lakes</td><td>49</td><td>44</td><td>38</td><td>47</td><td>48</td><td>55</td></tr>
<tr><td>Location J
Creagan Residence</td><td colspan="6">Negotiated agreement in place</td></tr>
<tr><td>Location AA</td><td>38</td><td>38</td><td>38</td><td>38</td><td rowspan="5">45</td><td rowspan="5">45</td></tr>
<tr><td>Locations AB and T</td><td>36</td><td>36</td><td>36</td><td>36</td></tr>
<tr><td>Locations D, F, G and Z</td><td>40</td><td>40</td><td>40</td><td>40</td></tr>
<tr><td>Location S</td><td>37</td><td>37</td><td>37</td><td>37</td></tr>
<tr><td>Other privately owned residences</td><td>35</td><td>35</td><td>35</td><td>35</td></tr>
</table>
Notes:

Receiver locations are shown in Appendix 2.
The above table may be varied if the Applicant enters into a negotiated agreement with any of the affected residents, or if existing agreements become void.
Noise from the development is to be measured at the most affected point on or within the residential boundary or at the most affected point within 30m of the dwelling (rural situations) where the dwelling is more than 30m from the boundary, to determine compliance with the LAeq(15 minute) noise limits in the above table. Where it can be demonstrated that direct measurement of noise from the development is impractical, the EPA may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy). The modification factors presented in Section 4 of the NSW Industrial Noise Policy must also be applied to the measured noise levels where applicable.

</td><td>Section 4.1
Table 11</td></tr>
</table>

<table>
<tr><th>Condition</th><th>Requirement</th><th>Reference</th></tr>
<tr><td></td><td>4. Noise from the development is to be measured at 1m from the dwelling façade to determine compliance with the LA1(1minute) noise limits in above table.
5. The noise emission limits identified in Table 1 apply under meteorological conditions of:
• Wind speed up to 3m/s at 10 metres above ground level; or
• Temperature inversion conditions of up to 3oC/100m and wind speed up to 2m/s at 10 metres above the ground.</td><td></td></tr>
<tr><td>Schedule 4
9</td><td>OPERATING HOURS
The Applicant must comply with the operating hours in Table 3
Table 3: Operating Hours for the Development
<table>
<tr><th>Activity</th><th>Days of the Week</th><th>Time</th></tr>
<tr><td>Extraction and Processing</td><td>Monday – Saturday</td><td>6.00am to 10.00pm</td></tr>
<tr><td>Production Transfer to Stockpiles</td><td>Monday – Saturday</td><td>6.00am to midnight</td></tr>
<tr><td>Maintenance</td><td>Monday – Saturday</td><td>24 hrs</td></tr>
<tr><td>Construction (including construction of the bund under Modification 8)</td><td>Monday – Saturday</td><td>7.00am to 6.00pm Monday to Friday
8.00am to 1.00pm Saturday</td></tr>
</table></td><td>Section 5.1.2
Table 14</td></tr>
<tr><td>Schedule 4
11A</td><td>NOISE OPERATING CONDITIONS
The Applicant must:
(a) take all reasonable steps to minimise the construction, operational and transport noise associated with the development;
(b) take all reasonable steps to minimise the noise impacts of the development during noise-enhancing meteorological conditions; when the noise criteria in this consent do not apply; and
(c) regularly assess noise monitoring data, and modify or stop operations on the site to ensure compliance with the relevant conditions of this consent, to the satisfaction of the Planning Secretary.</td><td>Section
5.1.3 5.1.4 1.1.1 5.1.6
5.1.7
9.1 10.8</td></tr>
</table>

Table 6 Noise Management Plan – Specific Requirements

Condition	Requirement	Reference
Schedule 4 14	**NOISE MANAGEMENT PLAN** The Applicant must prepare a Noise Management Plan for the development to the satisfaction of the Planning Secretary. This plan must: (a) be prepared in consultation with the EPA; (b) be submitted to the Planning Secretary for approval prior to commencing quarrying operations in the Croome West Pit, unless the Planning Secretary agrees otherwise; (c) describe the measures to be implemented to ensure: • compliance with the noise criteria and operating conditions of this consent; • best practice management is being employed; • noise impacts of the development are minimised during stage 3 extraction of the Croome West Pit, particularly during the shoulder period; and	Section 5.1.3 5.1.4 1.1.1 5.1.6 5.1.1

	• noise impacts of the development are minimised during meteorological conditions under which the noise criteria in this consent do not apply (d) describe the proposed noise management system; and (e) include a monitoring program to be implemented to measure noise from the development against the noise criteria in Table 2. The Applicant must implement the Noise Management Plan as approved by the Planning Secretary.	5.1.7 6.1 9.4

Table 7 Blasting and Vibration Related Conditions

<table>
<tr><th>Condition</th><th>Requirement</th><th>Reference</th></tr>
<tr><td>Schedule 4
16</td><td>AIRBLAST OVERPRESSURE CRITERIA
The Applicant must ensure that the airblast overpressure level from blasting at the development does not exceed the criteria in Table 4 at any residence or sensitive receiver on privately-owned land.
Table 4: Airblast Overpressure Limits
<table><tr><th>Airblast overpressure level [dB(Lin Peak)]</th><th>Allowable Exceedance</th></tr><tr><td>115</td><td>5% of the total number of blasts over a period of 12 months</td></tr><tr><td>120</td><td>0%</td></tr></table></td><td>Section 4.2
Table 12</td></tr>
<tr><td>Schedule 4
17</td><td>GROUND VIBRATION CRITERIA
The Applicant must ensure that the peak particle velocity from blasting at the development does not exceed the criteria in Table 5 at any residence or sensitive receiver on privately -owned land.
Table 5: Ground Vibration Limits
<table><tr><th>Peak Particle Velocity (mm/s)</th><th>Allowable Exceedance</th></tr><tr><td>5</td><td>5% of the total number of blasts over a period of 12 months</td></tr><tr><td>10</td><td>0%</td></tr></table></td><td>Section 4.2
Table 12</td></tr>
<tr><td>Schedule 4
18</td><td>BLASTING RESTRICTIONS
Blasting operations at the site may only take place
a) between 9am and 5pm Monday to Saturday inclusive;
b) are limited to 2 blasts each day; and
c) at such other times as may be approved by EPA.</td><td>Section 7.4</td></tr>
<tr><td>Schedule 4
19</td><td>BLAST OPERATING CONDITIONS
During blasting operations, the Applicant must:
a) take all reasonable steps to:
i. protect the safety of people in the surrounding area;
ii. protect public or private infrastructure/property in the surrounding area from any damage; and</td><td>Section 7
7.3.2 7.3.3
7.3
7.3.1</td></tr>
</table>

Condition	Requirement	Reference
	iii. minimise blast-related dust and fume emissions; and	7.8
	b) operate a suitable system to enable members of the public to get up-to-date information on the proposed blasting schedule on the site, to the satisfaction of the Planning Secretary.	7.7

Table 8 Blast Management Plan – Specific Requirements

<table>
<tr><th>Condition</th><th>Requirement</th><th>Reference</th></tr>
<tr><td>Schedule 4
20</td><td>BLAST MANAGEMENT PLAN
The Applicant must prepare a Blast Management Plan for the development to the satisfaction of the Planning Secretary. This plan must:
a) be submitted to the Planning Secretary for approval within 6 months of Modification 8, or as otherwise agreed by the Planning Secretary;
b) describe the measures that would be implemented to ensure compliance with the blast criteria and operating conditions of this consent;
c) include measures to manage and monitor the avoidance of impacts on the heritage values on the buildings on Lot 10 DP977931;
d) include measures to manage flyrock;
e) include a monitoring program for evaluating and reporting on compliance with the blasting criteria in this consent;
f) include community notification procedures for the blasting schedule, in particular to nearby residences; and
g) include a protocol for investigating and responding to complaints
The Applicant must implement the approved Blast Management Plan as approved from time to time by the Planning Secretary.
Note: Prior to the approval of the Blast Management Plan revised under Modification 8, the most recent approved version must continue to have full force and effect and must be implemented.</td><td>Section 7
Section 8

7.2 7.4
7.2 7.4
7.2 7.4

7.5
10.9</td></tr>
<tr><td>Schedule 4
21</td><td>BLAST MONITORING
The Applicant must monitor the airblast overpressure and peak particle velocity impacts of the development at the permanent monitoring station as approved by the EPA, to the satisfaction of the EPA and Planning Secretary, using the specified units of measure, frequency, sampling method, and location in Table 6:
Table 6: Airblast Overpressure and Peak Particle Velocity Monitoring
<table>
<tr><th>Parameter</th><th>Units of Measure</th><th>Frequency</th><th>Sampling Method</th><th>Measurement Location</th></tr>
<tr><td>Airblast overpressure</td><td>dB (Lin Peak)</td><td>During every blast</td><td>AS2187.2-1993</td><td>Not less than 3.5m from a building or structure (or as otherwise agreed by EPA)</td></tr>
<tr><td>Peak particle velocity</td><td>mm/s</td><td>During every blast</td><td>AS2187.2-1993</td><td>Not less than 3.5m from a building or structure (or as otherwise agreed by EPA)</td></tr>
</table></td><td>Section 8

8.2</td></tr>
</table>

Table 9 General Management Requirements

Condition	Requirement	Reference
Schedule 4A	**NOTIFICATION OF EXCEEDANCES** 1. As soon as practicable and no longer than 7 days after obtaining monitoring results showing an exceedance of any noise or air quality criterion in Schedule 4 of this consent, the Applicant must provide the details of the exceedance to any affected landowners and/or tenants.	Section 10.7
Schedule 4A	**INDEPENDENT REVIEW** 3. If a landowner considers the development to be exceeding any relevant noise or air quality criterion in Schedule 4 of this consent, they may ask the Planning Secretary in writing for an independent review of the impacts of the development on their residence or land. 4. If the Planning Secretary is not satisfied that an independent review is warranted, the Planning Secretary will notify the landowner in writing of that decision, and the reasons for that decision, within 21 days of the request for a review. 5. If the Planning Secretary is satisfied that an independent review is warranted, within 3 months, or other timeframe agreed by the Planning Secretary and the landowner, of the Planning Secretary's decision, the Applicant must: a. commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Planning Secretary, to: i. consult with the landowner to determine their concerns; ii. conduct monitoring to determine whether the development is complying with the relevant criterion in Schedule 4 of this consent; and iii. if the development is not complying with the relevant criterion, identify measures that could be implemented to ensure compliance with the relevant criterion; b. provide the Planning Secretary and landowner a copy of the independent review; and c. comply with any written requests made by the Planning Secretary to implement any findings of the review.	Section 10.10

Condition	Requirement	Reference
Schedule 5.2	**MANAGEMENT PLAN REQUIREMENTS** The Applicant must ensure that the management plans required under this consent are prepared in accordance with any relevant guidelines, and include: a) detailed baseline data; b) a description of: • the relevant statutory requirements (including any relevant approval, licence or lease conditions); • any relevant limits or performance measures/criteria; and • the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures. c) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria d) a program to monitor and report on the: • impacts and environmental performance of the development; and • effectiveness of any management measures (see (c) above); e) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible; f) a program to investigate and implement ways to improve the environmental performance of the development over time. g) a protocol for managing and reporting any: • incidents; • complaints; • non-compliances with statutory requirements; and • exceedances of the impact assessment criteria and/or performance criteria; h) a protocol for periodic review of the plan; and i) a document control table that includes version numbers, dates when the management plan was prepared and reviewed, names and positions of people who prepared and reviewed the management plan, a description of any revisions made and the date of the Planning Secretary's approval.	This document
Schedule 5.4	**REVISION OF STRATEGIES, PLANS AND PROGRAMS** Within 3 months of the submission of an: a) incident report under condition 7 below; b) Annual Review under condition 9 below; c) audit report under condition 10 below; and d) any modifications to this consent, | the Applicant must review, and if necessary revise, the strategies, plans, and programs required under this consent, to the satisfaction of the Planning Secretary.	Section 9
Schedule 5.7	**INCIDENT REPORTING** The Applicant must immediately notify the Department and any other relevant agencies after it becomes aware of an incident. The notification must be in writing via the Major Projects	Section 10.3

Condition	Requirement	Reference
	Website and identify the development (including the development application number and name) and set out the location and nature of the incident.	
Schedule 5.7A	**NON COMPLIANCE NOTIFICATION** Within seven days of becoming aware of a non-compliance, the Applicant must notify the Department of the non-compliance. The notification must be in writing via the Major Projects Website and identify the development (including the development application number and name), set out the condition of this consent that the development is non-compliant with, the way in which it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the non-compliance. Note: A non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.	Section 10.4
Schedule 5.9	**ANNUAL REVIEW** By the end of September each year, or other timing as may be agreed by the Planning Secretary, the Applicant must submit a report to the Department reviewing the environmental performance of the development to the satisfaction of the Planning Secretary. This review must: a) describe the development (including rehabilitation) that was carried out in the previous financial year, and the development that is proposed to be carried out over the current financial year; b) include a comprehensive review of the monitoring results and complaints records of the development over the previous financial year, which includes a comparison of these results against the: • relevant statutory requirements, limits or performance measures/criteria; • requirements of any plan or program required under this consent; • monitoring results of previous years; and • relevant predictions in the documents listed in condition 2 of Schedule 3; c) identify any non-compliance over the last financial year, and describe what actions were (or are being) taken to ensure compliance; d) identify any trends in the monitoring data over the life of the development; e) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and f) describe what measures will be implemented over the current financial year to improve the environmental performance of the development. The Applicant must ensure that copies of the Annual Review are submitted to Council and are available to the Community Consultative Committee (see condition 6 of Schedule 5) and any interested person upon request.	Section 9.2

2.1 ENVIRONMENT PROTECTION LICENCE

Boral is the licensee of EPL 77 for the "Boral Dunmore Quarry" for >200,000 tpa of extractive activities and processing. The EPL noise limits are the same as the consent noise conditions presented in **Table 5**, and for the same meteorological conditions.

3 EXISTING ACOUSTIC ENVIRONMENT AND ASSESSMENT LOCATIONS

As per the approved Dunmore Quarry Noise Management Plan (NMP) (EMM 2017), noise emissions from the quarry are measured at five locations (assessment locations K, S, T, G and F).

Historic noise monitoring results from noise compliance monitoring are summarised in Table 3.1 of the Modification 13 Noise and Vibration Impact Assessment (EMM Consulting Report E210719RP#1, the 'Mod13 NIA') shows that noise from the quarry is below the relevant operational noise limits at all noise monitoring locations and is often not audible at most locations.

Appendix 2 of the consent shows the privately owned assessment locations surrounding Dunmore Quarry which are reproduced in **Table 10**.

Table 10 Noise Assessment Locations

Reference ID	Description	Easting	Northing
D	Privately owned – 316 Croome Rd, Croom	298183	6169201
F	Privately owned – 316 Croome Rd, Croom	298285	6169804
G	Privately owned – 316 Croome Rd, Croom	298176	6169349
J	Privately owned – 4 Swamp Rd, Dunmore	301505	6167630
K	Privately owned – 40 Swamp Rd, Dunmore	301395	6167360
O	Privately owned – 7 Fuller Drive, Dunmore	301486	6166699
S	Privately owned – 86 Croome Vale Rd, Croom	298214	6167335
T	Privately owned – 1338 Jamberoo Rd, Croom	297519	6168261
Z	Privately owned – 316 Croome Rd, Croom	298173	6169276
AA	Privately owned – 272 Croome Rd, Croom	297979	6169974
AB	Privately owned – 11A Whistlers Run, Albion Park	297587	6170062

4 CRITERIA AND PERFORMANCE INDICATORS

4.1 NOISE

Condition 7 of Schedule 4 of the development consent nominates the noise limits for the quarry, as reproduced in **Table 11**.

Table 11 Consent Noise Criteria

Description	Day (7am - 6pm)	Evening (6pm - 10pm)		Night (10pm - 7am)	Morning Shoulder (6am - 7am)	
	dB LAeq(15min)	dB LAeq(15min)	dB LAeq(15min)	dB LA1(1min)	dB LAeq(15min)	dB LA1(1min)
Location K Stocker	49	44	38	48	47	55
Location O Dunmore Lakes	49	44	38	48	47	55
Location J Creagan	Negotiated Agreement in place					
Location AA	38	38	38	45	38	45
Location AB and T	36	36	36	45	36	45
Locations D, F, G and Z	40	40	40	45	40	45
Location S	37	37	37	45	37	45
Other privately owned residences	35	35	35	45	35	45

Notes:

1. *Receiver locations are shown in Appendix 2.*
2. *The above table may be varied if the Applicant enters into a negotiated agreement with any of the affected residents, or if existing agreements become void.*
3. *Noise from the development is to be measured at the most affected point on or within the residential boundary or at the most affected point within 30m of the dwelling (rural situations) where the dwelling is more than 30m from the boundary, to determine compliance with the LAeq(15 minute) noise limits in the above table. Where it can be demonstrated that direct measurement of noise from the development is impractical, the EPA may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy). The modification factors presented in Section 4 of the NSW Industrial Noise Policy must also be applied to the measured noise levels where applicable.*
4. *Noise from the development is to be measured at 1m from the dwelling façade to determine compliance with the LA1(1minute) noise limits in above table.*
5. *The noise emission limits identified in Table 1 apply under meteorological conditions of:*
   - *Wind speed up to 3m/s at 10 metres above ground level; or*
   - *Temperature inversion conditions of up to 3°C/100m and wind speed up to 2m/s at 10 metres above the ground.*

The Quarry is required to meet the noise criteria in **Table 11** for stated meteorological conditions noted. Noise generated by the Quarry is to be measured in accordance with the relevant requirements of the NPI as outlined in **Section 6.1**. It should also be noted that the noise criteria outlined above does not apply if Boral has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and Boral has advised the Department in writing of the terms of this agreement.

4.2 BLASTING

Condition 16 and 17 of Schedule 4 of the development consent nominates the blasting limits for the quarry, as reproduced in **Table 12**.

Table 12 Consent Blasting Criteria – Any Receiver on Privately Owned Land

Allowable Exceedance	Airblast Overpressure	Peak Particle Velocity
	dB Lin Peak	mm/s
5% of the total number of blasts over a 12 month period	115	5
0%	120	10

Notes:

1. Blasting operations at the site may only take place
   a) between 9am and 5pm Monday to Saturday inclusive;
   b) are limited to 2 blasts each day; and
   c) at such other times as may be approved by EPA.

The Quarry is required to meet the blasting criteria in **Table 12** measured in accordance with the relevant requirements outlined in **Section 7**. It should also be noted that the noise criteria outlined above does not apply if Boral has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and Boral has advised the Department in writing of the terms of this agreement.

4.3 NOISE AND BLAST MANAGEMENT OBJECTIVES AND PERFORMANCE CRITERIA

The NVMP provides the noise management framework and control measures to ensure the quarry meets the noise criteria and other relevant consent conditions. The performance criteria outlined in **Table 13** will be used to assess the success of the noise and blast management measures.

Table 13 Noise and Blast Management Objectives and Performance Criteria

Objective	Performance Criteria
Compliance with regulatory requirements including development consent and EPL	No non compliances
Implement best reasonable and feasible noise and blast management practices to minimise noise levels emitted by the Project	All noise management controls in the NVMP are in place
Identify potential noise sources and their relative contribution to noise impacts from the development	Review of regular noise monitoring data
Identify potential conditions and factors that have potential to lead to exceedances of blast criteria	Review of regular blast monitoring data and blast design
Provided data suitable to demonstrate compliance with the development consent	Monitoring undertaken as per the NVMP
Ensure noise levels are below relevant criteria at the nearest residences	Review of regular noise monitoring data including complaints All management controls in the NVMP are in place
Ensure blast emissions satisfy relevant criteria at the nearest receivers	Review of regular blast monitoring data including complaints All blast management controls in the NVMP are in place

Avoidance of impacts on the heritage values on the buildings on Lot 10 DP977931	Blast monitoring at the site of the heritage buildings (Lot 10 DP977931). Annual dilapidation survey to verify building condition.

To reasonably manage and minimise potential cumulative noise impacts generated by the quarry and the Dunmore Lakes Sand Quarry the Quarry's Environmental and Stakeholder Advisor will communicate regularly and work closely with Dunmore Lakes Sand Quarry operational team to reduce occurrences of simultaneously loud activities from both sites, that increase the potential for noise levels at receivers that exceed each project's noise limits.

5 NOISE MANAGEMENT CONTROLS

5.1 NOISE MANAGEMENT CONTROLS

The Mod13 NIA did not identify any specific noise management measures for the quarry to operate within the consent criteria The primary objective of the following noise management controls is to minimise noise impacts on the surrounding community. The following hierarchical approach is used to ensure that operations comply with the relevant conditions of the consent:

- Quarry operations will be managed to meet the criteria presented in Table 2 of the consent (**Table 5** of this plan) and EPL noise criteria, through operational practices and the implementation of reasonable and feasible noise controls as outlined in **Sections 5.1.1, 5.1.3** and **5.1.4.**
- Where noise levels exceed noise criteria or verified noise complaints are received, ensure all noise controls are in place or determine the need to reduce operations and point of source noise.
- Liaise with the local community regarding scheduled works which are predicted to have increased noise impacts.

5.1.1 General Noise Management Measures

In *Dunmore Quarry Modification 9 – Noise Assessment* (EMM 2016), it was predicted that noise levels would exceed non-mandatory EPA criteria at nearby residences during Stage 3 extraction (ie operations at the western most point of the Croome West Pit) under adverse weather conditions.

As per the Modification 9 noise assessment, adverse weather conditions experienced at the site are defined as:

- wind speeds of 2.5 metres per second during the evening period; and
- atmospheric stability category F during the morning shoulder period.

As such, during the latter phases of Stage 3 extraction, operations at the western most points of the Croome West Pit will be restricted to the lower benches during these periods, when the relevant adverse weather conditions prevail as guided by the on-site weather station.

Management practices will be reviewed annually to ensure that current practices align with contemporary best practice standards. These actions will be documented, and their implementation monitored. Boral will maintain awareness of new technologies for noise mitigation through participation in relevant industry groups. Boral will implement noise mitigation measures in line with industry best practice noise management where reasonable and feasible to do so.

5.1.2 Operating Hours

The quarry is to operate within the approved operating hours as presented in **Table 14**.

Table 14 Operating Hours for the Development

Activity	Days of the Week	Time
Extraction and Processing	Monday – Saturday	6.00am to 10.00pm
Production Transfer to Stockpiles	Monday – Saturday	6.00am to midnight
Maintenance	Monday – Saturday	24 hrs
Construction (including construction of the bund under Modification 8)	Monday – Saturday	7.00am to 6.00pm Monday to Friday 8.00am to 1.00pm Saturday

Blasting	Monday – Saturday	9:00am and 5:00pm

5.1.3 Design Controls

Dunmore quarry is committed to implementing and maintaining the following design controls to manage noise generation:

- the primary, secondary and tertiary crushing plant are located to maximise natural topographic shielding and reduce noise impacts on surrounding areas to the north and west;
- the primary, secondary and tertiary crushing plant and associated conveyors are enclosed and/or cladded;
- the noise/visual bund outlined in Modification 8 has been constructed and will provide significant attenuation to all future operations including the stripping; and
- noise impacts have been considered during the extraction planning process.

5.1.4 Management of operational activities, Plant and Equipment

Site activities that are likely to generate the most noise include:

- Drilling of rock to be blasted.
- In-pit extraction and processing operations.
- Haulage of overburden material to the overburden emplacements, spreading of material on the emplacements and shaping/contouring the emplacements.
- Haulage of rock to stockpiles and processing plant;
- Rail loading and product transportation.
- Loading and unloading of material to crushers, stockpiles, trains and trucks.

The following additional noise controls, where reasonably practical, will be adopted to minimise the potential of exceeding the noise criteria: These measures will be utilised overall operating periods, including shoulder periods, where necessary:

- no oversized raw feed material will be processed during the shoulder period of operations. As per condition 11
- operational activities will be modified or ceased if they have the potential to be intrusive
- Select the most effective mufflers, enclosures and low-noise tools and equipment where possible.
- Select suitable equipment (dozers, drill rigs) with the lowest possible sound power level emissions.
- Less annoying alternatives to audible reversing alarms (such as broadband noise emitting models i.e. ‘squashed duck’, or ‘smart’ alarms) are used on site.
- Use alternatives to diesel and petrol engines and pneumatic units, such as hydraulic or electric-controlled units, where feasible and reasonable.
- Reduce throttle settings where feasible and turn off equipment and plant when not being used.
- Regularly inspect and maintain equipment to ensure it is in good working order.
- Regular check noise control equipment and devices such as exhaust mufflers, attenuators, enclosures, insulation/cladding and barriers/bunds. Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.
- Fit for purpose and pre start checks are required on all mobile equipment which includes ensuring effective mufflers and reversing alarms are installed and in good working order.

- For machines with fitted enclosures, check that doors and door seals are in good working order and that the doors close properly against the seals.
- Utilise site topography or structures to shield noise emission sources from local receivers, where practicable.

5.1.5 Road Transport

All road trucks are required to operate in accordance with Boral's Driver Code of Conduct (Appendix A) and should not cause unnecessary noise emissions to minimise the potential of exceeding the noise criteria.

5.1.6 Rail Transport

Rail operations are managed by Pacific National who are obligated to comply with the operational noise limits of the EPL 3142 (held by ARTC) for the operation of rail vehicles on the network.

5.1.7 Monitoring of Meteorological Conditions

Weather conditions have the potential to increase noise levels at the residential receivers in the vicinity of the Quarry. Routine monitoring of meteorological conditions is conducted using data from the on-site meteorological station and local weather forecasts.

This noise management strategy is of particular importance during operations at the western most points of the Croome West Pit, which is the extractive operations are closest to receivers, and are susceptible to the effects of prevailing winds and temperature inversions.

Meteorological data is monitored and evaluated to plan onsite activities potentially associated with high noise level generating activities, prior to and as close as possible to the work being undertaken. The expected weather conditions and their effect on the noise generated, is considered and timing of planned activities altered if necessary. Meteorological conditions considered are:

- prevailing wind direction and velocity;
- temperature inversions (particularly during the morning shoulder period);
- time of day;
- seasonal effects on weather patterns; and
- cloud cover.

A weather station has been installed to provide real-time monitoring of meteorological conditions via a remote telemetry to transmit data directly to a computer at the site office/control room (refer **Figure 2**).

Forecasts of the predictions of noise enhancing meteorological conditions will be discussed with the Quarry operations team on a regular basis at the site start-up meetings.

6 NOISE MONITORING

6.1 NOISE MONITORING PROGRAM

Noise monitoring will comprise of an operator attended monitoring program (refer **Section 6.2**) capable of determining compliance with the noise criteria.

Noise monitoring shall be undertaken with due regard to and in accordance with the procedures outlined in the NPI, EPA Approved Methods and Standards Australia AS 1055:2018 (AS 1055) – Acoustics – Description and Measurement of Environmental Noise.

The findings of noise monitoring will guide the general planning of quarrying operations and the implementation of both proactive and reactive noise mitigation and management measures to ensure compliance with the noise criteria in the consent.

6.1.1 Instrumentation Requirements

All acoustic instrumentation shall meet the requirements of Standards Australia AS/NZS IEC 61672.1:2019 Electroacoustics - Sound level meters (AS61672.1) as applicable to the device.

Operator attended monitoring should be conducted using a Type 1 'integrating-averaging' Sound Level Meter (SLM) capable of measuring in third octaves with A, C and Z weightings and Fast and Slow time weightings. SLMs shall be able to continuously record statistical noise level parameters in 15 minute intervals which may include the L_{Amax}, L_{A1}, L_{A10}, L_{A90}, L_{Amin} and L_{Aeq}.

Instrument calibration (all devices) shall be checked before and after each measurement survey, with the variation in calibrated levels not exceeding ±0.5 dB(A). A hand held acoustic calibrator will be used to do these field checks and will comply with the requirements of Standards Australia AS/IEC 60942:2004 (IEC60942) – Australian Standard – *Electroacoustics – Sound Calibrators*.

All acoustic instrumentation used for monitoring under the noise monitoring program will have current NATA or manufacturer calibration certificates and as per the EPA's Approved Methods for the measurement and analysis of environmental noise in NSW (EPA, 2022).

6.2 OPERATOR ATTENDED NOISE MONITORING

6.2.1 Noise Monitoring Locations

Operator attended noise monitoring will be undertaken by an independent, suitably qualified acoustic consultant.

Operator attended noise monitoring shall be conducted at locations representative of receivers NM1 to NM5 and are listed in **Table 15** and **Figure 2**. The representative monitoring locations will be selected by the acoustic consultant during the initial attended monitoring program. Monitoring locations (NM1 to NM5) shown are indicative and, where appropriate, preference to publicly accessible positions should be adopted to reduce disturbance to residents.

It should be noted that in instances where monitoring may not be conducted at residential receivers due to access limitations, noise levels may be measured at the nearest accessible point and extrapolated via calculation to the nearest residential receiver location for comparison to noise assessment criteria.

Table 15 Noise Monitoring Locations

ID	Monitoring Location	Representative of Receivers
NM1	K (Swamp Road)	South Eastern Receivers - C, K
NM2	S (Croome Vale Road)	Southern Receivers - S
NM3	T (Jamberoo Road)	South Western Receivers – T
NM4	G (Croome Road)	Western Receivers – G, D, Z
NM5	F (Croome Road)	North Western Receivers – F, AA, AB

6.2.2 Measurement Requirements

The Sound Level Meter (SLM) shall be programmed to record statistical noise levels including the L_{Amax}, L_{A1}, L_{A10}, L_{A90}, L_{Amin} and the L_{Aeq} parameters, for each measurement conducted. The SLM microphone must be placed between 1.2 and 1.5 metres above the ground and be at least 3.5m from any reflecting structure other than the ground.

The operator shall quantify site noise emissions and estimate the $L_{Aeq(15min)}$ noise contribution from the operation (i.e. haul trucks, dozers, drills, excavators etc.) as well as the overall level of ambient noise. Information to be recorded for all operator attended monitoring will include:

- date and time, location and operator;
- meteorological conditions (i.e. temperature, humidity, cloud cover, and wind speed and direction);
- statistical noise level descriptors (LA1, LA10, LA90) and LAmax levels together with notes identifying the dominant noise sources;
- measurements in one-third octave bands from 10 Hz to 8 kHz inclusive (or a broader range of bands) for the 15 minute interval to assess if modifying factors are to be applied;
- overall C-weighted and A-weighted level to assess low frequency noise;
- instrument make, model, serial number and calibration details;
- a brief description of activities at the quarry wherever possible;
- identify quarry related noise sources and their relative contribution to overall ambient noise levels; and
- where possible, identify other extraneous and non-quarry noise sources.

Any significant quarry generated noise sources (i.e. haul trucks, bulldozers, front-end loaders, etc) will be recorded, together with any extraneous noise sources.

In the event of an exceedance of the noise criteria attributable to the quarry, identified during operator attended monitoring, the operator will promptly contact the Environmental and Stakeholder Advisor, advising of the exceedance and informing location, the degree of exceedance and the source of emission where possible.

FIGURE 2
NOISE MONITORING LOCATIONS
MAC180747
Dunmore Quarry

KEY

- Receivers
- RIC Extension
- Cadastral Boundary
- Noise Monitoring Locations
- Weather Station

0 100 200 300 400 500 m

N

MAC
Muller Acoustic Consulting

6.2.3 Frequency of Monitoring

Operator attended noise monitoring will be undertaken by an independent, suitably qualified acoustic consultant on an annual basis as a minimum, typically during the winter months where the effect of temperature inversions are more likely to occur.

Monitoring will be undertaken during the daytime, evening and morning shoulder at each of the nominated representative receiver locations. The attended noise monitoring must include, as a minimum, one 15 minute measurement at each of the five attended noise monitoring locations during the following periods:

- daytime (7 am-6 pm Monday to Saturday and 8 am-6 pm Sundays and public holidays);
- evening (6 pm to 10 pm); and
- morning shoulder (6 am to 7 am).

6.2.4 Data Analysis and Determining Compliance

Compliance with the consent and EPL is determined by comparison of the quarry contributed noise level at each monitoring location for the daytime, evening and morning shoulder with the relevant consent and EPL noise limits.

The $L_{Aeq(15min)}$ noise level contributions from the operations as well as the overall ambient noise levels together with the weather and quarry operating conditions shall be compiled and reported for each monitoring event.

It should be noted that the ambient noise levels do not necessarily reflect the contributed level of noise emissions from quarrying operations. The ambient noise level data quantifies the overall noise level at a given location independent of its source or character. The ambient noise monitoring data will provide indications of the cumulative noise emissions from all industrial noise sources and amenity levels.

All monitoring data is reviewed upon completion, including the annual noise compliance survey and any other noise monitoring conducted at any other time.

6.2.5 Accounting for Annoying Noise Characteristics – Low Frequency Noise

The NPI states that a noise source may exhibit a range of characteristics that increase annoyance, such as tones, irregularity, low frequency noise and intermittent noise. Where this is the case, an adjustment ("modifying factor" penalty) is applied to the source noise level received at an assessment point before it is compared with criteria to account for the additional annoyance caused by the particular characteristic.

Application of these modifying factors is described in Fact Sheet C of the NPI. It also provides the following definitions to support the modifying factor corrections:

- Tonal Noise – containing a prominent frequency and characterised by a definite pitch.
- Low Frequency Noise – noise with an unbalanced spectrum and containing major components within the low-frequency range (10–160 Hz) of the frequency spectrum – refer **Table 16**.
- Intermittent Noise – noise where the level suddenly drops/increases several times during the assessment period, with a noticeable change in source noise level of at least 5 dB(A); for example, equipment cycling on and off.

Table C1 of NPI Fact Sheet C sets out the corrections to be applied and is reproduced below in **Table 17** The corrections specified for tonal, intermittent and low-frequency noise are to be added to the measured or predicted noise levels at the receiver before comparison with the project noise trigger levels. The adjustments for duration are to be applied to the criterion.

All noise levels generated by the quarry will be assessed with due regard to these modifying factor penalties, and in accordance with the requirements presented in the consent and EPL. Tonal noise and low frequency noise modifying factors are most relevant to the quarry and are reproduced in **Table 17**.

In accordance with the NPI, a maximum correction (considering other factors of intermittent noise and duration) of up to 10 dBA will be applied where two or more modifying factors are present. Where a source emits tonal and low frequency noise, only one 5 dBA correction will be applied if the tone is in the low frequency range.

One-third octave low-frequency noise thresholds referenced in Table C2 of NPI Fact Sheet C, are identified in **Table 16**.

Table 16 One-Third Octave Low-Frequency Noise Thresholds

Hz/dB(Z)	One-third octave LZeq,15min threshold level												
Frequency (Hz)	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
dB(Z)	92	89	86	77	69	61	54	50	50	48	48	46	44

6.2.6 Meteorological Parameters

Note 5 of Table 2 in Condition 7 of Schedule 4 the consent, states that the noise limits apply under the following meteorological conditions:

- wind speeds of up to 3 m/s at 10 metres above ground level; or
- temperature inversion conditions of up to 3°C/100 m and wind speeds up to 2 m/s at 10 metres above ground level

All noise measurements shall be accompanied by both qualitative description (including cloud cover) and quantitative measurements of prevailing local weather conditions throughout the survey period.

Assessment of the meteorological conditions during the noise surveys will be made using the following parameters obtained from the on-site weather station:

- mean wind speed;
- mean wind direction;
- rainfall; and
- Pasquill-Gifford stability class or temperature lapse rate in degrees per 100m.

Table 17 NPI Modifying Factors

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (ISO1996.2-2017 – Annex D).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5dB[2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. Note: Narrow-band analysis using the reference method in ISO1996-2:2017, Annex C may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low-frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10– 160 Hz	Measure/assess source contribution C and A-weighted Leq,T levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5dB and cannot be mitigated, a 2dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2dB or 5dB[2]	A difference of 15 dB or more between C-and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5dB(A) and the intermittent nature of the noise is clearly audible.	5dB	Adjustment to be applied for night-time only.

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Duration	Single-event noise duration may range from 1.5 min to 2.5 h.	One event in any assessment period.	0 to 20dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum adjustment	Refer to individual modifying factors.	Where two or more modifying factors are indicated.	Maximum correction of 10dB(A)[2] (excluding duration correction).	

1. Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
2. Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.
3. Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2017 standard.

6.3 NOISE MONITORING REPORTS

All routine monitoring results will be documented and reported. Initially this will be three months from the date of the consent. Afterwards it will be annually.

Annual reports must consist of the following information:

- summary of all attended noise monitoring results;
- measured, calculated and/or operator estimated quarry LAeq,15 minute contributed noise levels for each monitoring location;
- measured, calculated and/or operator estimated quarry LAmax or LA1,1 minute contributed noise levels for each monitoring location;
- statement of compliance/non-compliance; and
- details of any complaints relating to noise and their state of resolution.

6.3.1 Review of Results and Reporting

Boral will review the monitoring report provided by the contractor to assess compliance with the limits outlined in Table 2 in Condition 7 of Schedule 4 of the development consent (refer to **Section 2** and **4.1**).

Where monitoring levels indicate that the noise level at the boundary or at a residence of a privately owned property exceeds the consent noise limits, then additional monitoring will be undertaken (with the approval of the land owner) across the property to develop a full understanding of the extent of the impact.

Condition 1 of Schedule 4A of the consent, requires that the details of any exceedances are provided to any affected land owner and/or tenants within 7 days.

7 BLAST MANAGEMENT CONTROLS

7.1 INTRODUCTION

Blast design will be managed by site personnel and the blasting contractor to control the airblast overpressure and ground vibration within the limits (refer **Table 12**). Blasting that will occur on the north eastern perimeter of the proposed RIC Pit extension (ie the north eastern most point of the pit) is a significant distance from recent blast monitoring results.

7.2 MINING LICENCE/WORK PLANS REGULATORY CONDITIONS

Dunmore Quarry operates drilling and blasting activities in accordance with a Ministerial consent granted in November 2004, issued for the Development Application DA 470-11-2003 and the Environmental Protection Licence 77.

7.3 BLAST DESIGN

Blasts are designed to

- Meet safety standards for site personal and surrounding properties
- Provide the required rock needed for processing
- meet the blasting limits
- to minimise (within practical limits) fumes, the occurrence of fly-rock and
- to eliminate unconfined explosives related air-blast i.e. face blowouts and rifling from the blast-hole collars.

Single-hole (delayed) initiation will be used with signal tube technology connecting each blast-hole and also being used to fire the blast. Stemming is used to produce reliable, controlled blasts.

Boral will review and approve all proposed blast designs and depending on sensitivity of location of the blast, review factors such as blast vibration. Blasts are designed to achieve maximum efficiency in terms of explosives used. Emissions are minimised when efficiency is maximised.

Individual blast design records shall be maintained to assist in the design and optimisation of future events, planning and control of blasting emissions and to provide a traceable system of documentation in case of accident or complaint. This is completed as part of the Boral Blast Management plan.

The blasting contractor shall record the blast parameters for each blast and include the location co-ordinates (East, North, RL) of the blast site and the maximum instantaneous charge (MIC) to be detonated in any eight millisecond (ms) interval.

For the purposes of blast emission monitoring, the quarry shall maintain a record of the Blast Design and monitoring Airblast Overpressure and Ground Vibration for each blast event in a suitable format guided by the requirements of AS 2187.2-2006.

To maximise the benefits of the blast monitoring process, the significant design parameters, emission levels and meteorological data shall be collated on a concise Blast Emissions Summary Record. The record shall form the basis for updating the blast emission site laws for vibration and air-blast at appropriate interval.

7.3.1 Explosive Loading, Initiation Hook-up and Firing

To ensure correct hook up and explosive loading the following measures from Orica's guidelines are implemented prior to blasting:

- Blast-hole depths are determined to within ±200 mm and recorded on the driller's log;
- Bulk explosive loading equipment is selected to offer a loading accuracy of ±10% of product, if required; and
- Column rise of the explosive product is measured and checked against design with corrective options in place to manage variations.

7.3.2 Engineered Exclusion Zone

An externally accredited blasting consultant can modify the default Exclusion Zone (as outlined within Boral's Drilling and Blasting Standard requirements) through a formal process which:

- Considers geological information;
- Reviews drilling and blasting parameters to identify a "Maximum Loading Scenario" which takes into account Maximum Charge, Minimum Burden, Minimum Stemming and Hole Angle;
- Uses a scientific method to model and predict maximum throw and trajectory of flyrock;
- Calculates an exclusion Zone Based on the following Factors of Safety;
- Protection of Buildings Plant and Equipment (this includes vibration)– Safety Factor 2.0
- Protection of People (this includes Flyrock) – Safety Factor 4.0
- Public or Critical Infrastructure – Safety Factor [Insert factor]

The Blast Consultant has also identified the triggers that would force a review of the Engineered Exclusion Zone. That is, any change to the sites Standard Blasting Parameters that extend the Maximum Loading Scenario as defined by Flyrock Modelling.

If there are technical concerns or if a hazard is discovered whilst loading the shot, and this hazard cannot be controlled with the placement of an artificial burden, a risk analysis is to be carried out to determine if the minimum safe distances need to be increased for the shot. The Shot Firer shall ensure that the minimum distances are determined and communicated prior to the placement of blast guards.

The Consultant Engineer's report is attached in Appendix B.

Determining the Blast Exclusion Zone for Dunmore Quarry

Production Blasts 102mm, Free-face and Buffered Free Face – SIS Compliant

Jonathon Keller - 11/03/2019

Report recommends 300m as the exclusion zone distance for personnel, and 150m exclusion zone distance for equipment.

It is important to note that the model used in developing these recommendations is limited to the SIS applicable to the site as of the date of this report assuming that;

a) the minimum stemming as per the SIS is applied
b) bridging does not occur; appropriate crushed aggregate fills the stemming column
c) the stemming collar is not in broken ground and overburden; that is, increased stemming lengths in these areas as per TBT's delivered to the blast crew
d) front row holes laser profiled, boretracked and loaded as per SIS.

Results from this study do not apply to specific blast types including oversize and toe or drop cut blasts. Larger exclusion zone distances should apply in these circumstances depending on the risk assessment conducted for each case.

7.3.3 Default Exclusion Zone

In the absence of a formal risk analysis, undertaken by an externally accredited blasting consultant, the following minimum Exclusion Zone distances shall apply:

- For non-blast personnel 800m in front of the shot and 400m to the side and rear of the shot;.
- Blast personnel must be positioned greater than 400 metres from the shot and not positioned in the direct line of fire and within retreat distance of a protective structure (i.e. fixed plant or blasting bell);
- No mobile plant is to be within 300 metres of the initiation point without signed site manager's approval;
- Where a blast is to occur within 100 metres of fixed plant an appropriate blasting specialist shall be engaged to design and control the loading and firing process.

7.4 PUBLIC SAFETY

Prior to all blasts strict protocols are in place to ensure the blasts are designed correctly with safety being priority.

As discussed above, designs take into account limiting fly rock, fume and vibration impact. The Blasting contractor works with Boral staff to plan each blast with the Quarry Manager approving the final design before a blast can occur. Designs are based on safety within the operating pit and quarry boundary. Therefore, it takes into account the nearest residences outside of the quarry boundary to ensure disturbance to people and property is minimised. Should an exclusion zone identify that the residence is within the Zone, a blast will be redesigned to minimise the exclusion zone required.

Adaptive strategies are in place during the planning process and if required on the day of the blast. Should there be concerns during drilling or in the process leading up to a blast, the blast will be postponed and the design revisited.

On the day of blasting, signage is displayed, the area within the identified exclusion zone is evacuated and all access to the area is supervised. Residents who which to be advised are notified.

7.5 BLASTING TIMES

In accordance with the development consent and environmental protection licence, blasting occurs between 9:00am and 5:00pm Monday to Saturday, and no more than two times per day or at such other times as may be approved by the EPA.

7.6 METEOROLOGICAL ASSESSMENT

Meteorological data will be evaluated prior to blasting, and as close as practical to the time of blasting. The expected weather conditions and their effect on the airblast level (as well as dust and fumes) generated by blasting will be considered and blast plans and/or timing altered, if necessary.

Meteorological conditions that will be considered are:

- Prevailing winds including the direction and velocity;
- Time of day;
- Seasonal effects on weather patterns;

- Cloud cover.

Blasting will be avoided, where possible, under the following meteorological conditions:

- When winds are blowing from the blast site to the nearest receiver at a strength (>10m/s) likely to enhance blasting impacts;
- When there is heavy low-level cloud.

The above meteorological triggers may be amended based on best practice or on the basis of blast monitoring.

7.7 Blast Notifications

Prior to production blasting, Boral will contact affected landowners, occupiers or sensitive facilities on the Blast Notification List and those landowners who have been asked to be notified. See **Table 18** for details.

Table 18 Blast Notifications

ID	Organisation	Contact	Preferred Contact Method & Details		Notification Period	Approval Required
			Phone Call	Email		
1	Resdient – Pemberton	Allan Pemberton	Not for publication	Not for publication	Day of Blast	No
2	Jetgo - Airport	Ian Douglas	Not for publication	Not for publication	24 hours	no

7.8 Blast fume management

The use of ammonium nitrate based explosives under variable conditions can lead to unwanted explosive reactions and the generation of oxides of nitrogen (NOx), a combination of post blast gases which are predominantly nitrogen dioxide (NO_2), but may also include small amounts of nitrous oxide, nitric oxide (NO), carbon monoxide and carbon dioxide. The two main gases, NO and NO_2 are often found as by-products in the post-blast gases of ammonium nitrate-based explosives. Nitric oxide is unstable in air and readily oxidises to nitrogen dioxide. A cloud of NO_2 can range from yellow to dark red/purple in colour depending on the concentration and size of the gas cloud. These gases are potentially harmful to humans and livestock.

The key contributing factors associated with the generation of blast fume are:

- Explosive formulation and quality assurance;
- Geological conditions;
- Blast design considerations;
- Explosive product selection;
- Contamination of explosives in the blast hole;
- On-bench practices, including sleep time;
- Weather;
- Post-blast fume management.

Strategies for the management of each of these contributing factors are detailed in **Table 19**.

Table 19 Aspects, risks, impacts and management controls for fume mitigation

Aspect	Indicators	Management Measure	Responsibility	
			Mining Operations	Drill/Blast Contractor
Explosive Formulation & Quality	Poor blast performance e.g. incomplete detonation of explosive leading to fume generation.	Ensure precursors have batch traceability and quality control documentation with tolerances for each batch held at manufacturing facilities.		x
	Incomplete detonation of the explosive column. Oxygen imbalance	Recording bench conditions and variations to blast design and communicating to all affected parties. Information that will be recorded includes: incorrectly drilled holes; missing holes; collapsed/slumping holes; density & amount of product loaded; presence of water (surface and sub-surface); and depth of holes	x	
		Review as-loaded data versus design to look for inconsistencies.	x	x
Quality Assurance	Failure to conduct quality tests	Quality check all raw materials used in the precursors for compatibility, including visual inspections of bulk and initiating explosives.		x
		QA sheets for delivery can be obtained from relevant suppliers.		x
		Diesel quantities are tracked on every blast and recorded in blast packs.		x
Product Rotation	Product past used by date.	Raw materials to be consumed as per the stock rotation process, initiating explosives will be managed as per magazine management rules and checked during stock take.		x
		AN prill to be consumed as per the stock rotation process. This minimises the effects of weather and deterioration.		x
Delivery System	Failure to conduct quality tests	Bi-monthly calibration of metering systems, undertaking density and visual checks during mixing of raw materials		x
Contractor	Failure to conduct quality tests	Auditing schedule to ensure compliance of storage and procedures.		x

Aspect	Indicators	Management Measure	Responsibility	
			Mining Operations	Drill/Blast Contractor
		Boral to undertake regular audit of blasting operations and systems	x	
Geology	Fume issues from blasts in areas known to contain weak/soft strata	Modifying blast design and/or explosive product selection to suit conditions, methodology should be to reduce the explosive density/energy in soft strata	x	x
		Planning schedule should also consider the size of the blast and where appropriate the extent of the blast boundaries	x	x
		Drill logs to be reviewed to map areas of concern, e.g. soft/broken/faulted ground	x	x
		Load sheets to contain specific instructions on loading so there is no overloading/over powering in blast holes	x	x
	Slumped blast holes & explosive column dislocation	Design blast geometry and timing to promote adequate movement and relief	x	
		Ensure primer is positioned in the column of explosive as per contractor procedures		x
		Holes to be primed as per manufacturers specifications, further priming to be used in areas of faulting		x
Blast Design	Incomplete detonation of the explosives column Desensitisation of adjacent columns Minimal or uncontrolled movement in blast	Selecting suitable explosives and accessories for the hole depth, diameter, moisture level, ground hardness and density. Products selected will be capable of mitigating against the presence of wet holes/extreme weather events (where appropriate)	x	x
		Selecting initiating devices that are suitable to initiate and maintain the detonation, compatible with the explosives and used in accordance with explosive manufacturer's recommendations	x	x
		Design blast geometry and timing to promote adequate movement and relief Optimise loading and timing around back and side walls to promote relief	x	x
		Shotfirer to inspect hole locations prior to loading & D&B Engineer to check as drilled data to ensure pattern is drilled to design	x	x
	Hole cratering or flyrock	Use appropriate/proven stemming heights, stemming will ideally be crushed aggregate	x	
		Utilise face scans to optimise face burden design	x	

Aspect	Indicators	Management Measure	Responsibility	
			Mining Operations	Drill/Blast Contractor
		Optimise loading and timing around back and side walls to promote relief	x	
Product Selection	Repeated significant fume events/poor blast performance Incomplete detonation of the explosives column Desensitisation of adjacent columns	Selecting suitable explosives and accessories for the hole depth, diameter, moisture level, ground hardness and density. Products selected will be capable of mitigating against the presence of wet holes/extreme weather events (where appropriate)	x	x
		Explosives technical data sheets to be followed when selecting appropriate explosives, if the technical data sheets cannot be adhered to then the design needs to be risk assessed with all appropriate parties. Consent by Boral's, Site Manager would need to be given prior to loading/firing	x	x
Contamination	Fume from product contamination Slumping blast holes	Shotfirer to inspect sleeping shots daily (N/A		x
		Holes with damp walls or water within the blast hole will be treated as 'wet' and will require appropriate bulk explosives	x	x
		Holes adjoining 'wet' hole will also be treated as being wet to mitigate impact of potential runoff or subsurface water		x
		Discharged water run-off to be kept away from blast holes as per blasting contractor procedure	x	x
	Cratering and fly rock	Stemming should be free from contamination and free flowing to allow accurate and controlled loading into the blast holes. Stemming should be stored so that there is minimised risk of contamination caused by larger rock/fines/clay.		x
On bench practices	Repeated significant fume events/poor blast performance	Ensuring all personnel involved in on bench activities are appropriately qualified and experienced and have a comprehensive understanding around the factors that can lead to the generation of blast fume		x
		Appropriate supervision/management of blasts crews		x
		As loaded data to be recorded and reviewed for compliance		x
		On bench quality control testing will carried out for every load of product and recorded on load sheets		x
		Bench preparation sign off prior to loading	x	x

Aspect	Indicators	Management Measure	Responsibility	
			Mining Operations	Drill/Blast Contractor
		Adequate bunding and drainage in place prior to drilling and loading	x	x
		Understand technical specifications of explosive products, blast crew training and manage blast schedule with loading, weather and sleep times being considered	x	x
		Scheduling sequence to minimise the delay between drilling and loading of the blast and sleep time of the explosives	x	x
Weather	Fume cloud is generated and is carried by wind towards a public area or private residence Water in blast hole limits detonation of explosive resulting in excessive fume	Assessing weather conditions prior to firing each shot.		x
		Use local weather to guide the scheduling of blast preparation activities	x	
Post blast fume management		Any excessive fume events will require an investigation to determine contributing factors and develop corrective actions.	x	

8 BLAST MONITORING

8.1 BLAST MONITORING LOCATIONS

All blasts at the quarry are monitored air blast overpressure and ground vibration impacts at key locations around the quarry. Currently the quarry has two blast monitors – 'McParland's' and 'Compliance Monitor'. The details for each monitor are shown in Table 20 and Figure 3.

The results of blast monitoring will guide the general planning of quarrying operations and the implementation of both proactive and reactive blast design measures to ensure compliance with the blasting emissions criteria in the consent.

Table 20 Blast Monitoring Locations

Monitoring Station	Entry Address	Station Description	Coordinates
Compliance Monitor	Entry is from the end of Croome Road.	The monitoring position is located approx. 115m South East of the Benny residence on the Boral property line.	34° 36.012'S 150° 48.022'E
McParlands Non-Compliance Monitor	Entry is from the rear gate of the quarry or alternately from Croome Vale Road.	The monitoring position is located approx. 30m North of the McParland residence on a solid rock floater.	34° 36.502'S 150° 48.329'E

Note: The blast monitor at Mc Parland's (Lot 10 DP977931) is located in the vicinity of the heritage buildings to directly measure vibration levels and to validate the avoidance of impacts on their heritage values.

8.1.1 Blast Monitoring Reports

Blasting reports will be prepared and made available after each blast. The Quarry Manager (or their delegate) will retain all blast reports (for a minimum of four years) and prepare a monthly summary of all blast activity conducted. An annual summary of the blast monitoring results will be compiled and submitted to the EPA within the Annual Return for the Licence: EPL 77

Where an exceedance is detected, the blast monitoring report will be prepared within 72 hours of a blast where possible, entered into the blast records and be available for internal review or distribution. Results are reported annually as required by Schedule 5, Condition 9 of the consent.

8.2 INSTRUMENTATION REQUIREMENTS

Table 21 presents the general instrumentation specification for blast monitoring equipment.

Table 21 General Instrumentation Specification for Blast Monitoring Equipment

Specification	Seismic	Air Blast
Sample Rate	Minimum 1024 samples per second per channel	
Frequency Response	2 Hz to 250 Hz (3 dB points)	
Resolution	0.016 mm/s	0.1 dB
Range	0.1 mm/s to 254 mm/s	88 dB to 148 dB
Accuracy	3% at 15 Hz	0.2 dB at 30 Hz

Specification	Seismic	Air Blast
Communications Link	Keyboard and modem	
Recording Mode	Full waveform recording and archiving	
Unit of Measurement	mm/s	dB (Lin Peak)
Measurement Locations	Not less than 30m from a building or structure (or as otherwise agreed by EPA)	Not less than 3.5m from a building or structure (or as otherwise agreed by EPA)
Sampling Method	AS2187.2-1993	
Frequency	Every Blast	

FIGURE 3

BLAST MONITORING LOCATIONS

MAC180747

Dunmore Quarry

KEY

- Receivers
- RIC Extension
- Cadastral Boundary
- Blast Monitor

0 100 200 300 400 500 m

N

MAC
Muller Acoustic Consulting

9 Environmental Performance Review and Improvement Program

9.1 Performance Evaluation

The performance of the Quarry is to be evaluated against the key performance criteria outlined in **Section 4. Table 22** indicates the evaluation schedule for each key performance criteria. Where performance criteria are not being met, the contingency plan in **Section 10.8** is to be implemented.

Table 22 Noise Management Objectives and Performance Criteria

Key Performance Indicator	Performance Evaluation Schedule
No non compliances	Annual
All noise and blast management controls in the NVMP are in place	Continuous
Review of regular noise monitoring data and blast monitoring results	Continuous
Review of regular blast monitoring data and blast design	Continuous
Noise monitoring undertaken as per the NVMP	Annual
Review of complaints (noise and/or blasting related)	Continuous
All management controls in the NVMP are in place	Continuous

9.2 Annual Review and Compliance Reporting

9.2.1 Noise

In accordance with Condition 9 of Schedule 5 of the consent, by the end of September each year, or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. The review must:

a) describe the development (including rehabilitation) that was carried out in the previous financial year, and the development that is proposed to be carried out over the current financial year;

b) include a comprehensive review of the monitoring results and complaints records of the development over the previous financial year, which includes a comparison of these results against the:
   - relevant statutory requirements, limits or performance measures/criteria;
   - requirements of any plan or program required under this consent;
   - monitoring results of previous years; and

c) Evaluate and report on:
   - The effectiveness of the noise management systems; and
   - Compliance with the performance measures, criteria and consent conditions;

d) identify any non-compliance over the last financial year, and describe what actions were (or are being) taken to ensure compliance; and

e) identify any trends in the monitoring data over the life of the development;

f) identify any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies; and

g) describe what measures will be implemented over the current financial year to improve the environmental performance of the development.

The Applicant must ensure that copies of the Annual Review are submitted to Council and are available to the Community Consultative Committee (see Condition 6 of Schedule 5) and any interested person upon request.

The findings of the annual review will confirm the noise performance of the Quarry and identify any areas of improvement to ensure the quarry can operate with minimal noise impacts to the surrounding area.

9.2.2 Blasting

In accordance with Condition 9, Schedule 5, by the end of September each year after the commencement of development, or other timeframe agreed by the Planning Secretary, a report must be submitted to the Department reviewing the environmental performance of the development, to the satisfaction of the Planning Secretary. The review must:

- Include a comprehensive review of any incidents, monitoring results and complaints records of the development over the previous financial year, including a comparison of these records against the:
- Relevant statutory requirements, limits or performance measures/ criteria;
- Requirements of any plan or program required under this consent; and
- Monitoring results of previous years;
- Evaluate and report on:
- The effectiveness of the blast management systems; and
- Compliance with the performance measures, criteria and operating conditions of the consent.
- Identify trends in the monitoring data over the life of the development;
- Identify any discrepancies between the predicted and actual impacts of the development and, analyse the potential cause of any significant discrepancies.

The findings of the annual review will inform the blast performance of the quarry and identify any areas of improvement to ensure the quarry can operate with minimal blast impacts to the surrounding area.

9.3 Public Reporting

Boral are required under the Environment Protection Licence to report on all required monitoring. All noise and blast monitoring are included within these reports. The reports are available on the Boral Dunmore web site.

https://www.boral.com.au/locations/boral-operations-dunmore/boral-quarries-dunmore

9.4 Continuous Improvement

9.4.1 Noise

The NVMP is to be reviewed as required by Condition 9 of Schedule 5 of the consent.

To improve the environmental performance of the Project, cater for future modifications or comply with regulator direction, it may be necessary to revise this NMP to the satisfaction of DPIE. Boral will continue to apply the approved NVMP until the approval of the revised NVMP.

Each year following the annual review outlined in **Section 9.2** and every three years after the independent environmental audit detailed in Condition 10 of Schedule 5, or modification to the consent, Boral will review

this NVMP and update it if necessary, with findings of the annual review and independent environmental audit, to promote continuous improvement. This review includes:

- A description of any changes to site operations with potential for noise impacts;
- A review of noise and blast monitoring data trends;
- A review of incidents and non-compliances;
- A review of noise and blast related complaint records for the year;
- Identification of any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies;
- A description of measures to be implemented to improve the noise performance of the quarry.

If changes are required to the NVMP it will be resubmitted to the Planning Secretary for approval within six weeks of the review. The most recent version of this NVMP as approved by the Planning Secretary is to be implemented.

9.4.2 Blasting

The BMP is to be reviewed in terms of Condition 9, Schedule 5 of the development consent.

To improve the environmental performance of the Project, cater for future modifications or comply with regulator direction, it may be necessary to revise this BMP to the satisfaction of DPHI. Boral will continue to apply the approved BMP until the approval of the revised BMP.

Each year following the annual review outlined in Section 9.2 and every three years after the independent environmental audit detailed in Condition 10, Schedule 5, Boral will review this BMP and update it if necessary, with findings of the annual review and independent environmental audit, to promote continuous improvement. This review includes:

- A description of any changes to site operations with potential for blast impacts;
- A review of blast monitoring data trends;
- A review of incidents and non-compliances;
- A review of blast complaint records for the year;
- Identification of any discrepancies between the predicted and actual impacts of the development, and analyse the potential cause of any significant discrepancies;
- A description of measures to be implemented to improve the blast performance of the quarry.

If changes are required to the BMP it will be resubmitted to the Planning Secretary for approval within six weeks of the review. The most recent version of this BMP as approved by the Planning Secretary is to be implemented.

9.5 TRAINING

All employees and contractors working on-site will undergo training relating to blast management including:

- General environmental awareness;
- The requirements of this NVMP;
- Relevant legislation;
- Roles and responsibilities for blast management and monitoring;
- Blast mitigation, management and monitoring measures; and
- Procedure to be implemented in the event of a noise or blast exceedance, incident and/or complaint.

10 INCIDENTS, NON-COMPLIANCE, COMPLAINT MANAGEMENT AND REPORTING PROTOCOL

10.1 INTRODUCTION

The objective of this section is to provide procedures for dealing with complaints and responding to impacts identified by the noise monitoring program and by routine monitoring of the noise management controls. It is also addressing the Condition 2(e) of Schedule 5 of the consent to provide a contingency plan for taking action in the unlikely event that an unforeseen incident occurs at the site (e.g. failure of noise control equipment or procedures). Responding to identified impacts will be the responsibility of the Site Manager or delegate.

10.2 REGULATORY COMPLIANCE

Boral will undertake the following to achieve compliance with all noise criteria and management requirements detailed in the consent, the EPL and this NMP:

- inspection and maintenance of noise mitigation controls;
- regular review of noise management measures and associated procedures;
- regular review of weather forecasting as necessary to predict noise-enhancing meteorological conditions and schedule operations to minimise noise impacts on receivers; and
- regular review of noise monitoring results.

10.3 INCIDENT REPORTING

In accordance with Condition 7 of Schedule 5 of the consent Boral will immediately notify the Department and any other relevant agencies after it becomes aware of an incident resulting in unauthorised noise and/or blasting impacts. The notification will be in writing through the Department's Major Projects Website and identify the development (including the development application number and name) and set out the location and nature of the incident.

The development consent defines an 'incident' as:

"An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a non-compliance".

Material harm is defined as:

"harm to the environment that:

involves actual or potential harm to the health or safety of human beings or to the environment that is not trivial, or

results in actual or potential loss or property damage of an amount, or amounts in aggregate, exceeding $10,000 (such loss includes the reasonable costs and expenses that would be incurred in taking all reasonable and practicable measures to prevent, mitigate or make good harm to the environment)

This definition excludes "harm" that is authorised under either this consent or any other statutory approval"

In accordance with EPL 77, notifications of environmental harm must be made by telephoning the Environment Line service on 131 555. Boral must provide written details of the notification to the EPA within seven days of the date on which the incident occurred. Boral or its employees must notify all relevant authorities of incidents causing or threatening material harm to the environment immediately after the person

becomes aware of the incident in accordance with the requirements of Part 5.7 of the *Protection of the Environment Operations Act 1997*.

10.4 Non-Compliance Reporting

The consent defines a 'non-compliance' as:

"An occurrence, set of circumstances or development that is a breach of this consent".

In accordance with Condition 7A of Schedule 5 of the consent Boral will, within seven days of becoming aware of a noise non-compliance, notify DPIE of the non-compliance. The notification will be in writing through the Department's Major Projects Website and identify the development (including the development application number and name), set out the condition of this consent that the development is non-compliant with, why it does not comply and the reasons for the non-compliance (if known) and what actions have been, or will be, undertaken to address the non-compliance.

The Site Manager (or delegate) is responsible for reporting noise exceedances or incidents to the DPIE.

Note that a non-compliance which has been notified as an incident does not need to also be notified as a non-compliance.

10.5 Noise Incident Response

Adverse noise impacts are likely to be associated with a malfunction of the quarry's noise control equipment, noise mitigation measures or operational procedures.

Once it is identified that a noise incident has occurred, the following actions will be taken:

- Operations that caused the noise incident are to be stopped if necessary until appropriate control systems can be implemented or repaired;
- DPIE and EPA will be notified of the incident/impact/potential impact immediately once an incident has been identified (as outlined in Section 10.3);
- An investigation will be undertaken to establish the root cause;
- Subject to the findings of the investigation actions will be taken to repair, replace or change the identified cause of the incident. These actions will be completed by appropriately qualified personnel or consultants;
- The identified cause of the incident and the selected response will be formally documented in an incident response report;
- Training will be undertaken if changes are required to procedures or operations.

Further to the management of an incident it is also noted that Schedule 4, Condition 6A allows that:

"Upon receiving a written request for mitigation from the landowner of any residence on the land listed in Table 1 or Table 1A, the Applicant must implement additional mitigation measures at or in the vicinity of the residence, in consultation with the landowner as per condition 6A. These measures must be consistent with the measures outlined in the Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Development (NSW Government, 2014), as may be updated or replaced from time to time. They must also be reasonable and feasible and proportionate to the level of predicted impact. If within 3 months of receiving this request from the landowner, the Applicant and the owner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Planning Secretary for resolution."

Such a request in writing will be considered as an incident and investigated accordingly in line with the Management plans and condition of consent.

10.6 Blast Incident Response

Adverse blasting impacts are likely to be associated with blast design or firing procedures.

Once it is identified that a noise incident has occurred, the following actions will be taken:

- Operations that caused the incident are to be stopped if necessary, until appropriate control systems can be implemented or repaired;
- DPIE and EPA will be notified of the incident/impact/potential impact immediately once an incident has been identified (as outlined in Section 10.3);
- An investigation will be undertaken to establish the root cause;
- Subject to the findings of the investigation actions will be taken to repair, replace or change the identified cause of the incident. These actions will be completed by appropriately qualified personnel or consultants;
- The identified cause of the incident and the selected response will be formally documented in an incident response report;
- Training will be undertaken if changes are required to procedures or operations.

10.7 Notification of Exceedances

In accordance with Condition 1 of Schedule 4A of the consent, as soon as practicable and no longer than seven days after obtaining monitoring results showing an exceedance of any noise limits in **Table 5** or blasting limits in **Table 7** Boral must provide the details of the exceedance to any affected landowners, tenants and the Community Consultative Committee (CCC).

10.8 Contingency Plan

Exceedances of the noise or blasting criteria may occur due to activities at the quarry or due to the surrounding environmental conditions and other activities. Exceedances are identified from results of operator attended or real time monitoring and verified to be as a result of the quarry operations or activity.

Should an exceedance be identified, the following actions will be taken:

- An investigation will be undertaken to establish the root cause of the exceedance. This will include checking weather conditions at the time of the exceedance / non-compliance, quarry operations, and any other possible factors;
- Subject to the findings of the investigation, actions will be taken to minimise any reoccurrence of the exceedance;
- The identified cause of the impact and the selected response will be formally documented in an incident response report;
- Additional noise management training will be provided to educate relevant personnel of changes to existing noise controls to minimise the reoccurrence of activities that have potential to result in an exceedance of the noise criteria.
- In the event of a blasting related exceedance, a review of the blast design is o be undertaken and the meteorological conditions at the time of the blast.

Should low frequency noise (as outlined in Section 6.2.5) be identified through a complaint and verified by measurement, it will be treated as an operational noise exceedance.

Should an exceedance result in a non-compliance the Department, affected residents and EPA will be notified within seven days of its verification.

10.9 COMPLAINTS PROTOCOL

After receiving a noise or blasting related complaint, the Environment Coordinator will:

- check the noise or blast measurement results from the relevant monitoring system, where available;
- obtain operations records and weather conditions at the time of the complaint;
- attend the location of the complaint to verify and obtain additional details.

For noise, it may be identified that additional monitoring is required. Depending on the type and location of the complaint, several measurement methods can be utilised to identify the noise source causing the complaint. Such methods may include:

- operator attended measurement at the affected location combined with audio recordings or at an alternate representative location;
- unattended noise monitoring;
- real-time noise monitoring combined with audio recordings;
- calculation from near field measurements;
- a combination of any or all of these methods.

For blasting, the blasting contractor will be advised of the complaint and a more detailed analysis report requested on the nature of the blast.

Where further investigations into the (noise or blast related) complaint are undertaken, the findings and any corrective action will be discussed with the complainant.

The results of any additional monitoring required will be reviewed and operations assessed for any required changes.

Noise and blasting related complaints received by Boral will be recorded in a Complaints Register (Sequence) which will include the following details where available:

- The date and time of the complaint;
- The method by which the complaint was made;
- Any personal details of the complainant which were provided by the complainants or, if no such details were provided, a note to that effect;
- The nature of the complaint;
- The action taken by Boral in relation to the complaint, including any follow-up contact with the complainant; and
- If no action was taken by Boral, the reasons why no action was taken.

The overarching complaints protocol for the quarry, which provides further details on how all complaints will be received, recorded, handled and responded to is described in the EMS.

10.10 INDEPENDENT REVIEW

In accordance with Condition 3 of Schedule 4A of the consent, if a landowner considers the development to be exceeding any relevant noise criterion, they may ask the Planning Secretary in writing for an independent review of the impacts of the development on their residence or land.

In accordance with Condition 4 of Schedule 4A of the consent, if the Planning Secretary is not satisfied that an independent review is warranted, the Planning Secretary will notify the landowner in writing of that decision, and the reasons for that decision, within 21 days of the request for a review.

In accordance with Condition 5 of Schedule 4A of the consent, if the Planning Secretary is satisfied that an independent review is warranted, within 3 months, or other timeframe agreed by the Planning Secretary and the landowner, of the Planning Secretary's decision, Boral must:

- (a) commission a suitably qualified, experienced and independent person, whose appointment has been approved by the Planning Secretary, to:
    i. consult with the landowner to determine their concerns;
    ii. conduct monitoring to determine whether the development is complying with the relevant noise criterion; and
    iii. if the development is not complying with the relevant noise criterion, identify measures that could be implemented to ensure compliance with the relevant criterion; and
- (b) give the Planning Secretary and landowner a copy of the independent review; and
- (c) comply with any written requests made by the Planning Secretary to implement any findings of the review.

11 REFERENCES

This NVMP has been prepared with consideration to:

- Boral integrated Health Safety, Environment and Quality Management System (HSEQ MS) as outlined in GRP-HSEQ-1-01 Management System Framework and Operational Control.
- Environmental Protection Licence (EPL No. 77) version dated 22 July 2021.
- Modification Report – Dunmore Hard Rock Quarry Modification 13 prepared by EMM Consulting January 2023 (Modification Report).
- The Development Consent for DA 470-11-2003 issued June 2024 for the Dunmore Hard Rock Quarry Modification 13.
- NSW Environment Protection Authority - Noise Policy for Industry (NPI, 2017), October 2017.
- NSW Environment Protection Authority (EPA), Approved methods for the measurement and analysis of environmental noise in NSW, 2022.
- Standards Australia AS1055–2018 (AS1055, 2018) - Description and Measurement of Environmental Noise.
- Standards Australia AS2187.2-2006 (AS2187.2, 2006) - Explosives - Storage and Use Part 2: Use of Explosives.
- Standards Australia AS 2436–2010: R2016 (AS2436, 2016) - Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.
- Standards Australia AS IEC 61672.1–2019 (AS61672) - Electro Acoustics - Sound Level Meters Specifications.
- International Organisation for Standardisation (ISO) 9613-2:1996 (ISO9613:2) - Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation.
- International Organisation for Standardisation (ISO) 1996-2:2007 – Acoustics - Description, Measurement and Assessment of Environmental Noise - Part 2: Determination of Environmental Noise Levels.

APPENDICES

APPENDIX A
Boral Drivers Code of Conduct

Boral Dunmore Quarry

Driver's Code of Conduct

1. Introduction

Dunmore Quarry is located immediately west of Dunmore Railway Station and the Princes Highway at Dunmore, in the Shellharbour City Council local government area (LGA). Boral is committed to ensuring employees and contractors access and exit the Dunmore Quarry in a safe and responsible manner. All employees and contractors are expected to comply with the relevant legal requirements and accepted community standards whilst travelling to and from work.

This Code of Conduct sets out specific requirements for the Dunmore site to be adopted by all Boral Fleet and contractor heavy vehicle drivers. The Code utilises industry best practice to minimise and manage the traffic impact associated with the movement of heavy vehicles to and from the quarry.

2. Scope

This Driver's Code of Conduct requires that specific measures are developed to focus on opportunities to minimise, mitigate and manage traffic volume, traffic safety and acoustic impact.

The following documents have been reviewed in the formulation of the Driver's Code of Conduct:

- Boral Logistics Truck Driver's Procedures.
- Boral Logistics Driver's Handbook.
- Boral Logistics CoR Accreditation.
- NSW Road Rules.

3. Objectives

The Objectives are to:

- Ensure respect for road users and the environment.
- Encourage the application of the Driver's Code of Conduct for all Boral Fleet and contractor heavy vehicles accessing Tabbita Road.
- Maximise public safety at all times.

4. Heavy Vehicle Routes

Access to Dunmore Quarry is achieved directly off the Princes Highway via Tabbita Road, a road used solely for access to the quarry. Speed limits and restrictions on these roads are discussed further below.

4.1 Princes Highway

The Princes Highway is a divided road with a speed limit of 100km/hr for all vehicles. North of the quarry, the highway bypasses the city centre of Wollongong and most townships in the Illawarra region. However the highway does not bypass the township of Oaks Flats-Albion Park Rail, which has a number of existing traffic signal and roundabout controlled intersections, and reduced speed limits ranging from 70-60 km/hr.

Care at all times should be taken with faster moving vehicles on the highway.

4.2 Tabbita Road Exit

On exiting the Princes Highway at Tabbita Road, the speed limit reduces to 70 km/hr.

Care should be taken when using these exits, particularly when approaching from the north, whereby the exit road turns sharply to the right to underpass the highway.

Figure 1: Princes Highway exit at Tabbita Road southbound

Figure 2: Princes Highway exit at Tabbita Road northbound

4.3 Tabbita Road

The general speed limit on Tabbita Road is restricted to 40 km/hr, and down to 15 km/hr in some sections of the quarry site. All speed limits and signage are to be obeyed at all times.

Figure 3: Tabbita Road Entrance to Dunmore Quarry

In particular, drivers should be aware of the following:

- Mobile quarry plant and equipment, such as dozers, excavators and haul trucks have right of way. Maintain a safe distance from these vehicles at all times.
- There are a number of site offices located off the Tabbita Road entrance to the quarry and as such, drivers should keep a safe distance from light vehicles.

5. Noise Minimisation Controls and Standards

This section designates the specific noise mitigation measures which must be adhered to at all times. This includes rules on compression braking, tipping practices and speed limits for the approach and departure from the quarry site.

- When in close proximity to residential streets, drivers are requested to limit noise from their vehicles and respect the local traffic and residents at all times.
- Compression brakes must not be used in the vicinity of residential dwellings.
- Tailgates must be secure and locked to avoid noise or spillage.
- Loads must be covered and compliant with relevant NSW road rules.
- All loaded vehicles must be cleaned of materials that may fall on the road before leaving site.
- Approach any speed humps at low speed.
- Always observe the posted speed on site and on public roads.
- No tailgating will be permitted.
- Equipment to be used must be fit for task.
- Driver must have a HV Licence and compliance to all authorities.

6. Incident Management and Reporting

To ensure that in the event of an incident, the affect is minimised, a rapid response from the haulage company is required. Drivers are to contact their supervisors immediately and in turn their supervisors are to take action and advise Boral of the issue.

If there is product spillage while loading or en route the driver must immediately inform and warn persons in the area that maybe at risk. The driver must then inform quarry staff or his supervisor of the spillage. All spills must be cleaned up and waste disposed of in an acceptable and environmental manner. Place warning signs where it is fit to do so.

7. Compliance Monitoring

This Code of Conduct will be reviewed every 2 years and compliance audits carried out on all haulage contractors under the Safety Act 2008 and the Chain of Responsibility and Fatigue Management.

In addition daily operations will be monitored for any breaches of required compliance and the haulage contractors are to explain, investigate and demonstrate corrective actions when a compliance breach occurs.

8. Operating Times

In line with the quarry's development approval, distribution by roads is permitted 24 hours, Monday to Saturday. Distribution on Sundays is limited and will only be undertaken with the express permission of the quarry manager.

9. Incident Reporting Numbers

Dunmore Quarry: 02 4237 2000

Boral Logistics: 0401 892 386

APPENDIX B
Consultant Engineers Report – Determining the Blast Exclusion Zone for Dunmore Quarry

BLAST EXCLUSION ZONE REVIEW

BORAL NSW

17/11/2023

By

Brendan Littlewood

Senior Technical Services Engineer

REVIEWED BY:

Gavin Yuill – Territory Manager

DOCUMENT LOCATION

Orica\DX_Quarries_Technical_Services_Team_Australia - Documents\NSW_TECH_TEAM\Projects\Exclusion Zone Review 2023\Boral NSW Exclusion Zone Report

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INTRODUCTION

To improve safety for their employees and customers, Orica has recently revised their process regarding the determination of exclusion zones and developed a detailed work instruction internally to support the implementation. The process developed is a standardised global approach which includes the addition of a SHOTPlus tool that streamlines the exclusion zone calculations. Exclusion Zone distances determined through this process specify the minimum distance that all Orica personnel must be when blasting activities are being undertaken. Distances determined are a minimum, the exclusion zone distance may be increased due to site requirements or discretion of personnel involved with the blast.

Orica's Quarry Services primarily undertake Total Load Services (TLS) at Boral quarries throughout New South Wales. As part of this service, exclusion zone maps are generated for each blast. Boral require exclusion zones distances to be 800m in front of the blast and 400m to the sides and rear of the blast, unless and engineered exclusion zone is available. Engineered exclusion zones have been previously supplied to assess the historical performance of blasts and advise on suitable exclusion zone distances. The revised process being implemented by Orica is an engineered approach and therefore satisfies the requirements of the Boral procedures to reduce exclusion zones from 800m and 400m.

The revised process being implemented by Orica follows the same methodology as the engineered exclusion zone reports previously supplied. Exclusion zone distances are determined using the Terrock Flyrock Model. This model uses k factors which are calibrated from video analysis of previous blasts at each site. Where no calibrations have been completed a k factor of 27 is adopted. Historically an exclusion zone report assessed all minimum blast parameters from the Site Information Sheet (SIS) and produced a static exclusion zone. The revised process will apply the blast parameters for each individual blast and determine the maximum distance specific for each blast.

The revised process requires the cratering mechanism to be considered for all blasts. Previously this mechanism was not considered when stemming lengths exceeded 20x the hole diameter. The adoption of cratering with a k factor of 27 resulted in exclusion zones exceeding historical distances and would likely result in operational impacts such as evacuation of nearby offices, houses, and requirements to close public roads. To avoid these impacts to operations, a calibration process has been completed which differentiates between stemming ejection and cratering to obtain k factors and resulting exclusion distances which are representative of historical distances, where possible. Faceburst k factors were re-calibrated for sites that had historic engineered exclusion zone reports. The faceburst k factor for all other sites remained un-calibrated as it is not expected to change the impact of exclusion zones from historical distances.

SUMMARY

Historical Blast videos for blasting at each of Boral's NSW operations were assessed with Table 1 summarising the calibrated k factors determined for each site.

Table 1 – K Factors Calibrated for Boral Sites

SITE	STEMMING K	CRATERING K	FACE BURST K
Beryl	13	13	27
Byrock	18	18	27
Currabubula	15	13	27
Dunmore	27	13	20
Hall	20	13	27
Johns River	17	13	27
Macksville	23	17	27
Marrington	23	13	27
Metz	16	13	27
Mugga Lane	14	13	27
Peppertree	21	13	27
Seaham	19	13	27
Shadforth	23	13	27
Teven	13	13	27

Indicative exclusion zone distances have been generated by applying the calibrated k factors to current SIS parameters for each site. They are provided to assist with planning at each site, not to specify a static exclusion zone to be adopted. Distances have been determined using the minimum face burden with the primary explosive product, target stemming height and design blasthole angle with an additional 10 degrees added.

The exclusion distance will vary between blasts, based on blasting parameters. In situations where technical services have approved parameters to be applied outside of the SIS tolerances, exclusion zone distances may exceed those outlined in this report. Additionally, exclusion zones may be reduced in situations where adopted blast parameters are more conservative, such as larger face burdens or larger stemming heights.

Table 2 – Indicative Exclusion Distances Based on Calibrated K Factors and SIS Parameters

SITE	FRONT	SIDE/REAR
Beryl	193	147
Byrock	429	264
Currabubula	251	118
Dunmore	222	222
Hall	223	151
Johns River	234	129
Macksville	176	176
Marrington	236	236
Metz	182	87
Mugga Lane	218	130
Peppertree	298	129
Seaham	341	146
Shadforth	214	214
Teven	152	71

CALIBRATION METHODOLOGY

The Exclusion Zone model is calibrated using site measurements of historical blast performance in the relevant blast domain and blasting conditions for which the calibration factors are applied. There are 2 methods available to calibrate the model, these include:

1. Measure distance of rock movement from face burst, cratering & stemming ejection
2. Measure initial velocity of rock movement from face burst, cratering & stemming ejection.

Blast videos were assessed to verify the measurements and to provide a record of the calibration calculation data. The following data is required for each historical blast used in the calibration process:

- Charge mass per metre (kg/m) for each explosive type and hole diameter used in the blast.
- Angle of inclination and azimuth of all blastholes.
- Explosives density and hole diameter used in the blast.
- Minimum burden (m)
- Minimum stemming length (m)

The maximum distance or initial velocity measured for each of the flyrock mechanisms in the appropriate domains & blasting conditions for the last 5 blasts with the available data were used to calculate calibrated k factors.

Where the required historical data was not available for 5 blasts, calibration is based on the available data (minimum 1 blast with the required data) and the calibration will be reviewed with each subsequent blast's data as blasting progresses (to 5 blasts).

The following formulae were used for calibration.

Equation 1 – Initial rock velocity measurements

$$k_{FB} = V_{FB} \times \left(\frac{\sqrt{m}}{B}\right)^{-1.3}$$

$$k_C = k_{SE} = V_C \times \left(\frac{\sqrt{m}}{SH}\right)^{-1.3}$$

k_{FB} = Face burst k factor

k_C = Cratering k factor

k_{SE} = Stemming ejection k factor

V_{FB} = Initial face velocity (m/s^2)

V_C = Initial collar velocity (m/s^2)

m = Charge mass per metre (kg/m)

B = Burden (m)

SH = Collar stemming height (m)

Equation 2 – Rock throw distance measurements

$$k_{FB} = \sqrt{L_{FB} \times g}\left(\frac{\sqrt{m}}{B}\right)^{-1.3}$$

$$k_C = \sqrt{L_C \times g}\left(\frac{\sqrt{m}}{SH}\right)^{-1.3}$$

$$k_{SE} = \sqrt{\frac{L_{SE} \times g}{sin2\theta}}\left(\frac{\sqrt{m}}{SH}\right)^{-1.3}$$

k_{FB} = Face burst k factor

k_C = Cratering k factor

k_{SE} = Stemming ejection k factor

L_{FB} = Face burst throw distance (m)

L_C = Cratering throw distance (m)

L_{SE} = Stemming ejection throw distance (m)

g = Acceleration due to gravity (m/s^2)

m = Charge mass per metre (kg/m)

B = Burden (m)

SH = Collar stemming height (m)

θ = Blasthole angle of inclination to vertical ($degrees$)

Stemming ejection k factors were determined by applying the initial rock velocity in Equation 1, initial velocities were determined by measuring the time required for rock particles to reach a maximum trajectory.

Cratering k factors were determined by applying the maximum distance in Equation 2, cratering calibrations were only determined where there were visible signs of cratering. Cratering was defined as expressions that moved in all directions while stemming ejection movement is predominantly in the trajectory of the blasthole inclination.

Faceburst k factors were determined by applying the initial rock velocity in Equation 1, initial velocities were determined by measuring the time and distance of rock particles from free faces.

EXCLUSION ZONE DISTANCE CALCULATION

Exclusion Zone distances are determined using the Terrock Flyrock Model equations. These equations for each flyrock mechanism are summarised as follows:

STEMMING EJECTION

Equation 3 – Maximum horizontal throw due to stemming ejection

$$L_{MAx} = \frac{K^2}{g} \times \left(\frac{\sqrt{m}}{SH}\right)^{2.6} sin2\theta$$

CRATERING

Equation 4 – Maximum horizontal throw due to cratering

$$L_{MAx} = \frac{K^2}{g} \times \left(\frac{\sqrt{m}}{SH}\right)^{2.6}$$

FACEBURST

Equation 5 – Maximum horizontal throw due to faceburst

$$L_{MAx} = \frac{K^2}{g} \times \left(\frac{\sqrt{m}}{B}\right)^{2.6}$$

L_{MAX} = Maximum horizontal throw (m)

K = Site constant

m = Charge mass per metre (kg/m)

g = Acceleration due to gravity (m/s^2)

B = Burden (m)

SH = Collar stemming height (m)

These equations have been incorporated into Orica's SHOTPlus software and is accessible through the Blast Exclusion Area Tool. Applicable blast parameters are populated from SHOTPlus without requiring any manual user input, this tool is shown in Figure 1. Adjustable parameters including the k factor, cratering dispersion angle and safety factor are specified within the SHOTPlus template for each site as shown in Figure 2.

k factors are outlined within this report and may be adjusted as necessary, k factors will be re-calibrated annually. Cratering dispersion angle remains as 45 degrees and safety factor is specified as 4 for personnel and 2 for equipment.

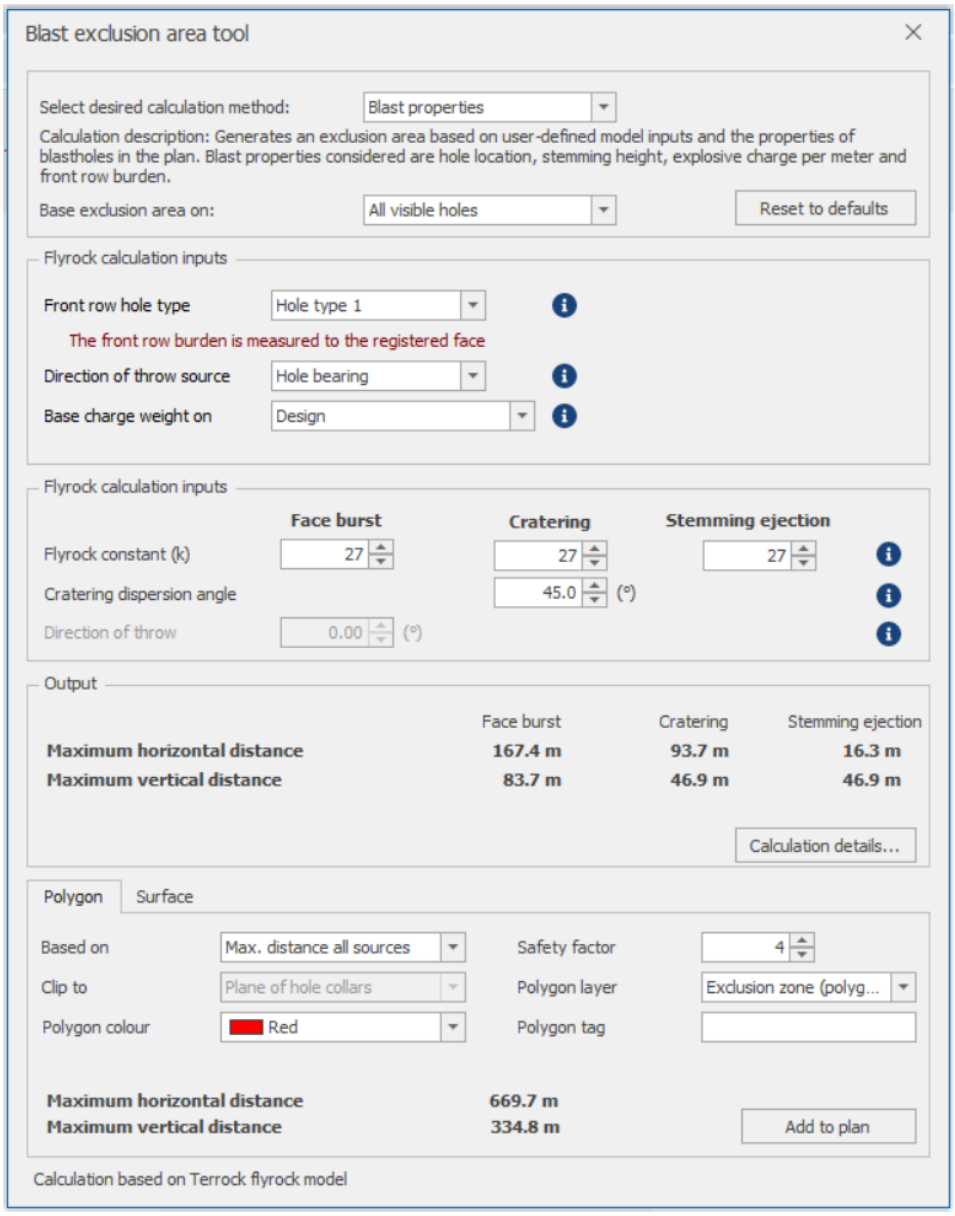

Figure 1 – Blast exclusion area tool in SHOTPlus

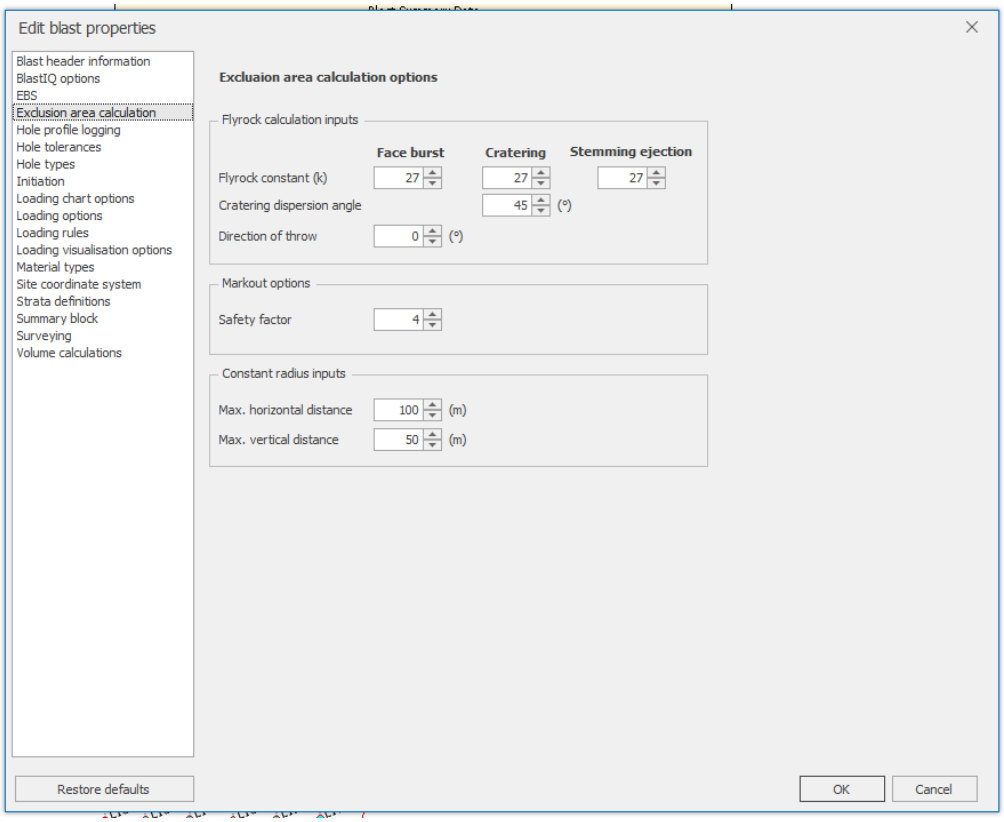

Figure 2 – Exclusion area calculations set in SHOTPlus templates

Additional functionality exists within the SHOTPlus Blast Exclusion Area Tool to consider the surrounding topography when determining the exclusion distance. While this method will not be applied for all blasts, it is available to be adopt where required. The application of this tool will reduce the exclusion zone when features such as highwalls imped the potential flyrock trajectory, inversely it may increase the exclusion zone distance where change in elevation occurs.

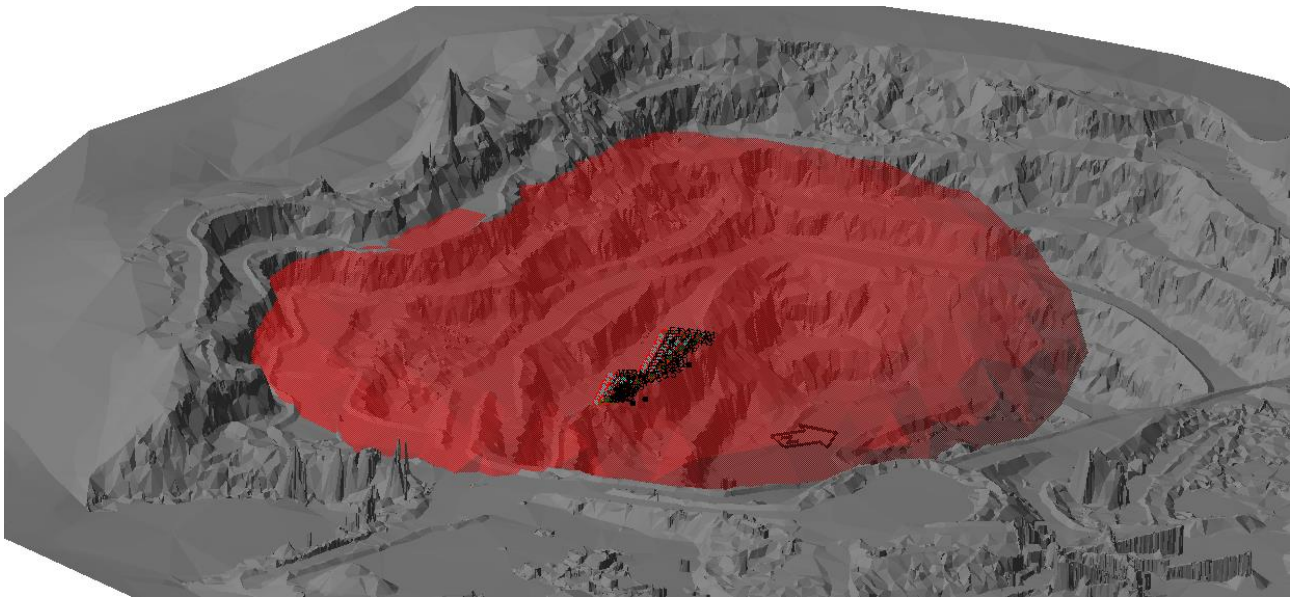

Figure 3 – Exclusion Zone adjusted to topography surface

APPENDIX 1

The following table details k factors calibrated for individual blasts at each of Boral's NSW operations. The maximum k factor for each site has been adopted with a minimum value of 13 adopted and a maximum of 27.

Blast Parameters			Stemming Ejection Results			Cratering Results			Faceburst Results		
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Beryl	BQ23-01	1.9	7.5	12.2	1.9	7.5	3.0	3.4	7.5	-
Blast #2	Beryl	BQ23-02	3	7.5	11.7	3	7.5	5.5	3.4	7.5	-
Blast #3	Beryl	BQ22-01	3	7.5	5.5	3	7.5	5.5		7.5	-
Blast #4	Beryl	BQ2021-01	2.2	8	0.0	2.2	8	0.0		8	-
Blast #5	Beryl	BQ2019-01	2	10.4	10.5	2	10.4	2.6		10.4	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Byrock	BYR23-01	2.1	7.5	16.4	2.1	7.5	16.4	3.4	7.5	-
Blast #2	Byrock	BYR22-03	2.1	7.5	15.3	2.1	7.5	3.5	3.4	7.5	-
Blast #3	Byrock	BYR22-01 & 02	2.26	7.5	17.3	2.26	7.5	17.3		7.5	-
Blast #4	Byrock	BYR20-02	1.8	7.5	15.5	1.8	7.5	15.5	2.4	7.5	-
Blast #5	Byrock	BHY20-01	1.4	7.5	9.6	1.4	7.5	9.6		7.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Currabubula	CQ23-03	2.2	7.5	12.8	2.2	7.5	0.0	4.2	7.5	-
Blast #2	Currabubula	CQ23-01	2.2	7.5	8.9	2.2	7.5	0.0	4.2	7.5	-
Blast #3	Currabubula	CQ22-05	2.2	7.5	3.7	2.2	7.5	0.0	4.2	7.5	-
Blast #4	Currabubula	CQ22-04	2.2	7.5	11.1	2.2	7.5	0.0	4.2	7.5	-
Blast #5	Currabubula	CQ22-03	2.2	7.5	14.8	2.2	7.5	12.9		7.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Dunmore	DQ23-29	3	10.5	4.4		10.5	0.0	4.1	10.5	7.3
Blast #2	Dunmore	DQ23-27	3	10.5	28.7		10.5	0.0	3.9	10.5	9.5
Blast #3	Dunmore	DQ23-26	3	10.5	15.1		10.5	0.0	3.9	10.5	9.1
Blast #4	Dunmore	DQ23-25	3	10.5	8.0		10.5	0.0	3.8	10.5	13.7
Blast #5	Dunmore	DQ23-23	3	10.5	4.4		10.5	0.0	3.8	10.5	19.4
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k

Blast #1	Hall	HQ23-04	2.6	10.5	19.2	2.6	10.5	11.8		10.5	0.0
Blast #2	Hall	HQ23-03	2.6	10.5	13.3	2.6	10.5	0.0	4.2	10.5	19.5
Blast #3	Hall	HQ23-01	2.6	10.5	11.1	2.6	10.5	0.0	3.9	10.5	16.6
Blast #4	Hall	HQ22-09	2.6	10.5	18.4	2.6	10.5	11.8	4	10.5	35.2
Blast #5	Hall	HQ22-07	2.6	10.5	12.3	2.6	10.5	0.0	4	10.5	19.7
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Johns River	JRQ23-06	2.6	7.5	9.2	2.6	7.5	0.0		7.5	-
Blast #2	Johns River	JRQ23-04	2.2	7.5	3.7	2.2	7.5	0.0	4.2	7.5	-
Blast #3	Johns River	JRQ23-03	2.2	7.5	3.7	2.2	7.5	0.0	4.2	75	-
Blast #4	Johns River	JRQ23-02	2.2	7.5	17.0	2.2	7.5	0.0		7.5	-
Blast #5	Johns River	JRQ23-05	3	7.5	5.5	3	7.5	0.0		7.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Macksville	MVQ23-03	2.5	7.5	18.3	2.5	7.5	0.0	3.6	7.5	-
Blast #2	Macksville	MVQ23-02	2.5	7.5	22.3	2.5	7.5	15.0		7.5	-
Blast #3	Macksville	MVQ23-01	2.5	7.5	20.6	2.5	7.5	16.9		7.5	-
Blast #4	Macksville	MVQ22-03	2.5	7.5	19.4	2.5	7.5	0.0	3.6	7.5	-
Blast #5	Macksville	MVQ22-02	2.5	7.5	13.1	2.5	7.5	0.0		7.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Marrington	MAQ23-02	2.2	7.5	22.1	2.2	7.5	3.7		7.5	-
Blast #2	Marrington	MAQ23-01	2.2	7.5	3.7	2.2	7.5	3.7		7.5	-
Blast #3	Marrington	MAQ22-10	2.2	7.5	14.0	2.2	7.5	3.7		7.5	-
Blast #4	Marrington	MAQ22-09	2.2	7.5	14.0	2.2	7.5	3.7	3.6	7.5	-
Blast #5	Marrington	MAQ22-08	2.2	7.8	3.6	2.2	7.8	3.6	3.6	7.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Metz	MZQ23-01	3.2	10.5	15.4	3.2	10.5	4.8		10.5	-
Blast #2	Metz	MZQ22-02	3	9.4	4.8	3	9.42	4.8	3.6	10.5	-
Blast #3	Metz	MZQ22-01	2.8	9.8	4.2	2.8	9.8	4.2		9.8	-
Blast #4	Metz	MZQ21-04	2.8	9.8	4.2	2.8	9.8	4.2		9.8	-
Blast #5	Metz	MZQ21-03	2.8	9.8	4.2	2.8	9.8	4.2		9.8	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Mugga Lane	MLQ23-09	2.5	10.5	7.0	2.5	10.5	3.5		10.5	-
Blast #2	Mugga Lane	MLQ23-06	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-

Blast #3	Mugga Lane	MLQ23-07	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-
Blast #4	Mugga Lane	MLQ23-08	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-
Blast #5	Mugga Lane	MLQ23-10	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-
Blast #6	Mugga Lane	MLQ23-11	2.5	10.5	13.1	2.5	10.5	3.5		10.5	-
Blast #7	Mugga Lane	MLQ23-12	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-
Blast #8	Mugga Lane	MLQ23-14	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-
Blast #9	Mugga Lane	MLQ23-15	2.5	10.5	3.5	2.5	10.5	3.5		10.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Peppertree	PTQ23-27	3.5	13	13.2	3.5	13	4.7		13	-
Blast #2	Peppertree	PTQ23-24	3.2	10.5	8.0	3.2	10.5	4.8		10.5	-
Blast #3	Peppertree	PTQ23-23	4.5	13	6.5	4.5	13	6.5		13	-
Blast #4	Peppertree	PTQ23-22	4	12	20.5	4	12	5.9		12	-
Blast #5	Peppertree	PTQ23-21	3.5	13	4.7	3.5	13	4.7		13	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Seaham	SQ23-11	2.7	10.5	10.6	2.7	10.5	0.0		10.5	-
Blast #2	Seaham	SQ23-10	2.7	10.5	15.5	2.7	10.5	0.0		10.5	-
Blast #3	Seaham	SQ23-08	2.7	10.5	3.9	2.7	10.5	0.0	3.6	10.5	-
Blast #4	Seaham	SQ23-07	2.7	10.5	9.1	2.7	10.5	0.0	2.7	10.5	-
Blast #5	Seaham	SQ23-06	2.7	10.5	18.6	2.7	10.5	12.6		10.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Shadforth	SQ23-01	2.7	10.5	15.5	2.7	10.5	3.9		10.5	-
Blast #2	Shadforth	SQ22-03	2.7	10.5	17.0	2.7	10.5	3.9		10.5	-
Blast #3	Shadforth	SQ22-02	2.7	10.5	15.6	2.7	10.5	3.9		10.5	-
Blast #4	Shadforth	SQ21-01	2.7	10.5	22.6	2.7	10.5	3.9		10.5	-
Blast #5	Shadforth	SQ21-04	2.7	10.5	16.8	2.7	10.5	3.9		10.5	-
Blast Number	Location	Shot ID	SH	Charge Mass	k	SH	Charge Mass	k	B	Charge Mass	k
Blast #1	Teven	BTQ-2307	2.6	6.5	8.1	2.6	6.5	5.0		6.5	-
Blast #2	Teven	BTQ-2306	2.6	7.5	4.6	2.6	7.5	4.6		7.5	-
Blast #3	Teven	BTQ-2305	2.6	7.5	8.3	2.6	7.5	4.6		7.5	-
Blast #4	Teven	BTQ-2304	2.6	7.5	7.3	2.6	7.5	4.6		7.5	-
Blast #5	Teven	BTQ-2303	2.6	7.5	9.2	2.6	7.5	4.6		7.5	-