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Adelaide Brighton Cement Ltd

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Noise Management Plan

Adelaide Brighton Cement Limited

Licence number: 1126

**Premises Address: Victoria & Elder Roads, Peterhead
(Birkenhead Site)**

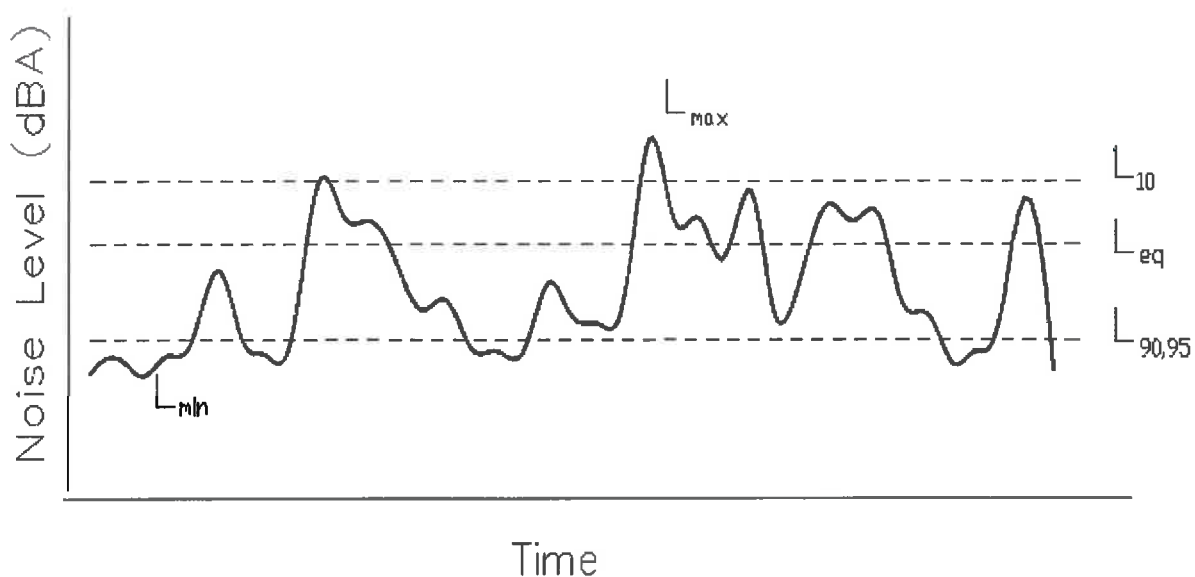
August 2018

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Glossary of acoustic terminology

dB(A)	A unit of measurement, decibels(A), of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
L_1	The noise level which is equalled or exceeded for 1% of the measurement period. L_1 is an indicator of the impulse noise level, and is used in Australia as the descriptor for intrusive noise (usually in dBA).
L_{10}	The noise level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level, and is used in Australia as the descriptor for intrusive noise (usually in dBA).
L_{90}	The noise level which is equalled or exceeded for 90% of the measurement period. L_{90} is an indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dBA).
L_{eq}	The equivalent continuous noise level for the measurement period. L_{eq} is an indicator of the average noise level (usually in dBA).
L_{max}	The maximum noise level for the measurement period (usually in dBA).



Note: The subjective reaction or response to changes in noise levels can be summarised as follows:

A 3 dB(A) increase in sound pressure level is required for the average human ear to notice a change; a 5 dB(A) increase is quite noticeable and a 10 dB(A) increase is typically perceived as a doubling in loudness

Noise Management Plan

1.0 Purpose

This plan details how noise is managed at the Birkenhead site, to minimise impacts on the local community.

It outlines how Adelaide Brighton Cement Limited (ABC) assesses and manages the impacts of noise generated at the Birkenhead site, with the aim of ensuring that

- Noise impacts are considered as part of routine operations
- Noise emissions are controlled at source by good operational practices, physical and management controls
- Appropriate, reasonable and practicable measures are taken to reduce noise emissions from the site and the impact on nearby receptors in the local community

2.0 Scope

The Noise Management Plan (NMP) addresses

- Monitoring of noise emissions from the site
- Identification of major noise sources
- Provision of measures to manage the cumulative impact of noise sources on site
- Compliance with relevant legislative requirements
- Management of noise complaints
- Continuous improvement in noise emissions
- Reporting on the implementation and effectiveness of the Plan
- Provision of public access to quarterly and annual reports and this plan

3.0 Applicable legislative requirements and guidance

South Australian Environment Protection Act 1993

South Australian Environment Protection Regulations 2009

South Australian Environment Protection (Noise) Policy 2007 (EP (Noise) Policy)

Guidelines for the use of the Environment Protection (Noise) Policy 2007, June 2009, Environment Protection Authority

Port Adelaide Enfield (City) Development Plan, Consolidated February 2018

South Australian Development Act 1993

Adelaide Brighton Cement's EPA Licence No1126, 1/11/2017, condition U – 787

1.7 SITE NOISE MINIMISATION (U - 787)

The licensee must:

1.7.1 take all reasonable and practicable measures to minimise noise generated at the Premises;

1.7.2 develop a Noise Management Plan to the satisfaction of the EPA by the date listed below;

1.7.3 ensure that the Noise Management Plan includes, but is not limited to:

- a detailed action and response strategies that will be taken to prevent and minimise noise emissions;*

- b a methodology and framework for the provision of quarterly reports and an annual report on the implementation and effectiveness of the Noise Management Plan;*
 - c a methodology and framework for providing public access to the Noise Management Plan (or any revised plan approved by the EPA) and to quarterly and annual reporting;*
- 1.7.4 implement the Noise Management Plan approved in writing by the EPA (or any revised plan approved in writing by the EPA).*

Compliance Date: 31-Jan-2018

4.0 Background

4.1 Site context

The Birkenhead plant is located on the Le Fevre Peninsula and has the Shell/ExxonMobil Birkenhead Terminal to the north, the Port River Expressway (A9) to the south, Victoria Road (A16) to the west and the Dry Creek-Port Adelaide railway freight line to Outer Harbour on the east as well as the Port Adelaide River.

ABC has been operating its cement and clinker manufacturing plant at Birkenhead for over 100 years which produces approximately 1.6 million tonnes of cement annually and operates 24 hours a day seven days a week.

ABC's customers and suppliers use the major arterial roads servicing the Birkenhead plant for the delivery of goods by road.

In addition, ABC has access to the deep-water port facilities of Port Adelaide for the receipt of raw materials and export of finished product. ABC's shipping movements can be summarised as follows:

- 7,500 tonnes of limestone (the main raw material used for cement manufacture) is received from Klein Point on a daily basis via ABC's purpose built limestone carrier. The vessel normally discharges from late afternoon continuously over a 12 hour period, but can discharge anytime in a 24hr period;
- Bulk cement exports in vessels ranging in size from 16,000 tonnes to 38,000 tonnes are loaded approximately every seven days, continuously from 24 to 48 hours;
- Slag imports are received in 28,000 tonne vessels approximately every six weeks and are unloaded continuously over about a four-day period;
- Other raw materials are received in vessels ranging between 12,000 tonnes and 38,000 tonnes from time to time; and
- Bulk clinker is exported in 4,000 tonne shipments, approximately every 6 to 8 weeks.

4.2 Noise

4.2.1 Introduction

Noise generation is an inherent part of most activities and has an almost unlimited range of sources including industrial activities, road traffic, and domestic activities.

The response to noise by individuals can be as wide and as varied as the number of activities that produce it.

A contemporary noise policy needs to have the flexibility to consider the range of factors that include the level of noise, time of day, how loud or quiet that area is expected to be, the history of the area in which the noise is located, the solutions that are applied to the noise in other similar situations and the capacity to deliver the solutions that result in noise reduction.

The Environment Protection (Noise) Policy therefore provides a set of appropriate guidelines for industry, acoustic consultants and regulators to manage the impact of noise emissions.

ABC uses acoustic noise specialists to undertake regular noise measurements on site, and in the local community in accordance with EPA noise measurement guidelines.

Acoustic engineer's reports note that there are other ambient noise sources, particularly road traffic, which contribute to the background ambient noise level and measured noise levels are not necessarily due to ABC operations alone.

4.2.2 Assessment of site noise emissions

To provide context for the noise management plan, a summary noise emissions profile report "Birkenhead Noise Emissions Profile Summary" report 50B-18-0036-TRP-805507-2, dated 10 August 2018,(Report), has been prepared by Vipac Engineers and Scientists Limited (Vipac), a copy of which is included in Appendix A.

The report provides a summary of measured noise emissions, noise modelling, identification and implementation of reasonable and practical noise mitigation projects undertaken by ABC to manage and minimise noise emissions from the Birkenhead site over the last three years.

4.2.2.1 Indicative noise levels

The relevant indicative noise levels, determined in accordance with the EP (Noise) Policy that are applicable for sensitive receivers near the site are contained in Table 1: Indicative noise levels.

Table 1: Indicative noise Levels

	Indicative noise Levels (L_{eq} , dB(A))	
	Day-time (7 am to 10pm)	Night-time (10pm to 7am)
Residential zone – Policy Area 57 (Le Fevre Peninsula East)	57	49
Residential zone – Policy Area 65 (Restricted Residential)	57	49

4.2.2.2 Noise emission profile

The noise emissions from the Birkenhead site operations are characterised as continuous broadband, steady-state noise, not comprising of any modulating or impulsive characteristics and the absence of tones.

In general, noise levels comply with the day-time indicative noise level of 57 Leq,dB(A) refer to table 1. Noise levels comply with the night-time indicative noise levels of 49 Leq,dB(A), for most noise sensitive receivers. Where noise levels exceed the 49 dB(A) night time criterion, the exceedance is generally less than 3 dB(A) which subjectively is a 'just noticeable change' when compared with the indicative noise level.

The most recent 'worst case' results (validated by attended measurement) are overlaid on an aerial photograph of the ABC plant and surrounding locality – Figure 1: 'Worst-case' predicted noise levels – May 2017.



Figure 1: 'Worst-case' predicted noise levels (L_{eq} , dB(A)) - May 2017

Figure 1 highlights areas of compliance, with green circles indicating compliance is predicted, orange circles indicate marginal compliance is predicted (less than 3dB) and red circles indicate that exceedance of the night time criterion is predicted (greater than 3 dB). Figure 1 indicates that in general exceedances of the night time criterion are generally limited to receivers within approximately 250 metres of the site boundary (i.e. to the east of Mary Street, Birkenhead).

Unattended noise logging surveys during normal operations and plant shutdown periods conducted near Victoria Road show that there is a significant contribution of road traffic noise from this major

arterial road during both shutdown periods and normal operations with average noise levels between 58dB(A) and 60 dB(A) being observed during the day period. This significant noise source contributes to higher noise levels being measured and hence an over estimate of ABC's noise emissions. Noise modelling has been used to supplement attended and unattended noise monitoring to provide an estimate of noise levels resulting from ABC's emissions alone (i.e. excluding the influence of other noise sources such as road traffic).

In response to resident concerns, ABC engaged Resonate Acoustics to undertake ground vibration monitoring studies in the vicinity of the nearest residential properties. The results of this work concluded that it is unlikely that ABC operations were a direct cause of measured peak vibration levels and that the likely cause was due to vehicle movements on adjacent or localised activity close to the accelerometer (monitor).

4.2.3 Approach to noise management

The approach that ABC takes to noise management is twofold:

1. Ongoing daily management of operational activities to minimise the impact of noise emissions on sensitive receptors and includes:
 - Maintenance of plant and equipment to minimise unnecessary noise emissions
 - Employees and contractors are aware of site noise requirements and their responsibilities to take action to minimise and prevent noise complaints
 - Ensuring that potential noise impacts are assessed and mitigated when plant modification and equipment changes are made
 - Investigation of noise complaints and implementation of corrective/preventative action
2. Continuous improvement in noise emissions through an ongoing programme to identify noise sources and implement reasonable and practical measures to reduce noise levels from these sources. This is summarised in Figure 1 Approach to continuous improvement.

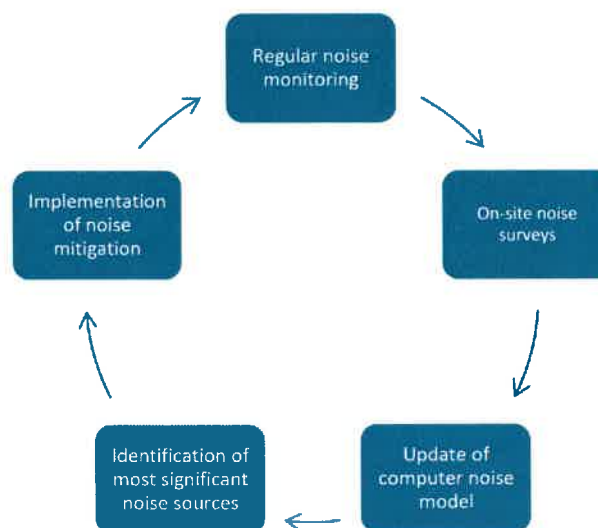


Figure 1: Approach to continuous improvement

5.0 Responsibilities

The organisational chart presented in Figure 1 shows personnel with roles that have been assigned in the noise management plan

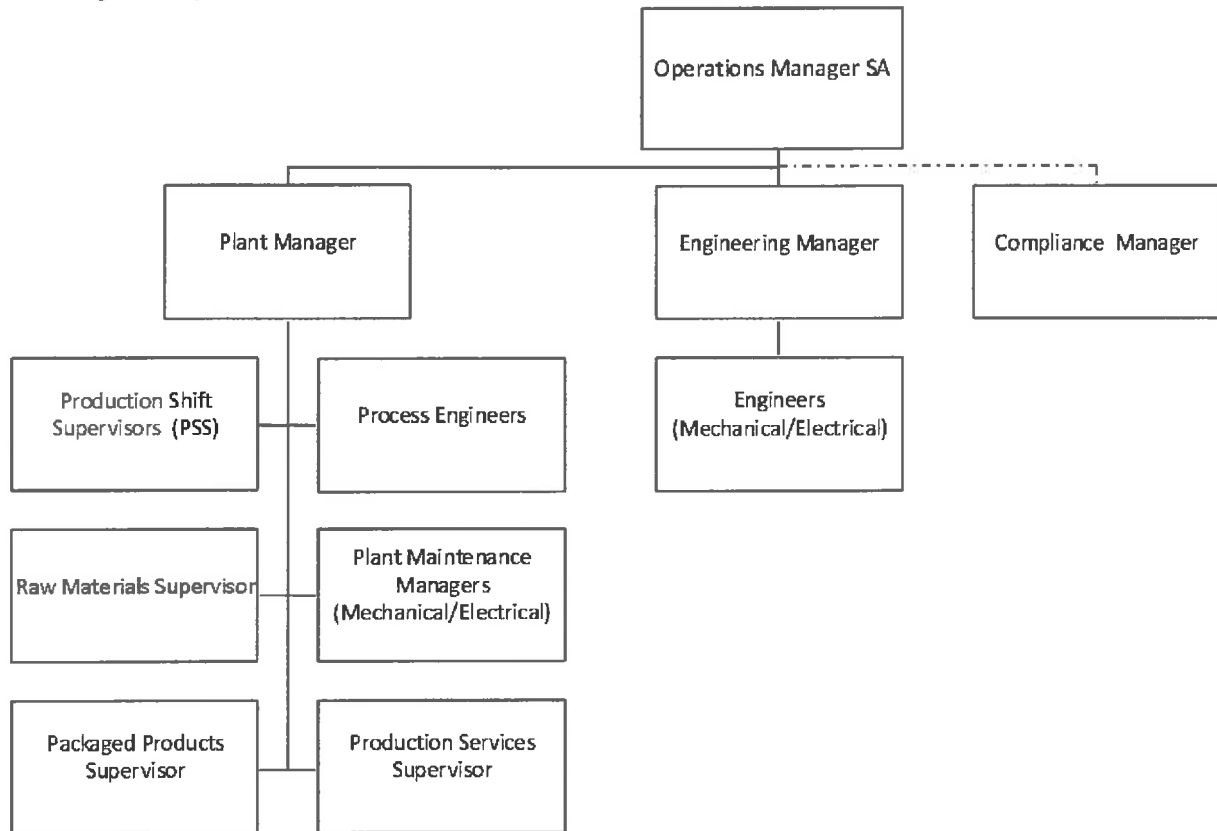


Figure 1 Organisation chart showing positions at the Facility with responsibilities under the NMP

All employees are responsible for complying with this plan, which includes:

- Taking action to minimise or prevent noise complaints
- Identifying and reporting noisy plant, equipment and activities

Table 2 General Responsibilities, details the responsibilities that apply in relation to this NMP.

Table 2: General Responsibilities

All Employees	<p>Responsible for complying with the Noise Management Plan.</p> <p>This includes:</p> <ul style="list-style-type: none"> • Taking action to minimise or prevent noise complaints • Reporting noisy plant, equipment and activities
Production Shift Supervisors, Supervisors	<p>Responsible for minimising noise emissions from operational activities.</p> <p>This includes:</p> <ul style="list-style-type: none"> • Monitoring operations and maintenance work to ensure noise emissions do not result in noise complaints • Investigating and responding to noise complaints received outside of business hours and taking immediate action (if possible) to reduce noise emissions • Identifying and reporting noisy plant, equipment and activities • Taking action to minimise or prevent noise complaints
Plant Manager, Process Managers, Engineering Manager, Process Engineers, Engineers, Plant Maintenance Managers & Supervisors	<p>Responsible for minimising noise emissions from operational activities. This includes:</p> <ul style="list-style-type: none"> • Ensuring employees and contractors are trained with respect to noise awareness, responsibilities, instructions, procedures • Monitoring operations and maintenance work to ensure noise emissions do not result in noise complaints • Timely plant and equipment maintenance to minimise noise emissions • Investigation of noise complaints, identification and implementation of corrective/preventative action • Developing and implementing contingency plans where there is a potential for nuisance noise complaints arising from activities such as demolition, construction, major shut down activities. • Noise impacts from plant modifications/equipment changes are assessed and appropriate controls identified before they are implemented • Reviewing operations and implementing noise reduction solutions.
Compliance Manager	<p>Responsible for:</p> <ul style="list-style-type: none"> • Ensuring annual noise monitoring is undertaken • Noise monitoring, modelling and assessments are undertaken by qualified acoustic engineers • Identification of noise mitigation opportunities • Inclusion of noise mitigation opportunities in an Environmental Improvement Plan (EIP) • Verifying implementation of corrective and preventive actions (via noise measurements / internal audits) • Reviewing noise complaints to identify noise issues/trends • Quarterly and annual noise reporting requirements • Informing the EPA of activities with potential to result in off-site atypical noise emission impacts on sensitive receptors • Informing affected sensitive receptors of the nature/duration of activities with potential to result in off-site, atypical noise emission impacts • Ensuring noise awareness is included in site induction and environmental training
Operations Manager	<p>Responsible for:</p> <ul style="list-style-type: none"> • Implementation of the Noise Management Plan Ensuring employees and contractors are aware of the site EPA licence, and other regulatory requirements relating to plant noise • Providing resources to reasonably and practically implement this plan

6.0 Measures to manage the cumulative impact of noise sources on site

6.1 Noise monitoring

Compliance noise monitoring is to be undertaken by qualified acoustic engineers in accordance with the EP (Noise) Policy and EPA noise measurement guidelines.

Noise measurements (attended and unattended) are to be undertaken for the following purposes:

- To determine the impact of plant operations on the local community
- Provide noise data at selected locations over time
- Provide baseline data for continuous improvement
- Evaluation of the plant operations against EP(Noise)Policy goals
- Provide data for noise impact modelling (Sound PLAN 3D noise modelling)
- Noise surveys to Identify highest risk noise sources and opportunities for noise mitigation
- Where appropriate assist in resolution of noise complaints and issues
- Confirm effectiveness of implemented noise attenuation/mitigation projects
- On completion of significant changes to plant, equipment or process
- To capture periods of atypical noise emissions e.g shutdowns, construction, demolition activities

To provide a consistent basis on which to evaluate noise impacts within the local community from plant operations and to evaluate effectiveness of mitigation measures, noise levels are to be measured at defined locations outside the plant boundary (refer to Appendix B).

Noise measurements are used to drive continuous improvement in noise emissions as illustrated in figure 1 Approach to continuous improvement.

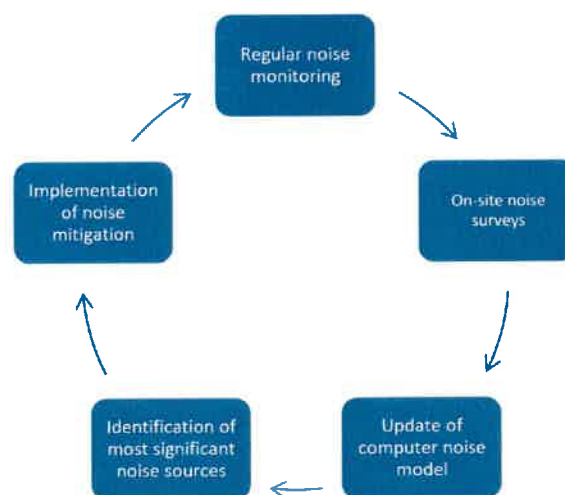


Figure 1: Approach to continuous improvement

An annual report prepared by a qualified Acoustic Engineer in accordance with the EP (Noise) Policy and EPA noise measurement guidelines that includes:

- Attended measurement of noise at defined locations within the community (Appendix B)
- A plant noise survey to identify highest risk noise sources
- Confirm implemented noise attenuation measures are effective
- Update the site noise model accordingly
- Identify opportunities to mitigate noise emissions

6.2 Management control measures

6.2.1 Employee and contractor awareness and training

All employees and contractors should, through delivery of appropriate training and induction programmes, understand that noise arising from activities that are undertaken on site could impact on residents and the need to:

- Take action to report, minimise and prevent noise complaints
- Understand the most appropriate times to undertake high noise generating activities
- Keep doors closed on buildings containing noisy equipment
- Respond to conditions that can result in noise complaints
- Use suitable equipment and noise controls such as acoustic enclosures when undertaking noisy activities
- Investigate and resolve noise complaints

ABC has an on line site induction and inbuilt assessment package, which records relevant details (name, company, date of successful completion of the induction training) within the induction database. All contractors and employees are required to successfully complete the site induction training package on the following frequency: contractors annually, employees every 2 years.

6.2.2 Acoustic planning

Noise prevention and abatement controls will be considered in the planning process for;

- Activities that are likely to impact on the local community
- Plant shutdowns for maintenance
- Purchasing replacement plant and equipment
- Process improvements and modifications
- Appropriate training and supervision of employees and contractors

Assessment of noise impacts during planning activities **will** be undertaken through the use of appropriate assessment tools and processes that may include

- Risk assessments
- HAZOP studies
- Plant design and modification processes
- Acoustic modelling
- Use of Acoustic and engineering consultants
- Noise measurements
- Current practice, knowledge and experience of similar process or equipment

6.3 Physical measures

6.3.1 Overview of existing plant noise attenuation techniques

The majority of the site operations are undertaken in fully enclosed buildings that act as a noise barrier, attenuating noise emissions from the enclosed plant, process and operational activities.

Where reasonably practicable particularly noisy plant/equipment is located in acoustically designed enclosures, e.g. compressors. Identified noisy plant and equipment that has a high risk of off-site noise impact has noise attenuation measures applied such as silencers, lagging, vibration mountings, acoustic baffles etc.

6.3.2 Acoustic barriers /noise attenuation

Acoustic barriers / noise attenuation controls are to be applied primarily to fixed machinery and plant with identified noise issues. Acoustic barriers may include the following:

- Acoustically treated walls /panels etc. to absorb noise
- Enclosed rooms or enclosures for stationary machinery such as compressors
- Noise attenuating equipment e.g. white noise reversing alarms, vibration isolation mountings
- Silencers
- Where possible plant/equipment modifications

6.4 Noise Contingency Measures

6.4.1 Noise Complaints

ABC provides a range of ways in which it can be contacted by members of the public about any matter of concern which include:

- A 24 hour, 7-day hotline phone number 8300 0520. This 24/7 service provides the option to be called back immediately by the on-site supervisor or to be contacted the next business day
- ABC's main switchboard on 8300 0300 between our normal business hours of 8:30 am to 5pm
- By email: BirkenheadCommunity@adbri.com.au
- By completing and submitting an online feedback form accessed through ABC Community webpage <http://adelaidebrightoncommunity.com.au/contact-us/>
- A process for community engagement, documented in a Community Engagement Plan, licence condition U-722

Complaints are managed in accordance with EPA licence 1126, 1/11/2017, condition 300-9. Details of all noise complaints are logged into the complaints database and are communicated to the appropriate staff member to be investigated.

Immediate action is to be taken to mitigate identified sources of noise complaints and longer term corrective action will be identified to minimise a reoccurrence.

Identified noisy plant, equipment and activities reported by site employees and contractors are logged into the complaints database and managed in the same way as external noise complaints.

6.4.2 Plant shutdowns/major site works

Planned events where the activity to be undertaken has the potential to change the characteristics of the normal plant background noise, such as plant shutdowns, demolition and construction activities, will be risk assessed and appropriate controls implemented to manage off site impacts. The manager with responsibility for the activity/project is to ensure a risk assessment appropriate to the nature of the activity and potential noise emissions impact is undertaken (refer section 6.2.2 Acoustic planning).

These controls may include,

- Where appropriate, the development of a specific noise minimisation plan for that activity
- Limiting particular activities to certain times of the day where this is reasonably practical
- Identification of controls to minimise noise from specific activities
- Noise measurements to ensure identified measures are effective (refer 6.1 Noise measurements)

The EPA is to be informed of activities that have the potential to result in atypical off-site noise emissions and advised of the nature, relevant details, duration and controls in place to mitigate off site noise impacts from such activities prior to their commencement. Sensitive receptors will be advised of relevant details (nature/duration of activities) prior to their commencement through the current accepted communication channels at the time, which may include letter box drops/print media/website/CLG meetings)

6.4.3 Emergency noise

Emergency alarms and sirens are used to alert people to a risk to their personal safety and plant process issues.

Metropolitan Fire Services personnel need to investigate fire alarms and assess that the situation / plant / building is safe, before fire alarms can be cancelled/silenced.

Audible pre warning alarms that are a mandatory safety requirement to alert employees to imminent plant /equipment start up are located within buildings close to the piece of equipment.

Plant process alarms are managed within the plant SCADA systems, which are, monitored 24/7 in a centralised control room manned by control room operators. Plant conditions giving rise to process alarms are addressed promptly to correct the process conditions generating the alarm. Most of the audible alarms are located within a building close to the relevant part of the process. The Kiln flush alarm is located externally within the preheater towers to alert process operators in these areas for safety reasons. The process conditions generating a kiln flush alarm occurs infrequently, and sound several times for about one minute duration over about a thirty min period as the process conditions are rectified.

6.5 Continuous improvement and reporting measures

Activities that drive continuous improvement in noise management are summarised in table 3

Table 3: Summary of activities driving continuous improvement in noise management

Activity:	Description:
On-site noise surveys	On-site noise surveys are conducted regularly to identify significant noise sources and inform updates to the noise model. The on-site surveys allow the effectiveness of previous noise mitigation projects to be quantified, and an accurate noise model of the site to be maintained. Regular on-site noise surveys also allow for the continued effectiveness of previous noise mitigation projects to be verified.
Computer noise modelling	Computer noise modelling of the site allows for an understanding of the relative contribution of each noise source to noise emissions in the community to be developed, which allows for a risk-based approach to noise mitigation to be adopted. The noise model is updated regularly (approximately every 12 months) to reflect recent changes in the noise profile of the plant (e.g. to incorporate recent noise mitigation projects)
Identification of highest risk noise sources	From the updated noise model (and site noise surveys), the noise sources with the highest risk of off-site noise impacts are identified (based on their relative contribution to predicted noise levels), and noise mitigation projects are targeted at these noise sources.

Activity:	Description:
Noise mitigation	Noise mitigation projects are targeted at the noise sources which pose the greatest risk to off-site noise impacts within the community (as identified above). This ensures that the maximum benefit to the community is realised.
Regular attended and unattended noise monitoring	Regular attended and unattended noise monitoring is undertaken in the community to determine the effectiveness of recent noise mitigation projects, validate the noise model for the site, and to form a baseline for the next round of noise mitigation projects. Regular noise monitoring at the same locations allows for trends over time to be observed with regard to noise impacts.
Ad-hoc noise monitoring	In addition to regular attended and unattended noise monitoring, ad-hoc surveys are also undertaken to capture periods of atypical noise emissions (such as shut-downs, construction projects and demolition activities, or introduction of new noise sources), and to address specific noise complaints. Surveys undertaken during shutdown periods also allow an understanding of the contribution of major noises to be gained, as well as an understanding of the noise level present in the absence of significant on-site noise sources to be developed.
Procurement/process changes	Consideration of lower noise emission products when selecting new plant and equipment, or when process changes are made.
Management processes	<p>Management and communication processes that help facilitate awareness of noise emissions and provide avenues for identifying, communicating, reporting, assessing, controlling and reducing site noise emissions, include:</p> <ul style="list-style-type: none"> • Internal and external management system audits. • Certified ISO 14001 Environmental Management System • Internal process change requests • Equipment/Task risk assessments (safety/environment/quality) • Housekeeping /workplace inspections • Plant equipment preventative maintenance schedules • Production meetings & tool box talks • Weekly and monthly management meetings
Complaints management	ABC provides a range of options for members of the public to raise concerns about operations, including a 24/7 telephone hotline, email, and an online feedback form. All complaints are logged into ABC's database, and are responded to within 72 hours. Immediate action to resolve the issue is taken if possible, and longer-term actions are taken to prevent recurrence.
Community engagement	ABC makes monitoring reports and plans available to the community on its website where appropriate, and participates in community liaison group meetings.
Training	ABC ensures that employees and contractors are trained and aware of requirements relating to noise (including reporting and taking action when noisy plant, equipment or processes are identified) through site inductions and environmental awareness training.

6.5.1 Measurement and reporting of improvement

6.5.1.1 Improvement projects

- Identified noise attenuation projects with a high risk of off-site noise impacts are to be captured in an Environmental Improvement Plan (EIP). The EIP provides a framework that summarises project details, implementation time frames and expected improvement in noise emissions. The EIP also provides a mechanism for communicating a commitment to continuous improvement in noise emissions to sensitive receptors.
- Noise measurements will be undertaken pre and post implementation of identified noise attenuation projects to verify effectiveness of the project.

6.5.1.2 Reporting

A quarterly report will be prepared detailing noise management activities for the quarter.

Quarterly reports will include where applicable:

- Details of noise complaints (excluding complainant name and identifying address details (for reasons of confidentiality), received during the quarter, including outcomes of the complaint investigation and where applicable corrective actions implemented
- Details on the progress of noise attenuation projects including effectiveness
- Details of noise monitoring reports
- Details of other noise minimisation activities

The annual report will include where applicable:

- Graph of noise complaints received for the year and trend report in noise complaints compared with the previous year
- Summary of noise monitoring in the local community and an assessment of results against previous monitoring results to identify trends in noise levels.
- Summary of noise minimisation actions and overall effectiveness
- Details of other noise minimisation activities
- Assessment of the effectiveness of this noise management plan

To manage licence reporting requirements, all noise reports will be submitted to the EPA, within 45 days of the end of the calendar year reporting periods; i.e. quarterly reports due before, 14 February, 14 May, 15 August, 15 November and annual report due by 14 February.

Following acceptance of the reports by the EPA they will be made available on the ABC Community Web Site, within 7 days.

6.5.2 Public Access

A copy of the current version of this Plan, as approved by the EPA, will be made available on the ABC Community Web Site within 7 days.

7.0 Plan Submission

Submitted by:

Name

Position

Authorised on behalf of

ADELAIDE BRIGHTON CEMENT LTD.

Signed :

Dated :/...../.....

8.0 Plan Approval

Approved by:

.....

DELEGATE OF THE ENVIRONMENT PROTECTION AUTHORITY

Signed :

Dated :/...../.....

Appendix A



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10 August 2018
Ref: 50B-18-0036-TRP-805507-2

Attention: Tim Radimissis

Birkenhead Noise Emissions Profile Summary

1 INTRODUCTION

Adelaide Brighton Cement (ABC) holds an EPA licence for their operations at Birkenhead. This summary report details ABC's legislative requirements with respect to noise, provides a summary of ABC's approach to noise management over the past 3 years and provides a snapshot of the current noise profile of the Birkenhead site with respect to off-site noise emissions.

2 REFERENCES

- [1] Licence No. 1126 Adelaide Brighton Cement Limited (issued 01 November 2017), Environment Protection Authority
- [2] Environment Protection Act 1993, Government of South Australia
- [3] Environment Protection (Noise) Policy 2007, Government of South Australia
- [4] Port Adelaide Enfield Council Development Plan (consolidated 6 February 2018), Department of Planning, Transport and Infrastructure (DPTI) (2017)
- [5] Guidelines for the Use of the Environment Protection (Noise) Policy 2007, Environment Protection Authority (EPA) (2009)
- [6] Adelaide Brighton Cement – Acoustic Consultancy: Ground Vibration Monitoring Survey, Resonate Acoustics, reference A15623RP3 Rev. C, dated 12 July 2016
- [7] Adelaide Brighton Cement – Vibration Investigation Residential Survey, Resonate Acoustics, reference A15623RP4, Rev. A, dated 13 October 2016
- [8] Adelaide Brighton Cement – Residential Vibration Investigation, Resonate Acoustics, reference A15623RP5, Rev. 2, dated 2 December 2016
- [9] Vipac report 50B-16-0007-TRP-804883-0, "Residential Noise Monitoring - April 2017", dated 31 July 2017
- [10] Vipac report 50B-13-0022-TRP-798180-3, "Rose St Noise Investigation", dated 6 August 2015
- [11] Vipac report 50B-13-0022-TRP-797221-1, "ABC Birkenhead Noise Investigation February 2015", dated 12 March 2015
- [12] Vipac report 50B-16-0007-TRP-457895-2, "Noise Abatement and Modelling Update", dated 13 July 2017
- [13] Vipac report 50B-16-0007-TRP-473094-2, "Noise Modelling Prediction", dated 24 May 2016
- [14] Vipac report 50B-16-0068-DRP-799861-3, "Adelaide Brighton Cement - Noise Abatement Project", dated 19 August 2016

10 August 2018

- [15] Vipac report 50B-13-0022-TRP-797501-2, "Birkenhead March 2015 Noise Survey", dated 07 May 2015
- [16] Vipac report 50B-13-0022-TRP-798400-2, "Birkenhead Shutdown", dated 26 August 2015
- [17] Vipac report 50B-13-0022-TRP-796411-2, "Birkenhead October 2014 Noise Survey", dated 26 November 2014
- [18] Vipac report 50B-16-0007-TRP-457761-3, "ABC – Noise Survey March 2017: Continuous Monitoring Encompassing Major Shutdown", dated 22 September 2017
- [19] Vipac report 50B-16-0007-TRP-804784-2 "ABC – Attended Noise Measurements May 2017", dated 12 July 2017
- [20] Vipac report 50B-16-0007-TRP-799543-2 "ABC Noise Survey February 2016", dated 18 May 2016
- [21] Vipac report 50B-16-0007-TPR-799629-1 "ABC Environmental Noise Assessment", dated 18 May 2016

3 ENVIRONMENTAL AUTHORISATION

The *Environment Protection Act 1993* [2] (EP Act) is the principal legislative instrument regulating pollution from industry in South Australia (including noise). Section 36 of the EP Act requires ABC to hold a licence in order to conduct activities of environmental significance (as listed in Schedule 1 of the EP Act). With reference to ABC's EPA licence [1], the following activities undertaken on-site require ABC to hold a licence:

- Cement works
- Activities producing listed wastes
- Bulk shipping activities
- Crushing, grinding or milling works (rock, ores or minerals)
- Fuel burning (coal or wood)
- Fuel burning (not coal or wood)

ABC's current licence was re-issued on the 1st of November 2017 [1], and contains the following condition (U – 787) relating primarily to noise emissions:

1.7 SITE NOISE MINIMISATION (U - 787)

The licensee must:

- 1.7.1 take all reasonable and practicable measures to minimise noise generated at the Premises;
- 1.7.2 develop a Noise Management Plan to the satisfaction of the EPA by the date listed below;
- 1.7.3 ensure that the Noise Management Plan includes, but is not limited to:
 - a detailed action and response strategies that will be taken to prevent and minimise noise emissions;
 - b a methodology and framework for the provision of quarterly reports and an annual report on the implementation and effectiveness of the Noise Management Plan;
 - c a methodology and framework for providing public access to the Noise Management Plan (or any revised plan approved by the EPA) and to quarterly and annual reporting;
- 1.7.4 implement the Noise Management Plan approved in writing by the EPA (or any revised plan approved in writing by the EPA).

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This noise emissions profile summary report is intended to supplement and provide additional context to the Noise Management Plan (NMP), and provide details of “all reasonable and practicable” measures which have been taken by ABC to manage and minimise noise emissions from the Birkenhead site.

4 SITE NOISE CRITERIA

Noise from the activities undertaken at the ABC Birkenhead site is subject to the provisions of the *Environment Protection (Noise) Policy 2007* (Noise EPP) [3]. The Noise EPP outlines Noise Goals which provide one method for demonstrating compliance with the General Environmental Duty under Section 25 of the *Environment Protection Act 1993* (the Act) [2]. Compliance with the Noise Goals is achieved either by noise from the site not exceeding the background noise level plus 5dB(A), or not exceeding the Indicative Noise Levels (INLs) applicable to the site as determined in accordance with Clause 5 of the Noise Policy and the relevant council Development Plan applicable to the subject site and the surrounding locality.

Indicative Noise Levels have been calculated in accordance with the procedure outlined in Clause 5 of the Noise EPP and the relevant provisions of the Port Adelaide Enfield Council Development Plan (consolidated 6 February 2018) [4]. With reference to the Development Plan, the site is located partially within the “Industry” zone, and partially within the “Light Industry” zone (no policy areas or precincts apply to either locality). The nearest noise sensitive receptors (NSRs) are located within Policy Areas 57 and 65 of the “Residential” zone.

In accordance with the Development Plan, the “Industry” zone primarily accommodates industrial, warehouse, storage and transport land uses, and the “Light Industry” zone promotes light industry, service industry, storage and warehouse land uses. With reference to the *Guidelines for the Use of the Environment Protection (Noise) Policy 2007* [5], it is therefore considered that the “Industry” zone principally promotes the “General Industry” Land Use Category as set out in Table 2 of the Noise EPP, while the “Light Industry” zone principally promotes the “Light Industry” Land Use Category. With reference to the relevant development plan provisions, it is considered that the “Residential” zone (and associated policy areas 57 and 65) principally promote the “Residential” land use category.

As such, the following Indicative Noise Levels (INLs) apply to ABC’s operations:

Table 4-1 – Indicative Noise Levels

	Indicative Noise Levels (L _{eq} , dB(A))	
	Day-time (7am to 10pm)	Night-time (10pm to 7am)
Residential zone – Policy Area 57 (Le Fevre Peninsula East)	57	49
Residential zone – Policy Area 65 (Restricted Residential)	57	49

The above criteria have been updated to reflect the current zoning outlined in the current Port Adelaide Enfield Council Development Plan (consolidated 6 February 2018) [4].

4.1 ADJUSTMENT FOR CHARACTERISTICS

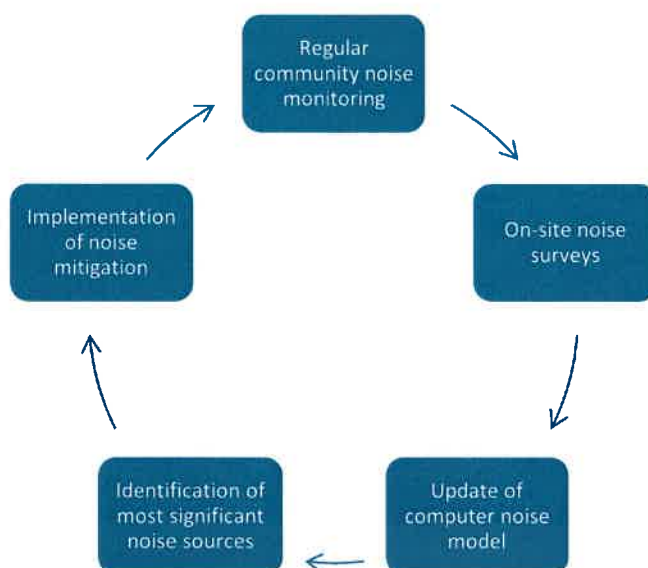
Note that for a noise containing a characteristic (tonal, impulsive, low frequency or modulating), the following adjustments are to be made to the source noise level:

- Noise containing 1 characteristic; a 5dB(A) penalty must be added to the noise level (continuous).

- Noise containing 2 characteristics; an 8dB(A) penalty must be added to the noise level (continuous).
- Noise containing 3 or 4 characteristics, a 10dB(A) penalty must be added to the noise level (continuous).

5 APPROACH TO NOISE MANAGEMENT

ABC's approach to noise management is based on continuous improvement, and incorporates risk-based elements with regard to identification and implementation of noise mitigation projects. Specifically, ABC regularly conducts on-site noise surveys to inform a computer noise model, identifies from the noise model and the on-site surveys the noise sources which have the highest potential to result in off-site noise impacts, implements noise mitigation projects targeted at providing the greatest benefit to residents, and conducts routine noise monitoring within the Birkenhead community to verify the results and provide a baseline for further noise mitigation. ABC's approach to noise management is summarised in the below flowchart and following table:



Activity:	Description:
On-site noise surveys	On-site noise surveys are conducted regularly to identify significant noise sources and inform updates to the noise model. The on-site surveys allow the effectiveness of previous noise mitigation projects to be quantified, and an accurate noise model of the site to be maintained. Regular on-site noise surveys also allow for the continued effectiveness of previous noise mitigation projects to be verified.

Activity:	Description:
Computer noise modelling	Computer noise modelling of the site allows for an understanding of the relative contribution of each noise source to noise emissions in the community to be developed, which allows for a risk-based approach to noise mitigation to be adopted. The noise model is updated regularly (approximately every 12 months) to reflect recent changes in the noise profile of the plant (e.g. to incorporate recent noise mitigation projects)
Identification of highest risk noise sources	From the updated noise model (and site noise surveys), the noise sources with the highest risk of off-site noise impacts are identified (based on their relative contribution to predicted noise levels), and noise mitigation projects are targeted at these noise sources.
Noise mitigation	Noise mitigation projects are targeted at the noise sources which pose the greatest risk to off-site noise impacts within the community (as identified above). This ensures that the maximum benefit to the community is realised.
Regular attended and unattended noise monitoring	Regular attended and unattended noise monitoring is undertaken in the community to determine the effectiveness of recent noise mitigation projects, validate the noise model for the site, and to form a baseline for the next round of noise mitigation projects. Regular noise monitoring at the same locations allows for trends over time to be observed with regard to noise impacts.
Ad-hoc noise monitoring	In addition to regular attended and unattended noise monitoring, ad-hoc surveys are also undertaken to capture periods of atypical noise emissions (such as shut-downs, construction projects and demolition activities, or introduction of new noise sources), and to address specific noise complaints. Surveys undertaken during shutdown periods also allow an understanding of the contribution of major noises to be gained, as well as an understanding of the noise level present in the absence of significant on-site noise sources to be developed.
Procurement/process changes	Consideration of lower noise emission products when selecting new plant and equipment, or when process changes are made.
Complaints management	ABC provides a range of options for members of the public to raise concerns about operations, including a 24/7 telephone hotline, email, and an online feedback form. All complaints are logged into ABC's database, and are responded to within 72 hours. Immediate action to resolve the issue is taken if possible, and longer term actions are taken to prevent recurrence.
Community engagement	ABC makes monitoring reports and plans available to the community on its website where appropriate, and participates in community liaison group meetings.



Activity:	Description:
Training	ABC ensures that employees and contractors are trained and aware of requirements relating to noise (including reporting and taking action when noisy plant, equipment or processes are identified) through site inductions and environmental awareness training

6 SUMMARY OF RECENT WORKS

Works conducted to monitor, manage and minimise noise impacts on the local community over the past 3 years have included the following:

- Regular attended and unattended monitoring of noise from typical operations
- Monitoring of noise during shut-down periods
- Monitoring of noise in response to specific complaints from members of the community
- On-site noise surveys
- Noise modelling
- Identification and implementation of reasonable and practicable noise mitigation projects

A summary of the work which has been conducted over the past 3 years (beginning of 2015 to present) for each of the above is summarised in the following sections. A summary of all work conducted by Vipac over this period (categorised by type of assessment) and associated reports provided is contained in Appendix A.

6.1 REGULAR ATTENDED AND UNATTENDED NOISE MONITORING

Over the past 3 years (and prior), ABC has commissioned Vipac to undertake regular attended and unattended noise monitoring surveys in the community to gain an understanding of how noise from the site impacts the community. Attended measurements have generally been conducted both during the day-time and night-time periods (as defined by the Noise EPP), and defined measurement positions have been established allowing for trends in noise levels at each location to be established over time. Similarly, unattended noise logging surveys have typically been conducted at the same location (R2) in each survey to enable a trend to be established. Note that more recent unattended noise logging surveys have been undertaken at the Adelaide Brighton Cement Social Club, in lieu of R2. The three most recent noise logging surveys have included the shut-down period which typically occurs around March or April each year; this has allowed for noise levels during the shut-down to be directly compared against those present during typical operations.

Discussion of the difference between noise levels measured during typical operations and plant shut-down periods is provided in Section 7.1 below.

The noise monitoring locations used for the attended and unattended surveys are shown in Figure 6-1 below.



Figure 6-1: Overview of attended noise measurement locations (note that unattended noise logging was previously also conducted at R2)

6.2 ADDITIONAL NOISE MONITORING SURVEYS

In addition to regular attended and unattended noise monitoring surveys, over the past 3 years ABC has commissioned Vipac to undertake several additional surveys targeted at resolving specific complaints from members of the community ([9] and [10]), or to investigate the noise emission of specific items of plant and equipment ([11]).

6.3 NOISE MODELLING

ABC has engaged Vipac to develop a comprehensive 3-dimensional computer noise model of the site using the SoundPLAN noise modelling package. The model of the site has been updated in each of the past 2 years (May 2017 [12] and May 2016 [13]).

A noise emissions survey of the plant during typical operations was undertaken to inform each update of the model, with attended measurements conducted at residential receivers used to assist with calibration of the model. In general, the predicted noise levels are within the range that would be considered 'in good agreement' with the measured data, especially given the complexity of the plant model and the very high number of noise sources.

6.4 NOISE MITIGATION PROJECTS

Following the May 2016 noise model update [13] and July 2016 noise abatement recommendations report [14], noise abatement were implemented by ABC on dust collector fans CS2 and CS2/3/4 with the installation of two new noise silencers. Refurbishment of the main fans also occurred during the main shutdown period 14 March – 7 April 2017.

In addition, routine maintenance within the limestone reclaimer shed was undertaken, and in the March 2016 shutdown the entire operational chain assembly was replaced.

Installation of a silencer on the Cement Mill 1 Compressor was also undertaken in April 2016.

Recommendations for further noise abatement following the May 2017 update [12] of the noise model include the following:

- Gas Train – installing a roof over the existing gas train walls to mitigate noise emissions
- 38 Blend Silo Top Dust Collector – Maintenance/Abatement
- 4A Discharge Fan – Maintenance/Abatement
- 4B Airside Blower – Maintenance /Abatement

7 SITE NOISE PROFILE SUMMARY

In general, noise levels comply with the day-time criterion applicable under the Noise EPP (as outlined in Section 4). At most noise sensitive receivers, night-time noise levels also meet the criterion applicable under the Noise EPP. Where noise levels exceed the 49dB(A) night-time criterion, the exceedance is generally less than 3dB(A) which subjectively is a 'just noticeable change' as compared with the criterion level. The most recent 'worst-case' predicted noise levels (validated by attended measurement results) are overlayed on an aerial photograph of the ABC plant and surrounding locality in Figure 7-1. Note that green circles indicate that compliance is predicted, tangerine circles indicate that marginal compliance is predicted (less than 3dB), and red circles indicate that exceedance of the night-time criterion is predicted (greater than 3dB). As can be seen from the below figure, predicted exceedances of the night-time criterion are generally limited to receivers within approximately 250 metres of the site boundary (i.e. to the east of Mary Street Birkenhead).

Summary results from recent attended noise monitoring surveys are presented in Appendix B, and noise modelling are presented in Appendix C.



Figure 7-1: Worst-case predicted noise levels (L_{Aeq}) – May 2017

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7.1 COMPARISON WITH SHUT-DOWN NOISE LEVELS

Recent unattended noise logging surveys have been timed to include both operational and shut-down periods. This has allowed a direct comparison between the noise levels present during typical operations and periods of reduced noise emissions to be made. Average L_{A90} noise levels measured during typical operations and shut-down periods from Vipac's two most recent unattended noise logging surveys (March – April 2017 [18] and February – April 2016 [20]) are presented in Table 7-1 below.

Table 7-1: Average L_{A90} Background Noise Levels

	Day, dB(A)	Night, dB(A)
March – April 2017 survey:		
Full ABC Operations (March 8-14, April 7-21)	60	58
ABC Shutdown Period (March 14 – April 7)	58	50
February – April 2016 survey:		
Full ABC Operations (February 9-26, March 19-April 5)	61	58
ABC Shutdown Period (February 27 – March 18)	60	52

Based on the above table, it can be seen that during both surveys day-shut-down time noise levels were above the 57dB(A) day-time noise goal, and night-time shut-down noise levels were above the 49dB(A) night-time noise goal respectively.

As the above measurements were conducted near Victoria Road, road traffic noise from this major arterial road represented the most significant contributor to the shut-down noise levels presented in the above table. Similar levels of road traffic noise are likely to be present during typical operational periods; this will contribute to higher noise levels being measured at these times and hence an over-estimate of ABC's noise emissions. Noise modelling (as discussed in Section 6.3 above) has therefore been used to supplement attended and unattended noise monitoring, and provide an estimate of noise levels resulting from ABC's emissions alone (i.e. excluding the influence of other noise sources such as road traffic noise).

7.2 CHARACTER OF ABC'S NOISE EMISSIONS

Noise emissions from the ABC Birkenhead site are characterised as continuous broadband, steady-state noise, not comprising any modulating or impulsive characteristics. While tonal noise has previously been identified at some locations (e.g. during the Wills Street Birkenhead survey [9]), in general these tones have been eliminated from the noise emission through corrective maintenance. The absence of tones is noted in Vipac reports [15], [16], [17]. Description of different types of noise characters are provided in the glossary of acoustic terminology attached to this report (Appendix D)

As ABC's noise emission profile is characterised as steady state (i.e. without significant modulation or impulsive components), the L_{A90} descriptor provides a good representation of the level of noise contributed by ABC's operations to the overall noise level present in the community. The L_{A90} descriptor has therefore been used to eliminate the influence of short term, extraneous noise sources from unattended logging results (such as intermittent passing traffic, for example) which would otherwise influence the measured L_{Aeq} noise level, and to enable noise level trends over time to be examined at attended monitoring locations.



7.3 VIBRATION

Resonate Acoustics was engaged to undertake ground vibration monitoring in the vicinity of the nearest residential properties [6], [7], [8]. The results of the vibration monitoring [8] indicate that the measured RMS acceleration levels at the selected residences are significantly less than the "Not uncomfortable" perception level. The results also indicated that the peak acceleration levels (short, intermittent periods of vibration) were generally above both the lower and upper interquartile perception ranges. Based on the time histories of the measured peak acceleration levels and the operating times of the plant at the Adelaide Brighton Cement facility, the report concluded that it is unlikely that the operational plant was a direct cause of the measured peak vibration levels. Resonate concluded that it is likely that the highest peak acceleration levels were caused due to localised activity close to the accelerometer or due to vehicle movements on the adjacent Victoria Road.

8 CONCLUSION

The above provides a summary of ABC's approach to noise management over the past 3 years, provides a snapshot of the current noise profile of the Birkenhead site with respect to off-site noise emissions, and details "reasonable and practicable" measures which have been taken by ABC to manage and minimise noise emissions from the Birkenhead site.



Yours sincerely,
Vipac Engineers & Scientists Ltd

A handwritten signature in black ink, appearing to read "Byron Holmes".

Byron Holmes
Acoustic Engineer
Author

A handwritten signature in black ink, appearing to read "Peter Teague".

Peter Teague
Principal Acoustic Consultant
Reviewer

Attachments:

- Appendix A – Assessment History**
- Appendix B – Recent Noise Monitoring Survey Results**
- Appendix C – Recent Modelling Results**
- Appendix D – Glossary of Acoustic Terminology**

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Appendix A ASSESSMENT HISTORY

Report date:	Report Reference:	Assessment type:	Comments:
13 July 2017	50B-16-0007-TRP-457895-2	Noise modelling update	Noise modelling and abatement update (May 2017)
31 July 2017	50B-16-0007-TRP-804883-0	Supplementary noise monitoring	Unattended noise logging at 142 Wills St Birkenhead (April 2017)
12 July 2017	50B-16-0007-TRP-804784-2	Routine noise monitoring	Attended measurements (19 locations) (May 2017)
22 September 2017	50B-16-0007-TRP-457761-3	Routine noise monitoring	Unattended noise logging (NL1) over 7 weeks, including shutdown (March 2017)
19 August 2016	50B-16-0068-DRP-799861-3	Noise abatement recommendations	Noise abatement recommendations, noise survey of 4B calciner start-up
24 May 2016	50B-16-0007-TRP-473094-2	Noise modelling update	Noise modelling prediction (May 2016)
18 May 2016	50B-16-0007-TPR-799629-1	Routine noise monitoring	Attended measurements (16 locations) (April – May 2016)
18 May 2016	50B-16-0007-TPR-799543-2	Routine noise monitoring	Annual Noise Survey 2016 (incl. shutdown) (February – March 2016) - Attended measurements (16 locations) - Noise logging (NL1) over 6 weeks
26 August 2015	50B-13-0022-TRP-798400-2	Routine noise monitoring	Annual Noise Survey May 2015 (incl. shutdown) - Attended measurements (7 locations) - Noise logging (R2) over 21 days
6 August 2015	50B-13-0022-TRP-798180-3	Supplementary noise monitoring	Noise investigation - Rose Street Birkenhead - Continuous noise logging (30 days) - Attended indoor noise measurements

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Report date:	Report Reference:	Assessment type:	Comments:
7 May 2015	50B-13-0022-TRP-797501-2	Routine noise monitoring	Annual Noise Survey March 2015: <ul style="list-style-type: none"> - Attended measurements (8 locations) - Noise logging (R2) over 7 days
12 March 2015	50B-13-0022-TRP-797221-1	Supplementary noise investigation	Investigative study (February 2015) <ul style="list-style-type: none"> - Attended measurements (4 locations) - Impact of different operational modes (i.e. certain plant online or offline)
26 November 2014	50B-13-0022-TRP-796411-2	Routine noise monitoring	Annual Noise Survey October 2014: <ul style="list-style-type: none"> - Attended measurements (7 locations) - Noise logging (R2)
31 July 2014	50B-13-0022-TRP-794999-1	Routine noise monitoring	Annual Noise Survey July 2014: <ul style="list-style-type: none"> - Attended measurements (8 locations) - Noise logging (R2) over 4 days
19 May 2014	50B-13-0022-TRP-793947-3	Supplementary noise investigation	Gantry Dust Collector Noise Control Investigation <ul style="list-style-type: none"> - On-site survey of gantry dust collector noise levels - Recommendation of noise abatement options
12 May 2014	40B-13-0022-TRP-793665-1	Routine noise monitoring	Annual Noise Survey April 2014 (incl. shutdown): <ul style="list-style-type: none"> - Attended measurements (7 locations) - Noise logging (R2) over 7 days (shutdown and normal operations)
22 November 2013	50B-13-0022-TRP-792315-0	Supplementary noise investigation	Tonality assessment October 2013: <ul style="list-style-type: none"> - Attended measurements at 7 locations - Assessment of tonality in 1/3 octave bands and narrow band



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Report date:	Report Reference:	Assessment type:	Comments:
31 October 2013	50B-13-0022-TRP-792137-0	Routine noise monitoring	Annual Noise Survey October 2013: <ul style="list-style-type: none">- Attended measurements (7 locations)- Noise logging (R2) over 7 days- 'On/off' testing
14 August 2013	50B-13-0022-TRP-791468-0	Supplementary noise investigation	Dust collector noise survey: <ul style="list-style-type: none">- Investigation into the impact of dust collector fans online vs offline
28 May 2013	50B-13-0022-TRP-781494-0	Routine noise monitoring	April 2013 Shut Down Noise Monitoring Survey <ul style="list-style-type: none">- Attended measurements (7 locations)- Noise logging (R2) over 6 days
15 April 2013	50B-13-0022-TRP-781296-0	Routine noise monitoring	Annual Noise Survey 2013: <ul style="list-style-type: none">- Attended measurements (7 locations)- Noise logging (R2) over 3 days

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Appendix B RECENT NOISE MONITORING SURVEY RESULTS

Recent noise measurement results (since February 2015) for both attended and unattended routine noise monitoring surveys are detailed below. Note that L_{A90} noise level results are presented in the below sections due to the influence of extraneous noise sources on measurement results, and the character of the noise emission from the ABC site (discussed in detail below).

ATTENDED MEASUREMENT SURVEYS

Five attended measurement surveys have been conducted during typical operations over the past 3 years. The results of these attended measurement surveys have previously been provided in Vipac reports [19], [21], [16], [20] and [15].

While the three most recent surveys have included up to 19 attended measurement locations, earlier surveys included only the seven locations identified as most important for characterising the noise impact. The noise levels measured during the past five attended measurement surveys between March 2015 and April 2018 are summarised in Table 8-1 below. Note that the measurements presented below represent a 'snapshot' at a point in time; as measurements may have been conducted at different times of the day (or night), on different days of the week and under varying weather conditions, it is therefore not possible to directly compare results to derive a trend in noise levels over the period.

The variability in the below results may be attributed to a combination of the above factors, in addition to the influence of noise sources unrelated to ABC's operations on the measured noise levels, particularly at locations further from the plant (such as R13) or those located close to other major sources of noise (such as Victoria Road).

Table 8-1: Recent attended noise measurement results

Location:	Time period:	Criterion (dB(A))	Attended Noise Measurement Results (dB(A))									
			May 2017		April 2016		Feb. 2016		May 2015		Mar. 2015	
			L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}	L_{Aeq}	L_{A90}
R2	Day	57	59	56	58	55	59	55	-	-	60*	55
	Night	49	57	55	54	53	58	55	60*	58	60*	57
R3	Day	57	57	47	53	44	49	42	-	-	60*	46
	Night	49	51	49	47	46	45	41	55*	50	55*	49
R5	Day	57	54	51	50	45	52	48	-	-	54*	49
	Night	49	54	52	50	49	51	47	53*	52	54*	53
R8	Day	57	55	52	50	47	53	46	-	-	57*	46
	Night	49	51	50	47	46	51	47	53*	46	52*	51
R12	Day	57	59	55	63	52	57	53	-	-	59*	52
	Night	49	58	54	49	48	51	47	59*	57	59*	55
R13	Day	57	44	41	49	42	49	42	-	-	53*	41
	Night	49	47	46	42	41	48	43	50*	47	47*	45
R15	Day	57	58	55	53	50	55	52	-	-	55*	52

Location:	Time period:	Criterion (dB(A))	Attended Noise Measurement Results (dB(A))									
			May 2017		April 2016		Feb. 2016		May 2015		Mar. 2015	
			L _{Aeq}	L _{A90}	L _{Aeq}	L _{A90}	L _{Aeq}	L _{A90}	L _{Aeq}	L _{A90}	L _{Aeq}	L _{A90}
	Night	49	55	54	54	50	56	52	56*	55	55*	53

March 2015 and May 2015 L_{Aeq} results (marked with an asterisk (*) in the above table) were not published in the corresponding reports [16] and [20]. Day-time attended measurements were not conducted as part of the May 2015 survey [16].

UNATTENDED MEASUREMENT SURVEYS

Unattended noise measurements have been undertaken regularly at location R2 (up to and including the May 2015 survey). More recently, unattended monitoring surveys have been undertaken at the ABC Social Club. As such, monitoring results are not directly comparable between the two sites (particularly as the Social Club fronts Victoria Road and is therefore more exposed to road traffic noise than the previous location (R2) approximately 100 metres from the road. The location of the new unattended noise logging position (NL1) relative to the previous position (R2) is shown in Figure 8-1.

The results for the four most recent unattended noise monitoring surveys are summarised in Table 8-2 below. Note that the results of these attended measurement surveys have previously been provided in Vipac reports [15], [16], [18] and [20]. Recent unattended noise logging surveys have included both operational and shut-down periods; data corresponding to operational periods is shown in bold text in the below table, while data corresponding to shut-down periods is shown inside brackets. Note that the unattended logging data for the March 2015 survey included both typical operational periods and shut-down periods; as such it was not possible to compare noise levels between shut-downs and typical operations for this survey.

Table 8-2: Recent unattended noise monitoring survey results

Location:	Time period:	Criterion (dB(A))	Daily average L _{A90} Noise Level (dB(A))			
			March – April 2017	Feb – April 2016	May 2015	Mar. 2015
NL1	Day	57	60 (58)	61 (60)	- -	- -
	Night	49	58 (50)	58 (52)	- -	- -
R2	Day	57	- -	- -	54 (51)	53 -
	Night	49	- -	- -	53 (47)	52 -



Figure 8-1: Overview of R2 and NL1 noise logging positions

Appendix C RECENT MODELLING RESULTS

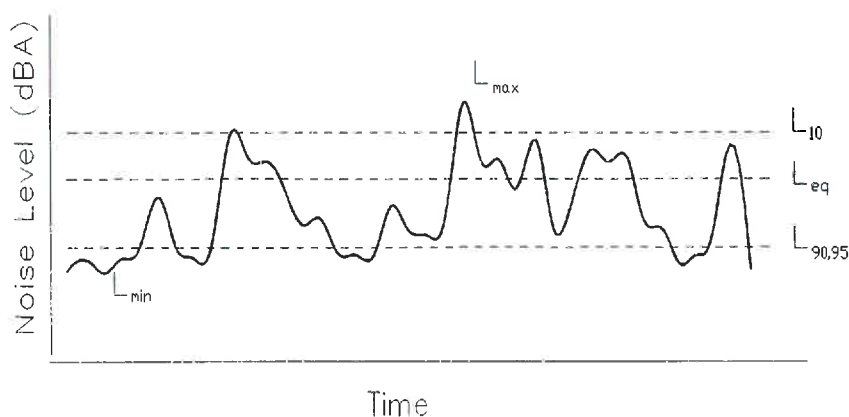
The results from the most recent noise modelling update are presented in Table 8-3 below. These results have previously been provided in Vipac report [12]. For comparison, the results for worst-case weather conditions from the previous noise modelling update (May 2016 [13]) are also provided. Locations where predicted noise levels marginally exceed the night-time criterion of 49dB(A) (by 3dB(A) or less) are indicated by light orange shading, those where noise levels are predicted to exceed the criterion by greater than 3dB(A) are indicated by pink shading..

Table 8-3: Recent noise modelling results (L_{Aeq})

Receiver ID	Criterion	Neutral predictions (dB(A))	Worst- case predictions (dB(A))	Previous worst-case predictions (dB(A))	Improvement
R2	49	52	53	55	2
R3	49	46	49	49	0
R4	49	43	46	47	1
R5	49	51	52	54	2
R6	49	44	45	46	1
R8	49	45	47	48	1
R9	49	37	39	40	1
R10	49	44	48	48	1
R11	49	39	41	41	1
R12	49	51	52	52	0
R13	49	40	43	43	0
R14	49	38	41	41	0
R15	49	52	53	53	2
R16	49	56	56	56	1
R17	49	43	45	45	0
R18	49	42	44	44	0
N1	49	51	52	-	-
N2	49	52	54	-	-
N3	49	48	49	-	-

Appendix D GLOSSARY OF ACOUSTIC TERMINOLOGY

dB(A)	A-weighted decibels; a unit of measurement of sound pressure level which has its frequency characteristics modified by a filter ("A-weighted") so as to more closely approximate the frequency response of the human ear.
L₁₀ or L_{A10}	The noise level which is equalled or exceeded for 10% of the measurement period. L ₁₀ is an indicator of the mean maximum noise level, and is used in Australia as the descriptor for intrusive noise (usually in dB(A)).
L₉₀ or L_{A90}	The noise level which is equalled or exceeded for 90% of the measurement period. L ₉₀ is an indicator of the mean minimum noise level, and is used in Australia as the descriptor for background or ambient noise (usually in dB(A)).
L_{eq} or L_{Aeq}	The equivalent continuous noise level for the measurement period. L _{eq} is an indicator of the average noise level (usually in dB(A)).
L_{max} or L_{Amax}	The maximum noise level for the measurement period (in dB(A))
Broadband noise	Noise comprising energy distributed across a large range of frequencies
Impulsive noise	A noise distinguished by a sharp rise and fall in noise level. Often characterised as thumping or banging.
Low frequency noise	A noise characterised as rumbling, roaring, booming or similar.
Modulating noise	A noise that fluctuates in either frequency (such as a wailing siren), or loudness (such as intermittent traffic). May be described as varying, fluctuating, pulsating or similar.
Tonal noise	A noise having a well-defined pitch or note which is clearly audible above other noise.



Note: The subjective reaction or response to changes in noise levels can be summarised as follows:

A 3 dB(A) increase in sound pressure level is required for the average human ear to notice a change; a 5 dB(A) increase is quite noticeable and a 10 dB(A) increase is typically perceived as a doubling in loudness.

Appendix B

Noise Measurement Locations:

Measurement Location	Location Address/ Description
R2	Corner of Alfred Street and Hargrave Street, Peterhead
R3	Adjacent to 145 Hargrave Street, Peterhead (facing Fletcher Road)
R4	Corner of Robert Street and Hargrave Street, Birkenhead
R5	Adjacent to 23 Levi Street, Birkenhead
R6	Adjacent to 19 Craigie Street, Birkenhead
R8	Adjacent to 39 Mary Street, Peterhead
R9	Corner of Wills Street and Whyte Street, Peterhead
R10	Corner of Olive Street and Victoria Road, Largs Bay
R11	Adjacent to 158 Fletcher Road, Largs Bay (facing east down Olive Street)
R12	Adjacent to 33 Hilton Street, Birkenhead
R13	Adjacent to 28 Whyte Street, Peterhead (facing east down Matilda Street)
R14	Adjacent to 15 Waverley Street, Largs Bay
R15	Adjacent to 9 Walton Street, Peterhead
R16	Adjacent to 77 Victoria Road, Birkenhead
R17	Corner of Fletcher Road and Rose St., Birkenhead (adjacent 53 Fletcher Rd)
R18	Adjacent to 20 Fletcher Road, Birkenhead (in the Park)
N1	Corner of Gunn Street and Well Street, Birkenhead (adjacent to 39 Wells St)
N2	Adjacent to 9 Mary Street, Peterhead
N3	Corner of Walton Street and Mary Street, Peterhead (adjacent to 23 Mary St.)



Figure 6-1: Overview of attended noise measurement locations (note that unattended noise logging was previously also conducted at R2)