



ANNUAL REVIEW

1 January 2018 – 31 December 2018

Dunloe Sand Quarry

TABLE OF CONTENTS

1	STATEMENT OF COMPLIANCE	7
2	INTRODUCTION	9
2.1	Name and Contact Details	13
3	APPROVALS	14
4	OPERATIONS SUMMARY	15
4.1	Exploration	15
4.2	Land Preparation.....	15
4.3	Construction Activities.....	15
4.4	Quarry Operations.....	15
	Total product tonnes in 2018 were well below the approved limit.....	15
4.5	Next Reporting Period.....	15
5	ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW	16
6	ENVIRONMENTAL PERFORMANCE	17
6.1	Meteorological Monitoring.....	17
	There was a total of 1,649.2 mm of rain at the Ballina Airport Weather Station in 2018.	17
6.2	Noise	17
6.2.1	EIS Predictions.....	17
6.2.2	Approved Criteria	17
6.2.3	Key Environmental Performance	18
6.2.4	Management Measures	18
6.2.5	Proposed Improvements	19
6.3	Air Quality.....	21
6.3.1	EIS Predictions.....	21
6.3.2	Approved Criteria	21
6.3.3	Key Environmental Performance	21
6.3.3.1	Depositional Dust	21
6.3.3.2	PM ₁₀ Monitoring.....	23
6.3.4	Management Measures	25
6.3.5	Proposed Improvements	25
6.4	Traffic Management	26
6.4.1	EIS Predictions.....	26
6.4.2	Approved Criteria	26
6.4.3	Key Environmental Performance	26
6.4.4	Management Measures	27
6.4.5	Proposed Improvements	27
6.5	Biodiversity	27
6.5.1	EIS Predictions.....	27

6.5.2	Approved Criteria	27
6.5.3	Key Environmental Performance	27
6.5.4	Management Measures	28
6.5.5	Proposed Improvements	28
6.6	Heritage	29
6.6.1	EIS Predictions	29
6.6.2	Approved Criteria	29
6.6.3	Key Environmental Performance	29
6.6.4	Management Measures	29
6.6.5	Proposed Improvements	29
6.7	Acid Sulphate Soils Management and Management of Fines	29
6.7.1	Acid Sulphate Soils Sampling	30
6.7.2	Extraction	30
6.7.3	Stockpiling & Sales	31
6.8	Summary of Environmental Performance	32
7	WATER MANAGEMENT	34
7.1	EIS Predictions	34
7.2	Approved Criteria	34
7.3	Surface Water	34
7.4	Surface Water Monitoring – Extraction Pond	37
7.5	Groundwater Results	39
7.6	Water Take	41
8	REHABILITATION AND LANDSCAPE MANAGEMENT	42
8.1	Rehabilitation Performance during the Reporting Period	42
8.2	Summary of Current Rehabilitation and Performance	43
	Rehabilitation monitoring of established rehabilitation has shown:.....	44
8.3	Actions for the Next Reporting Period	46
9	COMMUNITY	47
9.1	Community Engagement Activities	47
9.2	Community Contributions	47
9.3	Complaints	47
10	INDEPENDENT AUDIT	48
11	INCIDENTS AND NON-COMPLIANCE	49
12	ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD	50
13	REFERENCES	51
14	APPENDICES	52

TABLES

Table 1: Statement of Commitments	7
Table 2: DPE Compliance Status Key	7
Table 3: Non-Compliances of PA 06-0030 for 2018	8
Table 4: Annual Review Requirements.....	12
Table 5: Approvals for the Dunloe Sand Quarry Operations	14
Table 6: EPL Fee-Based Activity at the Dunloe Sand Quarry	14
Table 7: Total Product Distributed (Dunloe Sand Quarry)	15
Table 8: Actions required from Annual Review – Holcim Proposed Actions	16
Table 9: Monthly Weather Observations at the Dunloe Sand Quarry for 2018 (Ballina Airport AWS 058198)	17
Table 10: Noise Criteria for the Dunloe Sand Quarry (PA 06_0030).....	18
Table 11: Noise Monitoring Assessment for the Dunloe Sand Quarry (MAC, 2018).....	20
Table 12: Long Term Impact Assessment Criteria for Deposited Dust	21
Table 13: Short Term Impact Assessment Criteria for Particulate Matter	21
Table 14: Long Term Impact Assessment Criteria for Particulate Matter	21
Table 15: 2018 Dust Monitoring (Depositional Dust) at Dunloe Sand Quarry	22
Table 16: Depositional Dust Monitoring Summary (2016-2018).....	22
Table 17: Particulate Matter (PM ₁₀) 2018 Dust Monitoring at Dunloe Sand Quarry	24
Table 18 PM ₁₀ Monitoring Trends.....	25
Table 19: Estimated Operational Times, Periods and Truck Movements (EIS 2007)	26
Table 20: Operational Times, Periods and Truck Movements.....	26
Table 21: Environmental Performance at the Dunloe Sand Quarry in 2018	32
Table 22: Discharge Criteria – LDP001 and LDP002	34
Table 23: Quarterly Surface Water Quality Criteria – Extraction Pond.....	35
Table 24: Monthly Monitoring Criteria – Blue Green Algae	35
Table 25: Quarterly Surface Water Quality Criteria – Surrounding Environment	35
Table 26: Monthly Groundwater Quality Criteria – Surrounding Environment.....	36
Table 27: Quarterly Groundwater Quality Criteria – Surrounding Environment	36
Table 28: Monthly Extraction Pond (Dam 1) Water Quality Monitoring 2018 Results	37
Table 29: Quarterly Extraction Pond (Dam 1) Chemical Analysis Monitoring 2018 Results	37
Table 30: Surface Water Quality Monitoring 2018 Results for Extraction Pond (Dam 1) – Blue Green Algae	38
Table 31: Monthly Groundwater Quality Monitoring 2018 Results	39
Table 32: Quarterly Groundwater Quality Monitoring 2018 Results	40
Table 33: Rehabilitation Performance in 2018.....	42
Table 34: Rehabilitation and Disturbance Status.....	43
Table 35: Rehabilitation and Closure Actions for the Next Reporting Period (2019).....	46
Table 36: Summary of Incidents and Non-Compliances	49
Table 37: Improvement Actions for 2018	50

FIGURES

Figure 1: Aerial view of the Dunloe Sand Quarry located at Dunloe Park, Pottsville (Source: Nearmaps November 2018).....	9
Figure 2: Site Location and Layout (Source GHD: 2017)	10
Figure 3: Environmental Monitoring Locations (Source: VGT)	11
Figure 4: Rehabilitation and Disturbance	45

APPENDICES

Appendix 1	Dunloe Sand Quarry Noise Monitoring 2018
Appendix 2	Dunloe Sand Quarry Longterm Environmental Monitoring
Appendix 3	Dunloe Sand Quarry Rehabilitation and Ecological Monitoring
Appendix 4	Dunloe Sand Quarry Truck Movement Summary 2018
Appendix 5	Dunloe Sand Quarry Acid Sulphate Soil Monitoring Results

SITE DETAILS

Name of operation	Dunloe Sand Quarry
Name of operator	Holcim (Australia) Pty Ltd
Project Approval	Project Approval 06- 0030
Name of holder of Project Approval	Holcim (Australia) Pty Ltd
Annual review start date	January 1, 2018
Annual review end date	December 31, 2018
<p>I, Garth Stacey, certify that this audit report is a true and accurate record of the compliance status of the DUNLOE SAND QUARRY for the period of 1 JANUARY 2018 - 31 DECEMBER 2018 and that I am authorised to make this statement on behalf of HOLCIM (AUSTRALIA) PTY LTD.</p> <p>Note.</p> <p>a) <i>The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, \$1 million and for an individual, \$250,000.</i></p> <p>b) <i>The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or \$22,000, or both).</i></p>	
Name of authorised reporting officer	Garth Stacey
Title of authorised reporting officer	Quarry Manager
Signature of authorised reporting officer	
Date	27 March 2019

1 STATEMENT OF COMPLIANCE

The statement of commitments for the 2018 reporting period for the Dunloe Sand Quarry is provided in **Table 1**. **Table 3** details the non-compliances of Project Approval (PA) 06-0030 identified within the 2018 reporting period, with the compliance status key provided in **Table 2**.

Table 1: Statement of Commitments

Were all conditions of the relevant approval(s) complied with?	
PA 06_0030	NO - see Table 3 for further details.
EPL 13077	Yes

Table 2: DPE Compliance Status Key

Risk level	Colour code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur
Low	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur
Admin NC	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

Table 3: Non-Compliances of PA 06-0030 for 2018

Relevant approval	Condition	Condition Description	Compliance Status	Section addressed in Annual Review														
PA 06_ 0030	Schedule 3, Condition 6	<p>The Proponent must ensure that particulate matter emissions generated by the project do not cause exceedances of the criteria in Table 3 at any residence on privately-owned land.</p> <table border="1"> <thead> <tr> <th>Pollutant</th> <th>Averaging Period</th> <th>Criterion</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Particulate matter < 10 µm (PM₁₀)</td> <td>Annual</td> <td>^{a,c} 30 µg/m³</td> </tr> <tr> <td>24 hour</td> <td>^b 50 µg/m³</td> </tr> <tr> <td>Total suspended particulates (TSP)</td> <td>Annual</td> <td>^{a,c} 90 µg/m³</td> </tr> <tr> <td>^dDeposited dust</td> <td>Annual</td> <td>^b 2g/m²/month ^o 4g/m²/month</td> </tr> </tbody> </table> <p>Notes:</p> <p>^a Total impact (i.e. incremental increase in concentrations due to the development plus background concentrations due to all other sources).</p> <p>^b Incremental impact (i.e. incremental increase in concentrations due to the project on its own).</p> <p>^c Excludes extraordinary events such as bushfires, prescribed burning, dust storms, fire incidents or any other activity agreed by the Secretary.</p> <p>^d Deposited dust is to be assessed as insoluble solids as defined by the Standards Australia, AS/NZS 3580.10.1:2003: Methods for Sampling and Analysis of Ambient Air- Determination of Particulate Matter – Deposited Matter – Gravimetric Method.</p>	Pollutant	Averaging Period	Criterion	Particulate matter < 10 µm (PM ₁₀)	Annual	^{a,c} 30 µg/m ³	24 hour	^b 50 µg/m ³	Total suspended particulates (TSP)	Annual	^{a,c} 90 µg/m ³	^d Deposited dust	Annual	^b 2g/m ² /month ^o 4g/m ² /month	Non-compliant	<p>Relating to monitoring of PM₁₀ during the period. Above the short term criteria on three occasions.</p> <p>Relating to missed depositional dust round of sampling in August 2018. There was a change over with monitoring contractors.</p> <p>Section 6.2 (Air Quality) and Section 11.</p>
Pollutant	Averaging Period	Criterion																
Particulate matter < 10 µm (PM ₁₀)	Annual	^{a,c} 30 µg/m ³																
	24 hour	^b 50 µg/m ³																
Total suspended particulates (TSP)	Annual	^{a,c} 90 µg/m ³																
^d Deposited dust	Annual	^b 2g/m ² /month ^o 4g/m ² /month																
PA 06_ 0030	Schedule 3, Condition 22	<p>Schedule 3 Condition 22</p> <p>Blue Green Algae Management Plan</p> <p>(a) be prepared by a suitably qualified blue-green algae expert, whose appointment has been approved by the Secretary;</p> <p>(b) be consistent with extant guidelines for blue-green algae management including the NHMRC's <i>Guidelines for Managing Risks in Recreational Water</i>;</p> <p>(c) describe the measures that would be implemented to prevent and control the sources of algal blooms over the short, medium and long term; and</p> <p>(d) define procedures for the management and notification of identified algal blooms.</p>	Non-compliant	<p>Non-compliance relating to missed monitoring of Blue Green Algae between September and December 2018. Holcim have discussed this requirement with the monitoring contractor.</p> <p>Section 7 (Water Management) Section 11</p>														

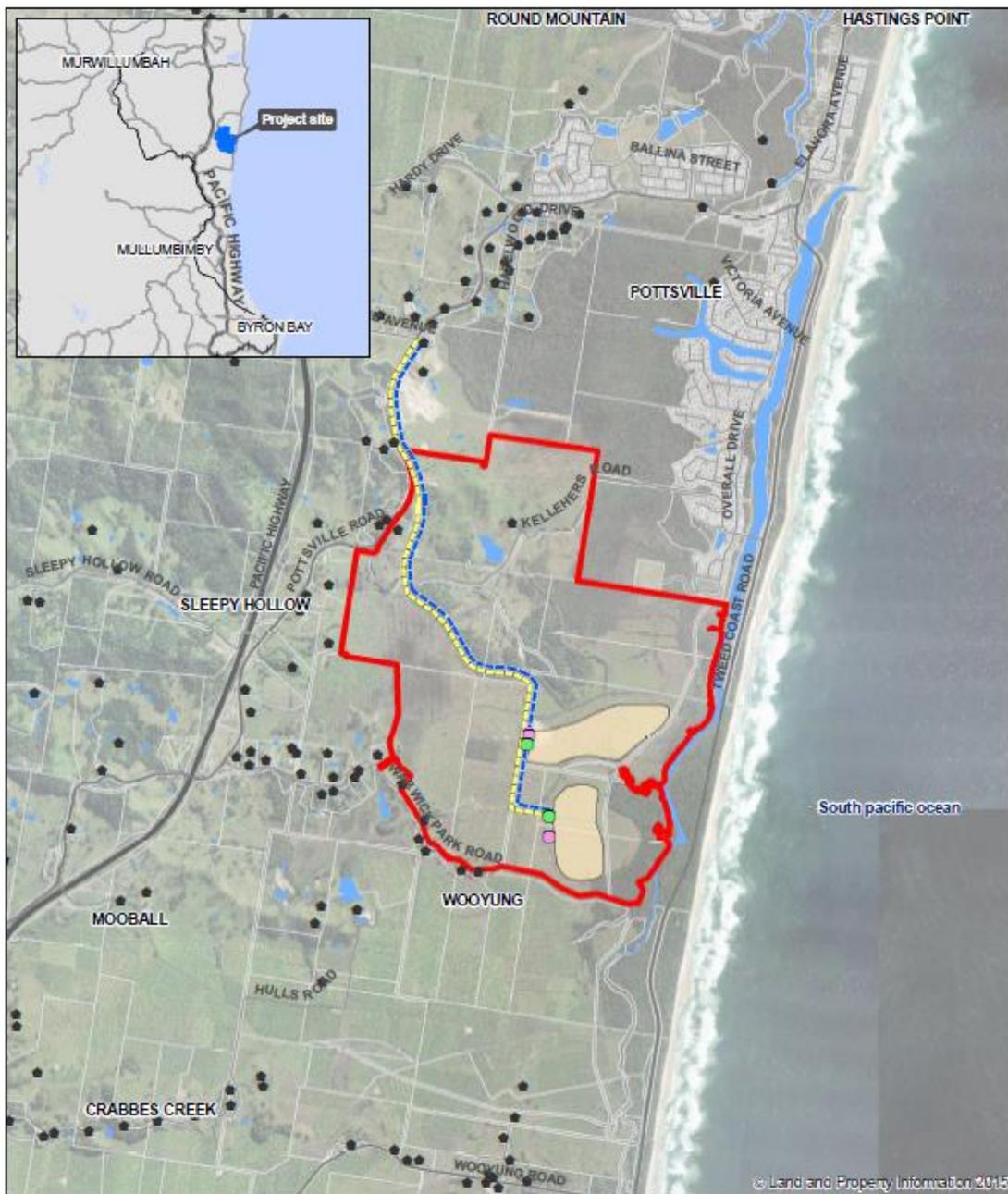
2 INTRODUCTION

The Dunloe Sand Quarry was granted Project Approval (PA06_0030) on 24 November 2008, with a subsequent modification (Mod 1) to this approval granted on 28 August 2009. The Dunloe Sand Quarry operations are located approximately 4.5 km south-southwest of Pottsville on the Pottsville Mooball Road, New South Wales (NSW).

The site is located adjacent to Mooball Creek, and is approximately 4km upstream of the creek mouth. Surrounding properties are currently used for agricultural purposes including sugar cane farming and grazing.



Figure 1: Aerial view of the Dunloe Sand Quarry located at Dunloe Park, Pottsville (Source: Nearmaps November 2018).



Legend

- Project boundary
- Sand extraction areas
- Incoming haul road
- Outgoing haul road
- Site office
- Washplant
- Existing dwelling house

Paper Size A4
 0 0.25 0.5 1
 Kilometers
 Map Projection: Transverse Mercator
 Horizontal Datum: GDA 1984
 Grid: GDA 1984 MGA Zone 56



Holcim (Australia) Pty Ltd
 Dunloo Sand Modification

Job Number: 22-18823
 Revision: A
 Date: 10 Apr 2017

Site location and layout

Figure 2

K:\AUGSydney\Projects\22118823\GIS\Map\Deliverables\22-18823-2001_SiteLocation.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9236 7100 F 61 2 9236 7199 E sydney@ghd.com.au W www.ghd.com.au

© 2017. Whilst every care has been taken to prepare this map, GHD (and its maps, LPs) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data source: Aerial Imagery: Stormaps (2017 - NSW LP), LPI DCD: Cadastre, 2012; LPI DTDB: Topo base data, 2012. Created by mking

Figure 2: Site Location and Layout (Source GHD: 2017)



Figure 3: Environmental Monitoring Locations (Source: VGT)

Holcim commenced operations on the site on August 1, 2016 with all previous responsibilities falling under the management of Ramtech Pty Ltd (Ramtech). Ramtech have previously been responsible for the commencement and operation of the site since Project Approval was granted in 2007.

In accordance with Schedule 5, Condition 5 of the modified Project Approval the site is required to undertake an Annual Review of the site in accordance with the conditions provided in **Table 4**.

Table 4: Annual Review Requirements

Condition	Section Addressed in Annual Review
5. ANNUAL REPORTING	
<i>Within 12 months of the date of this approval, and annually thereafter, the Proponent shall submit an Annual Review to the Secretary and relevant agencies. This report must:</i>	
a) <i>identify the standards and performance measures that apply to the project;</i>	Section 4 and 6
b) <i>describe the works carried out in the last 12 months;</i>	Section 4 and 6
c) <i>describe the works that will be carried out in the next 12 months;</i>	Section 13
d) <i>include a summary of the complaints received during the past year, and compare this to the complaints received in previous years;</i>	Section 9.3
e) <i>include a summary of the monitoring results for the project during the past year;</i>	Section 6 and 7
f) <i>include an analysis of these monitoring results against the relevant: • impact assessment criteria/limits; • monitoring results from previous years; and • predictions in the documents listed in condition 2 of Schedule 2.</i>	Section 6 and 7
g) <i>identify any trends in the monitoring results over the life of the project;</i>	Section 6 and 7 Appendix 2
h) <i>identify any non-compliance during the previous year; and</i>	Section 6, 7 and 11
i) <i>describe what actions were, or are being, taken to ensure compliance.</i>	Section 6, 7 and 11

This Annual Review has also been prepared in accordance with the *Annual Review Guideline: Post-approval requirements for State significance mining developments* (October 2015). This report documents the environmental performance of the site from 1 January to December 2018.

2.1 Name and Contact Details

The key contact details for the site are outlined below:

Quarry Supervisor

Daniel Dwyer
0411 795 060
daniel.dwyer@lafargeholcim.com

North NSW Aggregates Manager

Chris Hamilton
Work: +61 2 6656 8620
Mob: +61 429 790 213
chris.s.hamilton@lafargeholcim.com

Quarry Manager

Garth Stacey
Work: +61 2 6687 8566
Mob: +61 429 790 217
garth.stacey@lafargeholcim.com

Planning & Environment Manager NSW

Luke Edminson
Holcim (Australia) Pty Ltd
Mob +61 429 790 756
Email: luke.edminson@lafargeholcim.com

Planning and Environment Coordinator NSW

Shilpa Shashi
Mob: +61 (0)429 790 756
Email: shilpa.shashi@lafargeholcim.com

3 APPROVALS

The site operates under the approvals listed in **Table 5**.

Table 5: Approvals for the Dunloe Sand Quarry Operations

Approval	Regulatory Authority
PA 06_0300	NSW Department of Planning & Environment (DPE)
EPL No. 13077	NSW Environment Protection Authority (EPA)
Bore Licence 30BL183076, 30BL183077, 30BL183078, 30BL183079, 30BL183080, 30BL183081, 30BL183082, 30BL183084 and 30BL183086	NSW Department of Industry - Water

Holcim holds Environment Protection Licence (**EPL**) **13077** which covers its activities at the Dunloe Sand Quarry. **Table 6** outlines these licensing limits.

EPL 13077 was varied by the EPA on 20 February 2018 to allow for increased production volume. The scale of activities was increased to 100,000 tonnes – 500,000 tonnes annual capacity. There were some other smaller variations to wording in this EPL variation. The February 2018 EPL variation included:

- Administrative conditions;
- Discharges to air and water applications to land;
- Limit conditions;
- Operating conditions.

Table 6: EPL Fee-Based Activity at the Dunloe Sand Quarry

Scheduled Activity	Fee Based Activity	Scale
Extractive Activities	Land-based extractive activity	>100,000 – 500,000 T annual capacity to extract, process or store

4 OPERATIONS SUMMARY

4.1 Exploration

There was no exploration undertaken at the Dunloe Sand Quarry during the 2018 reporting period.

4.2 Land Preparation

There was no land preparation (clearing) the Dunloe Sand Quarry in 2018.

4.3 Construction Activities

There were no construction activities undertaken at the Dunloe Sand Quarry during the 2018 reporting period.

4.4 Quarry Operations

The Dunloe Sand Quarry officially commenced operations under Holcim on August 1, 2016.

Activities undertaken in 2018 included:

- Stripping of topsoil and overburden within the existing extraction limit boundary;
- Load and haul activities;
- Washing, screening and stockpiling of product;
- Overburden removal and stockpiling;
- Maintenance of rehabilitation undertaken in the north and eastern areas of the site; and
- Load out and sales of topsoil, brickies loam and concrete sands to the local market.

Operating hours in 2018 were undertaken between 7am to 5pm, Monday to Friday and 7am-12pm on Saturdays. These timeframes were applied for all operations on-site with no works occurring outside the approved operating hours. All activities took place within the approved operating hours in 2018.

Table 7 includes a summary of the operations undertaken during the reporting period against the Project Approval conditions regarding product transported from the Dunloe Sand Quarry.

Table 7: Total Product Distributed (Dunloe Sand Quarry)

Material	Approval Limit (Tonnes)	2017 Reporting Period (Tonnes)	2018 Reporting Period (Tonnes)
Product Distributed- Total	300,000	150,339	174,583

Total product tonnes in 2018 were well below the approved limit.

4.5 Next Reporting Period

Development activities proposed at the Dunloe Sand Quarry in 2019, include:

- Stripping of topsoil and overburden within the existing extraction limit boundary;
- Load and haul activities;
- Washing, screening and stockpiling of product;
- Overburden removal and stockpiling;
- Maintenance of rehabilitation undertaken north eastern area; and
- Load out and sales of topsoil, brickies loam and concrete sands to the local market.

No exploration, land preparation or construction activities are proposed to occur in the 2019 reporting period.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The DPE reviewed the 2017 Annual Review and provided a letter to Holcim on 29 August 2018 requesting additional information. Holcim resubmitted to 2017 Annual Review with the document subsequently approved by the DPE.

The status of proposed actions from Holcim that were outlined in the 2017 Annual Review are shown in **Table 8**.

Table 8: Actions required from Annual Review – Holcim Proposed Actions

Commitment	Compliance Status
Progressive Rehabilitation - The site will continue to progressively rehabilitate available areas on the northern and eastern boundary lines.	This was not completed during 2018. No additional rehabilitation proposed during 2019.
Development Application (Truck Movements Modification) - Application to modify the current Project Approval condition limiting truck movement to 4 (in and out) per hour.	This is still in progress.
EMP Review - Development of a new <i>Environmental Management Plan</i> with alignment to Holcim Australia's Environmental Management System.	The EMP's were reviewed and resubmitted to the DPE. The <i>Dust Monitoring Program, Landscape Management Plan and Aboriginal Cultural Heritage Management Plan</i> were approved by the DPE on 27 July 2018.
Water Quality Monitoring - Ensure water quality monitoring is completed in accordance with the EMP.	There have been some issues with analysis of data in 2018 based on a changeover of monitoring contractor. Holcim is committed to ensuring data analysis is consistent for the rest of 2019. See Section 7 .
Dust Monitoring - Ensure dust monitoring is completed in accordance with the EMP.	Dust monitoring for depositional dust and PM ¹⁰ were completed at site. PM ¹⁰ monitoring is no longer required with the revision and approval of the <i>Dust Monitoring Program</i> .

6 ENVIRONMENTAL PERFORMANCE

6.1 Meteorological Monitoring

Monthly rainfall, wind and temperature data for 2018 has been provided in **Table 9**. The nearby Bureau of Meteorology Ballina Airport Weather Station (Station ID 058198) has been used for this Annual Review.

Table 9: Monthly Weather Observations at the Dunloe Sand Quarry for 2018 (Ballina Airport AWS 058198)

Month	Temperature		Rain			Wind
	Min Temp (°C)	Max Temp (°C)	Total (mm)	Max Daily (mm)	No rain days > 1 mm	Max Wind Gust (km/h)
Jan-18	12.5	33.3	91.2	34.2	7	102
Feb-18	15.1	31.8	233.8	41.4	19	59
Mar-18	16	32.6	121.8	38.2	12	59
Apr-18	13.4	31.9	222.8	46.8	12	72
May-18	7.7	26.6	109.0	30.4	11	56
Jun-18	5.4	23.9	139.6	56.8	8	63
Jul-18	3.2	26.6	43.0	12.2	6	59
Aug-18	1.7	26.5	46.0	19.4	4	65
Sep-18	7.3	27.5	281.0	100.0	10	52
Oct-17	9.3	29.8	218.4	73.6	15	70
Nov-18	11.7	32.7	106.0	96.8	4	57
Dec-18	13.5	34.2	36.6	20.2	5	74

There was a total of 1,649.2 mm of rain at the Ballina Airport Weather Station in 2018.

6.2 Noise

6.2.1 EIS Predictions

The EIS (2007) stated that based on noise modelling the operations within the south west corner of the southern extraction pond (stage 2) may generate levels which exceed the relevant noise impact requirements.

The EIS (2007) stated that to mitigate this minor impact, the dredge is to have acoustical treatment when operating within the southern extraction pond.

6.2.2 Approved Criteria

In accordance with Schedule 3, Condition 2 of PA 06_0030, the approved noise criteria for the Dunloe Sand Quarry are outlined in **Table 10**.

Table 10: Noise Criteria for the Dunloe Sand Quarry (PA 06_0030)

2. The Proponent shall ensure that the noise generated by the project does not exceed the noise impact assessment criteria in Table 1.

<i>Receiver Location</i>	<i>Day L_{Aeq} (15 min) dB(A)</i>
Residences on privately-owned land	48

Table 1: Noise Impact Assessment Criteria

Notes:

- Noise from the site is to be measured at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary, to determine compliance with the identified noise limits, except where otherwise specified below.
- Where it can be demonstrated that direct measurement of noise from the project is impractical, alternative means of determining compliance may be acceptable (see Chapter 11 of the NSW Industrial Noise Policy).
- The modification factors presented in Section 4 of the NSW Industrial Noise Policy shall also be applied to the measured noise level where applicable.
- The identified noise emission limits apply under meteorological conditions of wind speed up to 3m/s at 10 metres above ground level, and temperature inversion conditions.

6.2.3 Key Environmental Performance

Attended noise monitoring was undertaken quarterly at the Dunloe Sand Quarry by Muller Acoustic Consulting on the following dates:

- 29 March 2018;
- 21 June 2018;
- 11 September 2018; and
- 21 November 2018.

The compliance assessments for each residential receiver (R1, R2, R3 and R4) are presented in **Table 11**.

The assessments identified that noise emissions generated by the Dunloe Sand Quarry were in compliance with relevant statutory noise criteria specified in the Project Approval on all occasion's at all assessed residential receivers. Copies of the quarterly noise monitoring reports for 2018 are attached as **Appendix 1**.

Longterm Trends:

Noise monitoring completed over a number of years for this project has generally been inaudible and within criteria. This trend continued for noise monitoring in 2018.

Comparison to EIS Predictions:

As noise levels were within criteria in 2018, results were within the EIS predictions.

6.2.4 Management Measures

Management measures relating to noise are outlined within the Dunloe Sand *Environmental Management Plan* and the *Noise Management and Monitoring Program*. These include:

- Restriction of operation hours of the Dunloe Sand Quarry to Monday to Friday 7.00 am to 5.00 pm and Saturday 7.00 to 12.00 pm;
- No work on Sundays or Public Holidays;
- All trucks to be well maintained and fitted with residential mufflers;
- Acoustic testing at commencement of quarry operations to ensure compliance with noise limit criteria;
- Dredge to be fitted with suitable mufflers if noise limit criteria is exceeded;
- Trucks to be limited to a speed of 25km/h on internal roads; and
- Prescribed buffer zones around the extraction ponds to be planted and maintained.

6.2.5 Proposed Improvements

There are no proposed improvements related to noise management.

Table 11: Noise Monitoring Assessment for the Dunloe Sand Quarry (MAC, 2018)

Assessment Period	Receiver No.	Quarrying Noise Criteria LAeq(15min)	Q1		Q2		Q3		Q4	
			Quarry Noise Contribution LAeq(15min)	Compliant						
Day	R1	48	Nil	✓	Nil	✓	Nil	✓	Nil	✓
	R2	48	Nil	✓	Nil	✓	Nil	✓	Nil	✓
	R3	48	Nil	✓	Nil	✓	Nil	✓	Nil	✓
	R4	48	Nil	✓	Nil	✓	Nil	✓	Nil	✓

6.3 Air Quality

6.3.1 EIS Predictions

The EIS (2017) Executive Summary states the following:

Airborne particulate matter concentrations and dust deposition from the proposed development have been predicted to exceed the relevant requirements prescribed by the Office of Environment and Heritage (OEH) at three of the eight monitoring locations.

In particular, exceedances are expected as a result of dust generated from the use of unsealed access roads by haul vehicles. In order to meet prescribed requirements, proposed dust controls include sealing of the entire internal roadway length, planting of a vegetated buffer along the southern boundary adjoining Warwick Park Road and the proposed outbound internal road.

6.3.2 Approved Criteria

Air Quality monitoring conducted at Dunloe Sand Quarry is compared to the monitoring criteria stipulated in PA 06-0030 and listed in **Table 12**, **Table 13** and **Table 14**.

Table 12: Long Term Impact Assessment Criteria for Deposited Dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited Dust	Annual	2 g/m ² /month	4 g/m ² /month

Table 13: Short Term Impact Assessment Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion
Particulate Matter 10 µm (PM ₁₀)	24 Hour	50 µg/m ³

Table 14: Long Term Impact Assessment Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion
Total suspended particulate (TSP) matter	Annual	90 µg/m ³
Particulate Matter 10 µm (PM ₁₀)	Annual	30 µg/m ³

6.3.3 Key Environmental Performance

6.3.3.1 Depositional Dust

Dust deposition monitoring was undertaken at 4 locations during the 2018 reporting period (see **Table 15**). All four monitoring points were found to be well below the annual average (4g/m²/month) and in compliance with the Project Approval. However it should be noted that there was no sampling completed in August 2018 when Holcim changed the monitoring contractor. This is a non-compliance with Schedule 3 Condition 6 of the Project Approval and has been reported in **Section 1** and **Section 11** of this Annual Review.

Table 15: 2018 Dust Monitoring (Depositional Dust) at Dunloe Sand Quarry

Date & Time On	Date & Time Sampled	DDG1	DDG2	DDG3	DDG4
		(g/m ² /month)			
28-12-2017	24-01-2018	0.1	0.1	0.1	0.1
24-01-2018	21-02-2018	2.7	0.7	1.6	0.6
21-02-2018	21-03-2018	0.4	4.9c	11.8c	7.1c
21-03-2018	18-04-2018	0.4	0.1	0.3	0.2
18-04-2018	16-05-2018	0.2	0.4	0.6	0.3
16-05-2018	13-06-2018	0.3	0.2	5.2c	0.4
13-06-2018	11-07-2018	0.5	0.4	0.5	0.2
11-07-2018	08-08-2018	0.4	0.5	0.3	0.2
08-08-2018	05-09-2018	NS	NS	NS	NS
05-09-2018	05-10-2018	0.1	0.4	0.3	0.7
05-10-2018	06-11-2018	0.1	0.1	1.5	0.7
06-11-2018	07-12-2018	1	0.2	1.6	0.3
Minimum Insoluble Solids		0.1	0.1	0.1	0.1
Maximum Insoluble Solids		2.7	0.7	1.6	0.7
Annual Average (4g/m²/year)		0.56	0.31	0.76	0.37
Result		Within Criteria	Within Criteria	Within Criteria	Within Criteria

c contaminated with bird droppings and insects.

A comparison of results from 2016 - 2018 has been undertaken in **Table 16**. The monthly average at all gauges remained below the allowable maximum increase of 2 g/m²/month and below the annual average of 4 g/m²/month. The 2018 results for the annual average were very similar to the 2017 results. According to laboratory notes, one sample (21 March 2018 – DDG3) was contaminated with bird droppings and insects and this was removed from the annual average.

Table 16: Depositional Dust Monitoring Summary (2016-2018)

Dust Depositional Gauge	Monitoring Summary for Annual Review Period	Monitoring Period		
		2018	2017	2016
		(g/m ² /month)		
DDG1	Min. Insoluble Solids	0.1	0.1	0.13
	Max. Insoluble Solids	2.7	0.8	0.8
	Insoluble Solids Reporting Period Average	0.56	0.35	0.41
DDG2	Min. Insoluble Solids	0.1	<0.1	0.4
	Max. Insoluble Solids	0.7	0.9	4.7
	Insoluble Solids Reporting Period Average	0.31	0.32	1.23
DDG3	Min. Insoluble Solids	0.1	0.2	0.2
	Max. Insoluble Solids	1.6	2.4	1.6
	Insoluble Solids Reporting Period Average	0.76	0.79	0.48
DDG4	Min. Insoluble Solids	0.1	<0.1	0.3
	Max. Insoluble Solids	0.7	0.9	1.6
	Insoluble Solids Reporting Period Average	0.37	0.39	0.57

Long term Trends:

The annual average depositional dust levels recorded in the 2018 reporting period at all monitoring locations are generally consistent with those recorded in 2016 and 2017. Annual averages for depositional dust were well below the Project Approval criteria.

Comparison to EIS Predictions:

The results for depositional dust were below the predicted limits of the EIS predictions (see **Section 6.3.1**).

6.3.3.2 PM₁₀ Monitoring

PM₁₀ monitoring is required to be undertaken in accordance with the criteria provided in **Table 13** and **Table 14**.

During 2016, the DPE advised Holcim of the requirement to undertake monitoring at the Dunloe Sand Quarry, unless changes were made to the site *Air Quality Management Plan*.

The updated *Dust Monitoring Program*, proposing PM₁₀ monitoring only be required once extraction on the site exceeded 200,000 tonnes per annum, was submitted to the DPE for approval on 23 October 2016. During this time, Holcim worked to procure a mobile PM₁₀ monitor whilst an updated management plan was under review by DPE.

On 15 November 2016, Holcim received what was mistakenly understood by the former Holcim Planning & Environment Coordinator, to be approval of the *Dust Monitoring Program*, subject to the comment from DPE being noted and complied with. This happened prior obtaining the mobile PM₁₀ monitor arriving on site.

Holcim provided DPE a letter on 22 September 2017 detailing the reasons behind the site's failure to monitor PM₁₀. Holcim were issued with an Official Caution from DPE on 4 October 2017.

In 2018, PM₁₀ monitoring was completed from 1 January 2018 until 18 July 2018. During this period there were three occasions where the PM₁₀ levels were above the short term impact assessment criteria of 50 µg/m³. These have been recorded as non-compliances in this Annual Review. Being a sand quarry operation the site has traditionally produced low levels of dust, with the three exceedances likely to be influenced by external sources.

It should be noted that with the revision and approval of the *Dust Monitoring Program* by the DPE on 27 July 2018, Holcim is no longer required to monitor for PM₁₀ unless the annual production rates increase to 200,000 tonnes or above. There are no plans in 2019 to produce above 200,000 tonnes, therefore no PM₁₀ monitoring is proposed.

Results of PM₁₀ monitoring during 2018 are provided in **Table 17**.

Table 17: Particulate Matter (PM₁₀) 2018 Dust Monitoring at Dunloe Sand Quarry

Date of Operation	µg/m³	Criteria
01-01-2018	24	Below Criteria
07-01-2018	4	Below Criteria
13-01-2018	23	Below Criteria
19-01-2018	125	Above Criteria
25-01-2018	17	Below Criteria
31-01-2018	22	Below Criteria
06-02-2018	27	Below Criteria
12-02-2018	79	Above Criteria
18-02-2018	2	Below Criteria
24-02-2018	14	Below Criteria
02-03-2018	25	Below Criteria
08-03-2018	67	Above Criteria
14-03-2018	25	Below Criteria
20-03-2018	31	Below Criteria
26-03-18	8	Below Criteria
1-04-18	18	Below Criteria
7-04-18	28	Below Criteria
13/04/18	20	Below Criteria
19-04-2018	24	Below Criteria
25-04-2018	9	Below Criteria
01-05-2018	20	Below Criteria
07-05-2018	21	Below Criteria
13-05-2018	11	Below Criteria
19-05-2018	17	Below Criteria
25-05-2018	32	Below Criteria
31-05-2018	35	Below Criteria
06-06-2018	5	Below Criteria
12-06-2018	21	Below Criteria
18-06-2018	2	Below Criteria
24-06-2018	30	Below Criteria
30-06-2018	8	Below Criteria
06-07-2018	5	Below Criteria
12-07-2018	4	Below Criteria
18-07-2018	44	Below Criteria
Average 1 Jan 2018 to 18 July 2018	24.9	

Trends

Trends relating to PM₁₀ monitoring is outlined in **Table 18**.

Table 18 PM₁₀ Monitoring Trends

Monitoring Summary for Annual Review Period	Monitoring Results January – July 2018 Period (µg/m ³)	Monitoring Results November and December 2017 Period (µg/m ³)
PM ₁₀ Reporting Period Average	24.9	10.97
Max. PM ₁₀	125	35.9
Min. PM ₁₀	2	1.2

The Long Term Impact Assessment Criteria (annual average) is not comparable due to results only being collected for two months of the 2017 reporting period. The 2018 results were only required from January 2018 – July 2018. With the different monitoring periods from 2017 and 2018 it is not possible to discuss longterm trends.

During the 2018 reporting period extraction remained below 200,000 tonnes per annum. The site has maintained dust suppression techniques throughout the reporting period in accordance with the requirements of the EMP.

6.3.4 Management Measures

Management measures relating to air quality are outlined within the *Dunloe Sand Quarry Environmental Management Plan and Dust Monitoring Program*. These include:

- Sealing access and egress road from the Quarry to Pottsville Road;
- The wheel shaker screen is to be utilised by all traffic leaving the quarry;
- The route for trucks within the quarry will be wet down daily by a water sprinkler/spray system;
- Additional vegetation rehabilitation areas throughout the site contributing as a buffer to Mooball Creek and surrounding areas;
- Loaded trucks will be covered before exiting the site;
- Dust that is transported onto the access road immediately outside the active quarry area will be removed from the road at least once per month using a local street sweeper;
- Visual daily inspections of all stockpiles will be undertaken to ensure that dust emissions do not occur;
- Visual review of exposed areas, and whether these areas are generating dust, should be undertaken daily;
- Dust generation is generally limited to freshly disturbed areas. To facilitate dampening, a portable hose or water spray/sprinkler system has been installed. The system installed is capable of servicing the entire site;
- Topsoil will not be stripped during windy weather conditions; and
- Six monthly audits of dust levels are to be undertaken by management.

6.3.5 Proposed Improvements

Completion of monitoring as per the EMP and Project Approval requirements. The depositional dust monitoring in 2019 will be spaced out to cover the full 12 months.

6.4 Traffic Management

6.4.1 EIS Predictions

The proposed operational times outlined within the EIS are outlined below:

Table 19: Estimated Operational Times, Periods and Truck Movements (EIS 2007)

Yearly Operation	Days Per Week	Hours per Week	Daily Times Operating	Truck Movements per Hour
50 weeks/year	5.5	46	Mon-Fri: 7:30am -5:00pm Sat: 7:30am -12:30pm	4

6.4.2 Approved Criteria

As per the Project Approval (Schedule 3 Condition 3), operations will be conducted Monday to Saturday. No operations are to be undertaken on Sunday or public holidays.

Table 20: Operational Times, Periods and Truck Movements

Yearly Operation	Days Per Week	Hours per Week	Daily Times Operating	Truck Movements per Hour
52 weeks/year	5.5	55	Mon-Fri: 7:30am -5:00pm Sat: 7:30am -12:00pm	8*

* Not to exceed more than 8 heavy vehicle movements (in and out) per hour

Internal roads are signposted to a 25-30km/h speed limit.

6.4.3 Key Environmental Performance

Holcim staff were notified during due diligence activities by representatives of Ramtech that operations prior to the acquisition by Holcim were based on a maximum of 8 movements per hour (i.e. - 8 in, 8 out). The DPE compliance team has since notified Holcim that this interpretation is incorrect and the site is only allowed 4 movements per hour (i.e. - 4 in, 4 out).

Holcim has operated in accordance with revised truck movements since direction was given by the DPE on October 20, 2016. It is noted that Holcim are currently undertaking an application to modify this condition to allow greater flexibility to hourly and daily movements for trucks entering and exiting the site. The modification is currently within the Response to Submissions stage.

Daily records of truck movements are recorded by Holcim. Based on the records, all truck movements were 4 movements per hour or below. A summary of the daily truck movements is provided in **Appendix 4**.

Traffic travelling to and from the site continued to make use of the Pacific Highway, via the Cudgera Creek interchange during the 2018 reporting period.

In summary:

- There was a total of 5320 trucks recorded leaving site during 2018. This is an increase from the 4382 trucks recorded leaving site during 2017;
- There were 258 haulage days during 2018; and
- Haulage occurred at an average of 20.6 trucks during haulage days during 2018. This is an increase on the average from 2017, which had 17.5 trucks.

6.4.4 Management Measures

Management measures relating to air quality are outlined within the *Dunloe Sand Quarry Environmental Management Plan* and the *Traffic Management Procedure*, including:

- Construction of a dedicated haulage road (sealed) to provide vehicular access between the sand extraction area and Pottsville-Mooball Road;
- Average truck movements limited to 4 movements per hour (4 in, 4 out);
- All vehicles to observe speed limits for public roads;
- No trucks are to leave the site via Warwick Park Road;
- Appropriate advisory signage placed on public roads to notify of trucks entering Pottsville – Mooball Road;
- Appropriate relevant advisory signage placed along the haulage road (especially approaches to the intersections with Kelleher’s Road and Pottsville – Mooball Road);
- Truck speed on the internal roads is to be limited to a maximum of 25km/h;
- All loaded vehicles entering or leaving the site are to have their loads covered; and
- Holcim shall ensure that all loaded vehicles leaving the site are cleaned of materials that may fall on the road before they leave the site.

6.4.5 Proposed Improvements

There are no proposed changes to transport management. Truck movements will continue to be monitored and recorded in the oncoming reporting period to ensure that they remain within the approved criteria.

6.5 Biodiversity

6.5.1 EIS Predictions

As part of the EIS (2007), a number of threatened species were identified within the surrounding vegetated areas of the site with none being found, or expected to occur, within the previously disturbed areas of the site (including proposed extraction areas).

Rehabilitation and revegetation measures proposed will provide improved flora and fauna links, additional food resources for identified threatened species, improved opportunities for breeding through the installation of breeding boxes and other benefits associated with visual screening and the like.

No clearing of vegetation is required in respect of the proposal, inclusive of haulage routes and operational areas. There is no proposed clearing for 2019.

6.5.2 Approved Criteria

There are no specific criteria associated with biodiversity management for the site. Activities need to be completed in accordance with the EIS.

6.5.3 Key Environmental Performance

There were no biodiversity issues identified during the Annual Review period. There was no clearing during 2018. There was some minor weed spraying at the site in 2018.

Biodiversity assessments are completed as part of the rehabilitation monitoring program. See **Appendix 4** for results.

An assessment on the use of Nest Boxes was completed by Ramtech in 2018.

In accordance with the Project Approval, 11 fauna nest boxes have been installed across the rehabilitation zones in a bid to increase potential nesting options for fauna. Routine fauna box monitoring forms are completed for each nest box on an annual basis. During the 2018 monitoring period, one nest box was being actively utilized at the time of inspection. A mountain brushtail possum was inspected within a cockatoo box located in Zone 1B. A photograph of the possum is included below. No other animals were located within the remaining nest boxes. All boxes were noted to be in a good condition. Spider webs covering the entrance hole of the glider box within Zone 1B were removed. The possum box located within Zone 2C was found to have minor exterior damage –

with evidence of pecking around the entrance hole, however no signs of bird or other fauna use was noted inside of the box.



Photo 1 Mountain Brushtail Possum in Cockatoo Box

6.5.4 Management Measures

Management measures relating to biodiversity are outlined within the *Dunloe Sand Quarry Rehabilitation and Revegetation Management Plan* and the *Dunloe Sand Vegetation Management Plan*. These include:

- Detailed clearing protocol as per Section 5.1 of the *Dunloe Sand Quarry Rehabilitation and Revegetation Management Plan*;
- Weed management;
- Installation of next boxes; and
- Rehabilitation/Ecological monitoring.

6.5.5 Proposed Improvements

Continuation of weed management and fauna box monitoring during 2019.

6.6 Heritage

6.6.1 EIS Predictions

A heritage assessment focusing on both Aboriginal and non-Aboriginal heritage was completed for the EIS (2007). An area of potential Aboriginal heritage significance was cordoned off.

6.6.2 Approved Criteria

There are no specific criteria associated with heritage relating to the project.

6.6.3 Key Environmental Performance

There were no issues relating to Aboriginal and historic heritage during the reporting period. An area was previously identified as having potential Aboriginal heritage significance. During 2018 the area was reviewed for potential artefacts with the assistance of Aboriginal Groups. The Aboriginal Groups did not find any items of heritage significance as part of the survey. Holcim can now complete quarrying activities within the area that was previously demarcated. No quarrying activities were completed within this area in 2018.

6.6.4 Management Measures

Management measures relating to heritage are outlined within the *Dunloe Sand Quarry Aboriginal Cultural Heritage Management Plan*. These include:

- Consultation with Aboriginal stakeholders during the preparation of the EIS;
- Records of known sites of Aboriginal heritage significance;
- Detailed excavation strategy and control of any finds;
- Inspections;
- Training of staff and contractors through the induction process; and
- Procedure for impacts of unexpected finds.

6.6.5 Proposed Improvements

No proposed improvements.

6.7 Acid Sulphate Soils Management and Management of Fines

Holcim undertakes fines management in accordance with Schedule 3 of Conditions 10 and 11, Project Approval 06_0030, in the following manner:

10. The Proponent shall ensure that all excavated potential acid sulfate soil fines material is returned back to below the watertable as soon as possible to prevent oxidation. No potential acid sulfate soil shall be removed from the site, unless adequately neutralised in accordance with methods approved under the Soil and Water Management Plan.

11. The Proponent shall ensure that all potential acid sulfate soil fines material is discharged into the pond at a depth of no less than 3 metres from the water surface, and that all fines are deposited to a final depth of at least 8 metres from the water surface, unless an alternative method(s) is approved by OOW and the Director-General.

Under the operation of Holcim, the site has undertaken a number of improvement works to ensure the effective management of **Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS)** during extraction, processing and sales operations. Details of specific management measures are outlined below.

6.7.1 Acid Sulphate Soils Sampling

Holcim undertakes acid sulphate soils sampling in advance of extraction. A sand core drilling program was undertaken in 2016, in accordance with the site's Environmental Management Plan (EMP), for an area of extraction required for the following 2-3 years. The drilling program was developed and undertaken in line with the following activities:

1. A minimum of 2 sand cores are drilled per hectare;
2. All samples are sent to Soil Surveys Australia Pty Ltd for immediate testing in accordance with the ASSMAC Guidelines;
3. Soil Surveys Australia Pty Ltd (NATA Accredited lab) test results provided a volume per m² for lime to be seeded across each hectare before stripping takes place;
4. Lime was spread across the reserve and then stripped to expose the loam and sand product; and
5. Stockpiled topsoil is tested by a NATA accredited laboratory to confirm there is no presence of PASS.
6. A minimum of 2 sand cores are drilled per hectare;
7. All samples are sent to Soil Surveys Australia Pty Ltd for immediate testing in accordance with the ASSMAC Guidelines;
8. Soil Surveys Australia Pty Ltd (NATA Accredited lab) test results provided a volume per m² for lime to be seeded across each hectare before stripping takes place;
9. Lime was spread across the reserve and then stripped to expose the loam and sand product; and
10. Stockpiled topsoil is tested by a NATA accredited laboratory to confirm there is no presence of PASS.

The ongoing management of acid sulphate soils during extraction in the sampled area is undertaken in accordance with the site's EMP. Further to the monitoring program that was completed in 2016, ongoing acid sulphate soils monitoring was completed during 2018, with no acid sulphate soils determined during the 2018 testing. A selection of monitoring results is attached in **Appendix 5**.

6.7.2 Extraction

Excavation of loam, dredging and washing activities is undertaken in accordance with the EMP and has been developed in line with the following activities:

1. Excavated loam is stockpiled and tested by NATA accredited laboratory to confirm there is no presence of PASS;
2. In the event that PASS is present in loam stockpiles a NATA accredited laboratory will provide a detailed report with liming rates for lime to be added by Holcim staff to screened loam to ensure no presence of PASS;
3. All dredged material is sent through the plant with fines re-interred below the 3 meter water mark at a depth of 8 metres in the returns pond; and
4. Testing of stockpiles to ensure that no PASS are present in concrete sands.

6.7.3 Stockpiling & Sales

Holcim have developed and implemented a testing regime using a NATA accredited laboratory to ensure compliance with PASS requirements for all sales of sand materials. This process includes:

1. Routine sampling of sales material stockpiles at designated locations; and
2. Implementation of a series of sales and production stockpiles to ensure any materials that have not been tested are isolated until tests confirm no presence of PASS thereafter sales loading occurs.

6.8 Summary of Environmental Performance

A summary of the performance of environmental management measures and sampling results for 2018 are detailed in **Table 21**.

Table 21: Environmental Performance at the Dunloe Sand Quarry in 2018

Aspect	Approval Criteria / EIS Prediction	Performance during 2018 reporting period	Trend / key management implications	Implemented / proposed management actions
Noise	EIS predictions are all below Project Approval criteria.	Quarterly monitoring has met the Project Approval Criteria.	Consistently meets criteria.	None Required.
Air Quality	EIS predictions are all below Project Approval criteria.	Dust deposition results are within criteria of EPL, EIS and Project Approval. However there was no sampling of depositional dust from 8 August 2018 – 5 September 2018. PM ₁₀ monitoring is no longer required at the site (when production remains below 200,000T/annum). There were three occasions where PM ₁₀ results were above the short term criteria	There continued to be some dust monitoring issues in 2018.	Complete monitoring as per the EMP and Project Approval requirements.
Traffic Management	EIS predictions are all below Project Approval criteria.	Met operating criteria (number of trucks per day).	This is an improvement on some past years.	None Required.
Water Management	EIS predictions are all below Project Approval criteria.	Criteria meets EIS, EPL and Project Approval criteria. There were some inconsistencies with testing of monitoring parameters (including algae) based on analysis by different monitoring contractors.	Groundwater consistent with trend data. Water monitoring generally consistent with trend data.	Ensure water quality monitoring and analysis is completed in accordance with the EMP.
Biodiversity	No impacts to threatened species. No Project Approval criteria.	No impacts	Consistently no impacts.	None required.

Aspect	Approval Criteria / EIS Prediction	Performance during 2018 reporting period	Trend / key management implications	Implemented / proposed management actions
Heritage	No impacts to Aboriginal Heritage. No Project Approval criteria.	No impacts. See Section 6.6 for an update on Heritage surveys.	Consistently no impacts.	None required.

7 WATER MANAGEMENT

7.1 EIS Predictions

The site is located within the Mooball Creek catchment and Sheens Creek sub-catchment areas. Detailed flood modelling confirms that the proposal will have no significant impact upon existing drainage regimes within the catchment.

Extraction operations have been designed in conformity with best practice environmental management procedures, including the use of appropriate sediment and water quality devices and the retention of ground cover in areas outside of the extraction ponds.

No negative impacts predicted to water quality with controls in place.

7.2 Approved Criteria

7.3 Surface Water

The site has the requirement to monitor discharges from the two Licenced Discharge Points (LDP) as per the criteria listed in EPL 13077 and reproduced in **Table 22**. LDP001 refers to silt pond discharge and LDP002 refers to dredge pond discharge.

Table 22: Discharge Criteria – LDP001 and LDP002

POINT 1

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	Visible				nil
pH	pH				6.5 - 8.5
TSS	milligrams per litre				50

POINT 2

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	Visible				nil
pH	pH				6.5 - 8.5
TSS	milligrams per litre				50

The site also has criteria outlined within the EMP. This includes commitments to undertaking quarterly extraction pond monitoring (see **Table 23**). Other sampling criteria and commitments from the EMP are outlined within **Tables 24-27**.

Table 23: Quarterly Surface Water Quality Criteria – Extraction Pond

Quarterly monitoring		
Quarterly monitoring shall include the above parameters as well as the parameters listed in the table below.		
Parameter	Interim Target Criteria	Baseline monitoring 9/06-8/07
Manganese	0.15 mg/L	0.01 – 0.56 mg/L
Magnesium	40 mg/L	0.8 – 173.0 (20) mg/L

Sodium	280 mg/L	7-1770 (213) mg/L
Potassium	17.5 mg/L	0 – 71 (12) mg/L
Bicarbonate	400 mg/CaCo3	-
Chloride	285 mg/L	15-3500 (356)mg/L
Sulphate	175 mg/L	9-753 (100) mg/L
Aluminium	0.75 mg/L	<0.01-4.96 (0.50) mg/L
Arsenic	<0.005 mg/L	<0.005 – 0.027 (0.01) mg/L
Iron	<7.5 ug/L	0.03-43 (6.12) ug/L
Chlorophyll a	2-10 ug/L	2-10 ug/L

The site has a commitment to Blue Green Algae monitoring within the extraction ponds at the site in accordance with the criteria listed in **Table 24**.

Table 24: Monthly Monitoring Criteria – Blue Green Algae

Algae and Blue-green algae	No.cells/mL (M.aeruginosa)	<50,000
	mm ³ /L (total biovolume)	<4

The site has a commitment to complete quarterly creek water monitoring within the surrounding environment in accordance with the criteria listed in **Table 25**.

Table 25: Quarterly Surface Water Quality Criteria – Surrounding Environment

Pollutant	Unit of Measure	Interim Target Criteria	Baseline Monitoring 9/06-8/07
pH	pH	5.5 – 7.5	3.55-8.44 (6.49)
Electrical Conductivity	uS/cm	1800-24000	286-45000 (11930)
Dissolved Oxygen	mg/L	>6	0.81-7.49 (4.34)
Turbidity	NTU	<20	3-67 (14.4)
Suspended Solids	mg/L	<25	1.5-48 (19)

Groundwater

The site has a commitment to complete monthly groundwater monitoring within the surrounding environment in accordance with the criteria listed in **Table 26**.

Table 26: Monthly Groundwater Quality Criteria – Surrounding Environment

Monthly Monitoring		
Parameter	Interim Target Criteria	Baseline Monitoring 9/06-8/07 Range (mean)
pH	4.2 – 7.0	3.58-7.54 (5.43)
Electrical Conductivity (EC)	<2.0 mS/cm	0.07-6.47 (1.24)
Dissolved Oxygen (DO)	>1.50 mg/L	0.16 – 4.83 (0.84)
REDOX Potential	Maximum (mg/L)	
Groundwater level	M (AHD)	0.25-1.52 (0.68)

The site has a commitment to complete quarterly groundwater monitoring within the surrounding environment in accordance with the criteria listed in **Table 27**.

Table 27: Quarterly Groundwater Quality Criteria – Surrounding Environment

Parameter	Interim Target Criteria	Baseline monitoring 9/06-8/07
Calcium	55	0.7-114 (26)
Manganese	0.15	0.01 – 0.56
Magnesium	40	0.8 – 173.0 (20)
Sodium	280	7-1770 (213)
Potassium	17.5	0 – 71 (12)
Bicarbonate	400	-
Chloride	285	15-3500 (356)
Alkalinity	185	0-534 (109)
Sulphate	175	9-753 (100)
Aluminium	0.75	<0.01-4.96 (0.50)
Arsenic	0.005	<0.005 – 0.027 (0.01)
Iron	7.5	0.03-43 (6.12)

7.4 Surface Water Monitoring – Extraction Pond

It should be noted that there were no surface water discharges in 2018 therefore criteria related to **Table 22** have not been triggered. A summary of results obtained from monthly sampling in the extraction pond is provided in **Table 28**.

Table 28: Monthly Extraction Pond (Dam 1) Water Quality Monitoring 2018 Results

Parameter	Unit	Interim Target Criteria	Baseline (2006/07)	Min	Max	2018 Average	2017 Average for Comparison
pH	-	5.0-8.5	3.55-8.44	3.96	4.6	4.2	4.55
EC	uS/cm	<2000	286-450	324	560	388	349.5
DO	Mg/L	>4.00	0.81-7.49	8.18	104	22.4	8.28
Turbidity	NTU	<20	3-67	0.2	3.0	5.3	68.5
Oil and Grease	Mg/L	10	-	<5	<5	<5	<5.0

A comparison of the 2018 results compared to 2017 results for the Extraction Pond are outlined below:

- pH results – there was a slight decrease in average pH from 4.5 in 2017 to 4.2 in 2018;
- EC results – there was a slight increase in average EC from 349 uS/cm in 2017 to 388 uS/cm in 2018;
- DO Results – based on the results provided to Holcim there was a large increase in the DO maximum with 104mg/L recorded. This result is far greater than past results and may be due to an error in entering the data or analysis;
- Turbidity Results – there was a decrease in the average turbidity level from 68.5 NTU in 2017 to 22.4 NTU in 2018. There were a couple of high readings in 2017 that skewed those results; and
- Oil and Grease were <5 Mg/L in 2017 and 2018.

A summary of results obtained from quarterly chemical analysis in the extraction pond is provided in **Table 29**.

Table 29: Quarterly Extraction Pond (Dam 1) Chemical Analysis Monitoring 2018 Results

Parameter (mg/L)	Interim Target Criteria	Baseline (2006/07)	2018 Min	2018 Max	2018 Average	2017 Average for Comparison
Calcium	55	0.7-114	-	--	-	-
Manganese	0.15	0.01-0.56	0.243	0.250	0.247	0.275
Magnesium	40	0.8-173.0	4.9	9	6.3	4.43
Sodium	280	7-1,770	14	45	24	18
Potassium	17.5	0-71	3.6	4	3.7	3.5
Bicarbonate	400	-	-	-	-	-
Chloride	285	15-3,500	21	86	42	25.5
Alkalinity	185	0-534	1	1	1	<5
Sulphate	175	9-753	99	135	114	104
Aluminium	0.75	<0.01-4.96	0.62	0.88	0.74	1.68
Arsenic	0.005	<0.005-0.027	Not detected	Not detected	Not detected	Not detected
Iron (Dissolved)	705	0.03-43	0.070	0.100	0.086	0.48

Results obtained from quarterly chemical analysis of extraction pond water shows the results to be generally in accordance with the baseline criteria and interim target criteria of the EMP. The largest

change between 2017 and 2018 was in relation for aluminium which decreased from an average of 1.68mg/L to 0.74mg/L.

Manganese was above interim criteria in 2017 and 2018.

A copy of all extraction pond water quality and chemical analysis are included in **Appendix 2** of this report.

The results of the monthly algae monitoring for the 2018 reporting period are displayed within **Table 30**.

Table 30: Surface Water Quality Monitoring 2018 Results for Extraction Pond (Dam 1) – Blue Green Algae

Date	Total Algae Count (cells/ml) Criteria: <50,000	Cyanophyta (Blue Green Algae) (cells/ml)
24 January 2018	350	<5
21 February 2018	100	<5
21 March 2018	3,960	<5
18 April 2018	4,580	<5
16 May 2018	250	<5
13 June 2018	5,820	<5
11 July 2018	16,100	<5
8 August 2018	13,800	<5
5 September 2018	Not monitored	Not monitored
5 October 2018	Not monitored	<5
6 November 2018	Not monitored	Not monitored
7 December 2018	Not monitored	Not monitored

It is noted that there were some months where cyanophyta and total algae count were not recorded. This is a non-compliance with the frequency outlined in the EMP. This non-compliance occurred when a new monitoring contractor was engaged for the site. Holcim aims to improve data analysis in 2019.

When tested, the cyanophyta results remained below the detection limit throughout the 2018 reporting period. The maximum total algae count in 2018 (16,100 cells/ml) was much lower than the maximum from 2018 (128,000 cells/ml).

The total algae count results gathered at site across several years have illustrated a large degree of variability. It is noted that variations in total algae count results are not identified as exceedances of the monitoring criteria listed in the EMP and the key to monitoring Blue Green Algae activity generally lies with total algae count readings.

Longterm Trends:

Appendix 2 outlined the longterm monitoring data, including a summary of minimum, maximum and average for key parameters. Key parameters continued to follow longterm trends, including:

- There was no surface water discharge in 2018;
- Generally acidic pH readings;
- High variability of turbidity;
- Low levels of oil and grease;
- Variable levels of total algae, but within longterm trends; and

- EC was highly variable, and generally lower than the longterm average.

Comparison to EIS Predictions:

There was no evidence of any detrimental impact from the Quarry on surface water. This is consistent with the EIS predictions.

7.5 Groundwater Results

Monthly groundwater monitoring was undertaken at 5 locations (DLP 1, DLP 3, DLP 5, DLP 6 and DLP 7) during the 2018 reporting period. Results obtained at each bore in 2018 have been generally consistent at each location with previous results.

DLP3, DLP5 and DLP 7 present conductivity levels above the maximum interim target of 2000 $\mu\text{S}/\text{cm}$ stated within the EMP, with this also being the case in previous years. These sites have also expressed similar levels of electrical conductivity (EC) within legacy background testing and are not causing any environmental impacts outside of the existing environment.

DLP 7 sits immediately adjacent to the existing wetland, which act as a 'drawer' of permanently saline conditions in order to sustain its dominant vegetative makeup. It is therefore considered likely that some localised salinisation of surficial groundwater has occurred within the vicinity of DLP3 and DLP 7 due to tidal influences within these nearby waterways and wetlands. This trend has previously been identified in Annual Reports prepared under the previous operator and is considered to be consistent with the natural salinity levels in the local environment.

A summary of monthly groundwater results for pH and EC is provided in **Table 31**. A copy of all monthly groundwater monitoring has been provided in **Appendix 2** of this report.

Table 31: Monthly Groundwater Quality Monitoring 2018 Results

Location	Parameter	Interim Target Criteria	Minimum	Maximum	2018 Average	2017 Average for Comparison
DLP1	pH	4.2-7.0	3.9	4.5	4.4	4.3
	EC ($\mu\text{S}/\text{cm}$)	<2000	114	204	146	134
DLP3	pH	4.2-7.0	5.4	6.2	5.9	6
	EC ($\mu\text{S}/\text{cm}$)	<2000	3760	8230	7320	7464
DLP5	pH	4.2-7.0	4.4	4.9	4.7	5.1
	EC ($\mu\text{S}/\text{cm}$)	<2000	201	2470	847.5	406
DLP6	pH	4.2-7.0	3.8	4.0	3.9	3.8
	EC ($\mu\text{S}/\text{cm}$)	<2000	463	866	607.5	1270
DLP7	pH	4.2-7.0	6.6	3.9	7.0	6.9
	EC ($\mu\text{S}/\text{cm}$)	<2000	2680	3650	3379	3125

There was a large degree in variability across the sites for the 2018 monitoring, with this also being the case in 2017. Generally the pH has been acidic to neutral. The EC has a high variability across sites ranging from 114 $\mu\text{S}/\text{cm}$ to 8230 $\mu\text{S}/\text{cm}$.

A summary of quarterly monitoring for Manganese and Magnesium is outlined in **Table 32**.

Table 32: Quarterly Groundwater Quality Monitoring 2018 Results

Location	Parameter	Interim Target Criteria	Q1	Q2	Q3	Q4	2018 Average	2017 Average (For Comparison)
DLP1	Manganese (mg/L)	0.15	0.028	0.024	0.001	0.003	0.014	0.024
	Magnesium (mg/L)	40	0.8	0.7	<1	<1	0.87	0.65
DLP3	Manganese (mg/L)	0.15	0.64	0.61	0.715	0.658	0.65	0.63
	Magnesium (mg/L)	40	150	120	137	118	131.2	126.7
DLP5	Manganese (mg/L)	0.15	0.066	0.019	0.0029	0.039	0.031	0.060
	Magnesium (mg/L)	40	25	4.8	7	8	11.2	14.5
DLP6	Manganese (mg/L)	0.15	0.45	0.4	0.49	0.65	0.49	1.12
	Magnesium (mg/L)	40	7.1	5.2	7	8	6.8	14.45
DLP7	Manganese (mg/L)	0.15	0.065	0.072	0.074	0.65	0.21	0.068
	Magnesium (mg/L)	40	41	37	40	39	39.25	37.3

Note: Where results are below the detectable limit (i.e. <0.5) the average has been calculated by removing the <.

When comparing the 2018 annual average for Manganese and Magnesium to 2017 totals, there is a large degree of similarity. The largest change is the Magnesium level at DLP06 which dropped from 14.45 mg/L to 6.8 mg/L in 2018. DLP3 was once again above the interim criteria, as per 2017 results.

Longterm Trends:

Results for Manganese and Magnesium are similar to previous years. DLP3 has been consistently above the interim target criteria, with this a trend across several years.

A copy of all Quarterly groundwater monitoring has been attached as **Appendix 2** to this report.

Comparison to EIS Predictions:

There was no evidence of any detrimental impact from the Quarry on groundwater. This is consistent with the EIS predictions.

7.6 Water Take

There is no water take associated with the Dunloe Sand Quarry.

8 REHABILITATION AND LANDSCAPE MANAGEMENT

8.1 Rehabilitation Performance during the Reporting Period

As part of the site's approved EMP, re-vegetation and regenerative landscaping is required (Appendix C of the EMP). Ongoing management of the surrounding vegetation is being carried out by Ramtech Pty Ltd over the lifetime of the Dunloe Sand Quarry operations.

The regenerative works have been undertaken via a combination of assisted and natural regrowth and all areas have been fenced so as to limit the intrusion of cattle. In this regard, depending on soil types and topography, each of the areas has been very successful in establishing quality regrowth.

The only limiting factors have been some cattle getting in and around existing fences (primarily at low tide where they have been able to traverse the creek lines).

A copy of all rehabilitation works, checklists and photos showing work areas have been attached as **Appendix 3** to this report.

A summary of rehabilitation at the Dunloe Sand Quarry is outlined in **Table 33**.

Table 33: Rehabilitation Performance in 2018

Guideline Requirement	Site Comment
Extent of the operations and rehabilitation at completion of the reporting period	There was no rehabilitation at site in 2018.
Agreed post- rehabilitation land use	The proposed rehabilitation aims to return the land to an endangered ecological community (EEC) Swamp Sclerophyll plus Eucalypt Open Forest species and EEC Coastal Wetland within the localised soaks.
Key rehabilitation performance indicators	Criteria are outlined in the <i>Rehabilitation and Revegetation Management Plan</i> .
Renovation or removal of buildings	None during reporting period
Any other Rehabilitation taken including: <ul style="list-style-type: none"> • Exploration activities; • Infrastructure; • Dams; and • The installation or maintenance of fences, bunds and any other works. 	No rehabilitation of these features was completed.
Any rehabilitation areas which have received formal sign off from the Resources Regulator.	None.
Variations to activities undertaken to those proposed (including why there were variations and whether Resources Regulator was notified)	No variations to the <i>Rehabilitation and Revegetation Management Plan</i> .
Outcomes of trials, research projects and other initiatives	No specific trials, however a summary of monitoring results is outlined in Appendix 3 .
Key issues that may affect successful rehabilitation	There are several potential issues including availability of material, seed stock, climatic events, tidal inundation and rehabilitation methodology.

8.2 Summary of Current Rehabilitation and Performance

A summary of the rehabilitation and disturbance status is outlined in **Table 34**. This is also shown in

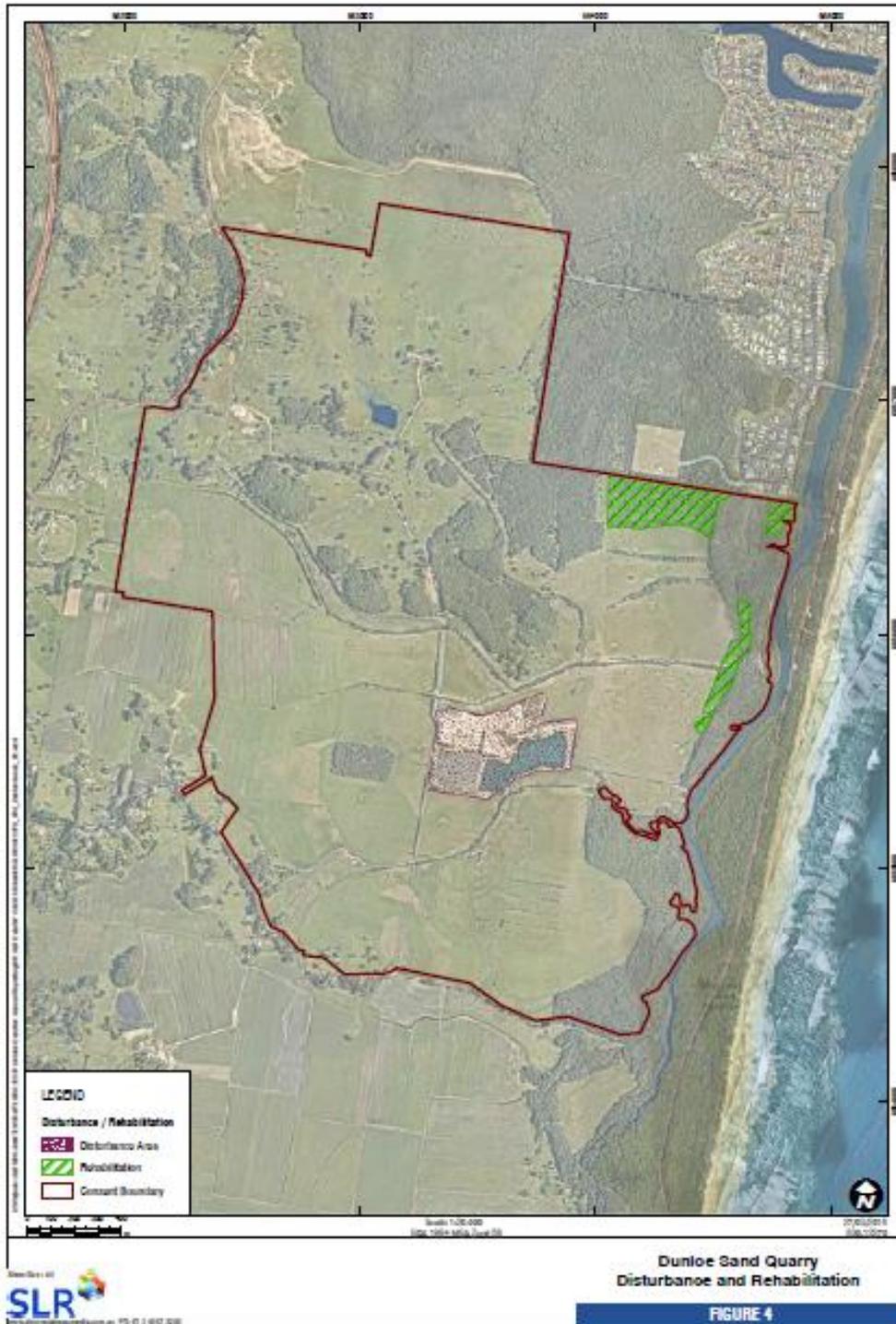


Figure 4.

Table 34: Rehabilitation and Disturbance Status

Quarry Area Type	Previous Reporting Period	This Reporting Period (Actual)	Next Reporting Period (Forecast)
		Current AEMR Period	Next AEMR Period

		(ha)	(ha)
A. Total Quarry Footprint	32.2	32.2	32.2
B. Total Active Disturbance	18.8	18.8	18.8
C. Land Being Prepared for Rehabilitation	0	0	0
D. Land Under Active Rehabilitation	13.4	13.4	13.4
E. Completed Rehabilitation	0	0	0

At the end of 2018 there was approximately 18.8 Ha of active disturbance and 13.4 Ha of active rehabilitation. There is no rehabilitation proposed in 2019.

Rehabilitation monitoring of established rehabilitation has shown:

- Most of the rehabilitation has been from natural regeneration;
- Dominant species are paper bark, melaleuca, banksia, casuarina and bracken fern;
- Evidence of grass and leaf litter;
- Some tree species greater than 15 metres high, shrub species greater than 5 m high and groundcover to 2 m; and
- During the 2018 monitoring period, one nest box was being actively utilised at the time of inspection. A mountain brushtail possum was inspected within a cockatoo box located in Zone 1B.

A copy of rehabilitation monitoring is included in **Appendix 3**.

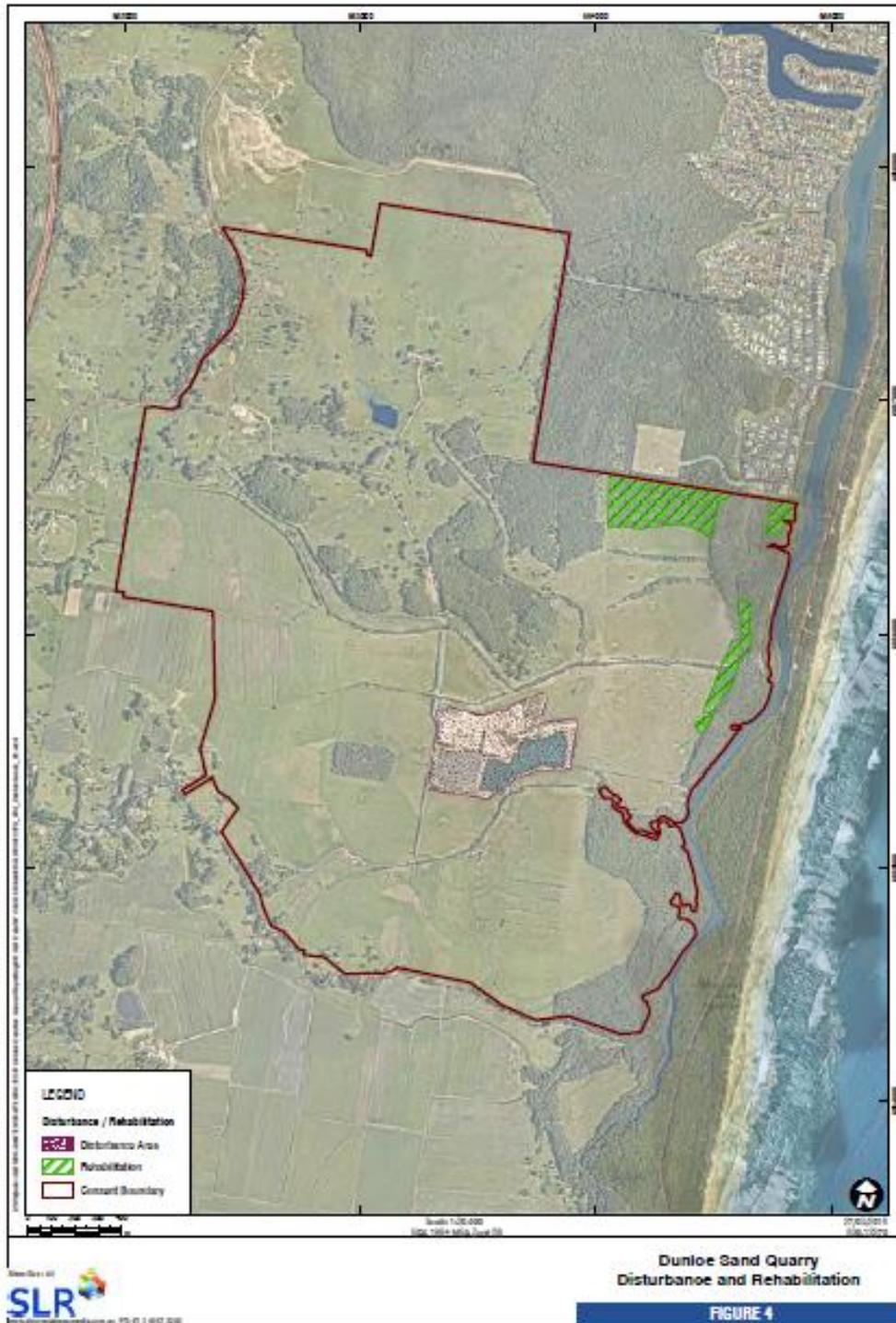


Figure 4: Rehabilitation and Disturbance

8.3 Actions for the Next Reporting Period

The DPE 2015 *Annual Review Guidelines* require the Annual Review to outline the rehabilitation actions proposed during the next reporting period. These actions are detailed in **Table 35**.

Table 35: Rehabilitation and Closure Actions for the Next Reporting Period (2019)

Requirement	Site Comment
Describe the steps to be undertaken to progress agreement during next reporting period, where final rehabilitation outcomes have not yet been agreed between stakeholders.	No rehabilitation proposed in 2019.
Outline proposed rehabilitation trials, research projects and other initiatives to be undertaken during next reporting period.	Rehabilitation inspections/monitoring to continue. An update will be provided in the 2019 Annual Review.
Summary of rehabilitation activities proposed for next report period.	No specific rehabilitation proposed for 2019. The three rehabilitation zones were managed and worked on in accordance with the approved EMP including invasive species removal and monitoring.

9 COMMUNITY

9.1 Community Engagement Activities

The site implemented a Community Consultative Committee (CCC) when under the operation of Ramtech as part of the conditions of consent. CCC meetings were undertaken on 2 February 2018 and 25 May 2018. All minutes from each of the meetings undertaken in 2018, along with a copy of the complaints register and all publicly listed information including contacts for locals in the community is available on the Dunloe Sand Quarry webpage in accordance with the Project Approval requirements (<http://www.holcim.com.au/about-us/community-link/dunloe-sand-quarry-pottsville-nsw.html>).

Holcim has maintained community engagement measures, including:

- Maintenance of a website (containing publicly available documents);
- A telephone number, email and postal address (on the website) for community complaints and feedback;
- A copy of the Complaints Register is maintained on the company website; and
- All documents and items displayed on the website are regularly updated by Holcim staff.

9.2 Community Contributions

Holcim supplied some sand free of charge to local schools during the Annual Review period.

9.3 Complaints

There were no community complaints at site during 2018. In 2017 there were two community complaints.

10 INDEPENDENT AUDIT

The site undertook an IEA in 2016 in accordance with the timeframes of the Project Approval. All actions raised in the IEA have been undertaken in accordance with the recommendations made by Consultants Mark Rigby & Associates. All actions were closed out in 2016. The next audit is due in 2019.

11 INCIDENTS AND NON-COMPLIANCE

Table 36 summarises the incidents and non-compliances at the Dunloe Sand Quarry in 2018.

Table 36: Summary of Incidents and Non-Compliances

Date	Incident/ Non – Compliance	Action															
Throughout the Annual Review period	<p>Schedule 3 Condition 6</p> <p>The Proponent must ensure that particulate matter emissions generated by the project do not cause exceedances of the criteria in Table 3 at any residence on privately-owned land.</p> <table border="1"> <thead> <tr> <th>Pollutant</th> <th>Averaging Period</th> <th>Criterion</th> </tr> </thead> <tbody> <tr> <td>Particulate matter < 10 µm (PM₁₀)</td> <td>Annual</td> <td>^{a,c} 30 µg/m³</td> </tr> <tr> <td></td> <td>24 hour</td> <td>^b 50 µg/m³</td> </tr> <tr> <td>Total suspended particulates (TSP)</td> <td>Annual</td> <td>^{a,c} 90 µg/m³</td> </tr> <tr> <td>^dDeposited dust</td> <td>Annual</td> <td>^b 2g/m²/month ^e 4g/m²/month</td> </tr> </tbody> </table> <p>Non-compliances related to:</p> <ul style="list-style-type: none"> • Being above the short term PM₁₀ criteria on 19 January 2018, 12 February 2018 and 8 March 2018. • There was no sampling of Depositional Dust Gauges from 8 August 2018 – 5 September 2018. This was during the changeover of monitoring contractors. 	Pollutant	Averaging Period	Criterion	Particulate matter < 10 µm (PM ₁₀)	Annual	^{a,c} 30 µg/m ³		24 hour	^b 50 µg/m ³	Total suspended particulates (TSP)	Annual	^{a,c} 90 µg/m ³	^d Deposited dust	Annual	^b 2g/m ² /month ^e 4g/m ² /month	<p>No further requirements to monitor for PM₁₀ while production remains below 200,000 T/annum.</p> <p>Depositional dust monitoring to improve in 2018 to ensure a full capture.</p>
Pollutant	Averaging Period	Criterion															
Particulate matter < 10 µm (PM ₁₀)	Annual	^{a,c} 30 µg/m ³															
	24 hour	^b 50 µg/m ³															
Total suspended particulates (TSP)	Annual	^{a,c} 90 µg/m ³															
^d Deposited dust	Annual	^b 2g/m ² /month ^e 4g/m ² /month															
September – December 2018	<p>Schedule 3 Condition 22</p> <p>It is noted that there were some months where cyanophyta and total algae count were not recorded. This is a non - compliance with the frequency outlined in the Blue – Green Algae Management (Component of the EMP).</p>	<p>Improve monitoring of algae for the rest of 2019.</p>															

12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Holcim staff will undertake the following works and improvement measures and projects in 2019 to ensure compliance with the consent and to ensure that effective environmental management controls are in place and operating in accordance with the requirements of the Consent.

Table 37: Improvement Actions for 2018

Improvement Measure	Activities
Development Application (Truck Movements Modification)	Application to modify the current Project Approval condition limiting truck movement to 4 (in and out) per hour.
Water Quality Monitoring	Ensure water quality monitoring is completed in accordance with the EMP.
Dust Monitoring	Ensure dust monitoring is completed in accordance with the EMP.
Biodiversity	Weed spraying will continue at site during the next Annual Review period.
	Conduct fauna box monitoring annually.

13 REFERENCES

DPI Water (2017) Water Access Licence Usage;

EPA (Ongoing) Environment Protection Licence) – 13077;

Holcim (2018) CCC Minutes;

Planit Consulting and Holcim (October 2016) *Environmental Management Plan*; and

Planit Consulting (2007) Environmental Assessment – Dunloe Park.

14 APPENDICES

APPENDIX 1

DUNLOE SAND QUARRY NOISE MONITORING 2018

Noise Monitoring Assessment Quarterly

Dunloe Quarry, Pottsville, NSW
March 2018.

Prepared for: VGT Pty Ltd
(on behalf of Holcim (Australia) Pty Ltd)
April 2018
MAC170440RP5



Document Information

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

March 2018

Prepared for: VGT Pty Limited (on behalf of Holcim Pty Ltd)

Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 262, Newcastle NSW 2300

ABN: 36 602 225 132

P: +61 2 4920 1833

www.mulleracoustic.com

Document ID	Status	Date	Written By	Signed
MAC170440RP5	Final	10 April 2018	Oliver Muller	

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1 INTRODUCTION5

2 NOISE CRITERIA7

3 METHODOLOGY9

 3.1 LOCALITY9

 3.2 NOISE MONITORING LOCATIONS9

 3.3 ASSESSMENT METHODOLOGY9

4 RESULTS 11

 4.1 ASSESSMENT RESULTS - LOCATION R1 11

 4.2 ASSESSMENT RESULTS - LOCATION R2 11

 4.3 ASSESSMENT RESULTS - LOCATION R3 12

 4.4 ASSESSMENT RESULTS - LOCATION R4 12

5 NOISE COMPLIANCE ASSESSMENT 13

6 DISCUSSION 15

 6.1 DISCUSSION OF RESULTS - LOCATION R1 15

 6.2 DISCUSSION OF RESULTS - LOCATION R2 15

 6.3 DISCUSSION OF RESULTS - LOCATION R3 15

 6.4 DISCUSSION OF RESULTS - LOCATION R4 15

7 CONCLUSION 17

APPENDIX A - GLOSSARY OF TERMS

This page has been intentionally left blank

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by VGT Pty Limited (VGT) on behalf of Holcim Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Dunloe Quarry ('the quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 1, March 2018.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Standards Australia AS 1055.1:1997 - Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

This page has been intentionally left blank

2 Noise Criteria

Schedule 3 Section 2 of the sites Project Approval, outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations with the site permitted to operate Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day dBA, LAeq(15min) Criteria ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the EPL.

This page has been intentionally left blank

3 Methodology

3.1 Locality

The quarry is located in Pottsville, NSW, and receivers in the locality surrounding the quarry are primarily rural/residential. The surroundings of the quarry generally consist of coastal bushland and elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

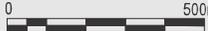
The attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Conditions of Consent. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Wednesday 28 March 2018. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2004-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

Measurements were conducted at each monitoring location during the day assessment period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Extraneous noise sources were excluded from the analysis as to calculate the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the applicable noise criteria.

FIGURE 1

LOCALITY PLAN

REF: MAC170440



KEY



RECEIVER LOCATION



SITE LOCATION



4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for each day survey period at R1 for Wednesday 28 March 2018 are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/03/2018	10:28	88	62	38	Dir: E Wind Speed: 1m/s Rain: Nil	Distant traffic 36-40
						Local residential noise 39-44
						Birds 44-58
						Insects <36
						Wind in trees 40-50
Dunloe Quarry L _{Aeq} (15min) Contribution						Quarry Inaudible

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for each day survey period at R2 for Wednesday 28 March 2018 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/03/2018	10:57	86	64	48	Dir: E Wind Speed: 1m/s Rain: Nil	Highway traffic 44-52
						Birds 47-52
						Wind in trees <44
						Local traffic 52-83
						Aircraft 52-54
Dunloe Quarry L _{Aeq} (15min) Contribution						Quarry Inaudible

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions for each day survey period at R3 for Wednesday 28 March 2018 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/03/2018	11:19	67	43	39	Dir: E Wind Speed: 1m/s Rain: Nil	Insects <38
						Aircraft 39-48
						Wind in trees <38
						Distant traffic 38-43
						Local residential noise 44-51
Dunloe Quarry L _{Aeq} (15min) Contribution					Quarry Inaudible	

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for each day survey period at R4 for Wednesday 28 March 2018 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/03/2018	11:39	78	51	41	Dir: E Wind Speed: 1m/s Rain: Nil	Wind in trees 42-62
						Birds 43-53
						Dunloe Quarry L _{Aeq} (15min) Contribution
					Quarry Inaudible	

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for day assessment periods.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	dBA, LAeq(15min)	dBA, LAeq(15min)	
R1	Nil	48	✓
R2	Nil	48	✓
R3	Nil	48	✓
R4	Nil	48	✓

This page has been intentionally left blank

6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise was inaudible at R1 during the March 2018 monitoring assessment, and therefore satisfies the relevant criteria of 48dBA LAeq(15min). Extraneous noise sources included distant traffic, local residential noise, residential traffic, birds, insects and wind in trees. All extraneous noises remained generally constant during the 15-minute measurement at R1.

6.2 Discussion of Results - Location R2

Quarry noise remained inaudible at R2 during the March 2018 monitoring assessment. Quarry contributions therefore satisfied the relevant criteria of 48dBA LAeq(15min). Highway and local traffic dominated the March 2018 measurements at R2 and extraneous sources including birds, wind in trees, aircraft and local residential noise which was predominantly masked by the traffic in the area although remained generally constant during the 15-minute measurement at R2.

6.3 Discussion of Results - Location R3

Quarry noise was inaudible during the March 2018 survey period at R3, satisfying the daytime criteria of 48dBA LAeq(15min). Non-quarrying noise sources included insects, aircrafts, wind in trees, distant traffic and local residential noise. Extraneous noises remained constant during the 15-minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry emissions were inaudible throughout the March 2018 monitoring quarter at R4. Therefore, quarry emissions satisfied the relevant daytime noise limit of 48dBA LAeq(15min). Extraneous non-quarrying sources include wind in trees and birds.

This page has been intentionally left blank

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for VGT Pty Ltd on behalf of Holcim Pty Ltd at the Dunloe Quarry, Pottsville, NSW. The assessment was completed to assess the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 1, March 2018 assessment.

Attended noise monitoring was undertaken on 28 March 2018 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry comply with relevant statutory noise criteria specified in the Project Approval at all assessed residential receivers.

This page has been intentionally left blank

Appendix A - Glossary of Terms

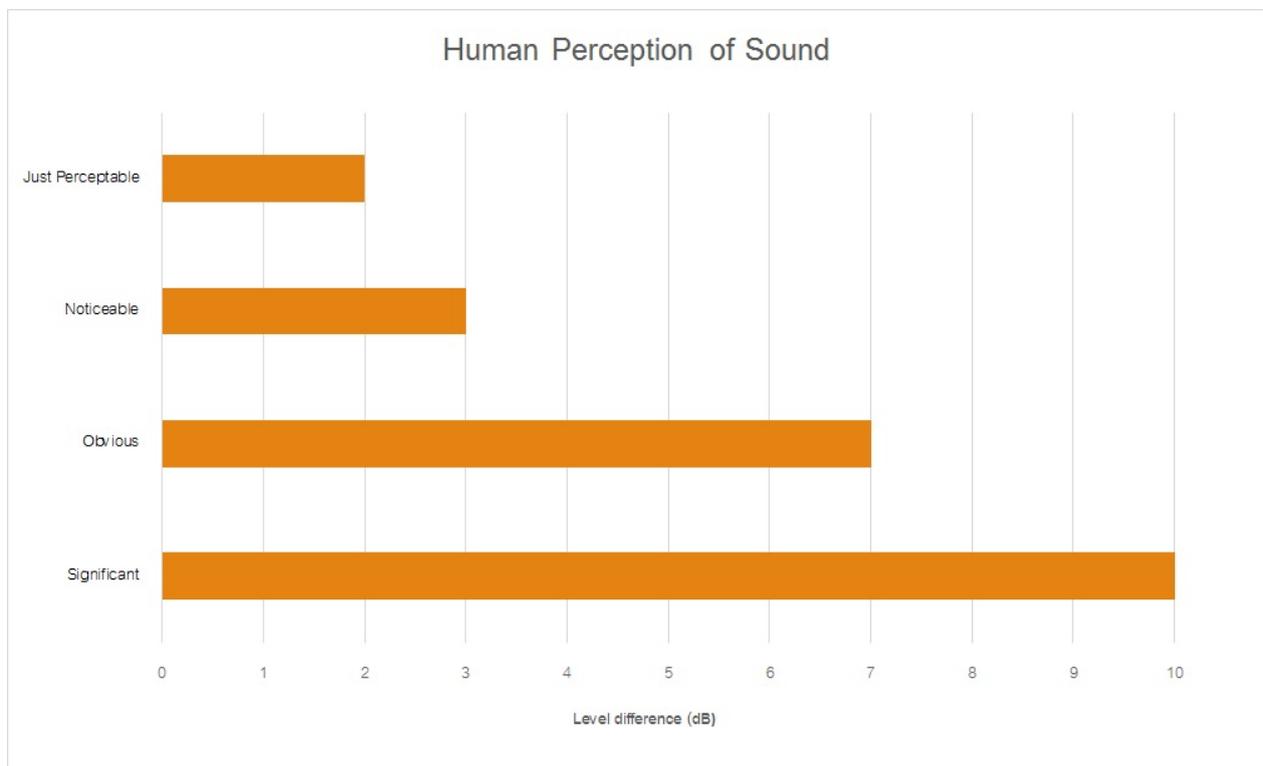
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com



Noise Monitoring Assessment Quarterly

Dunloe Quarry, Pottsville, NSW
June 2018.



Document Information

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

June 2018

Prepared for: VGT Laboratories Pty Limited (on behalf of Holcim (Australia) Pty Ltd)

Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 262, Newcastle NSW 2300

ABN: 36 602 225 132

P: +61 2 4920 1833

www.mulleracoustic.com

Document ID	Status	Date	Written By	Signed
MAC170440RP6	Final	27 June 2018	Oliver Muller	

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1 INTRODUCTION5

2 NOISE CRITERIA7

3 METHODOLOGY9

 3.1 LOCALITY9

 3.2 NOISE MONITORING LOCATIONS9

 3.3 ASSESSMENT METHODOLOGY9

4 RESULTS 11

 4.1 ASSESSMENT RESULTS - LOCATION R1 11

 4.2 ASSESSMENT RESULTS - LOCATION R2 11

 4.3 ASSESSMENT RESULTS - LOCATION R3 12

 4.4 ASSESSMENT RESULTS - LOCATION R4 12

5 NOISE COMPLIANCE ASSESSMENT 13

6 DISCUSSION 15

 6.1 DISCUSSION OF RESULTS - LOCATION R1 15

 6.2 DISCUSSION OF RESULTS - LOCATION R2 15

 6.3 DISCUSSION OF RESULTS - LOCATION R3 15

 6.4 DISCUSSION OF RESULTS - LOCATION R4 15

7 CONCLUSION 17

APPENDIX A - GLOSSARY OF TERMS

This page has been intentionally left blank

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by VGT Laboratories Pty Limited (VGT) on behalf of Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for Dunloe Quarry ('the quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 2, June 2018.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Standards Australia AS 1055.1:1997 - Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

This page has been intentionally left blank

2 Noise Criteria

Schedule 3 Section 2 of the sites Project Approval, outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations with the site permitted to operate Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day dBA, LAeq(15-min) Criteria ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the EPL.

This page has been intentionally left blank

3 Methodology

3.1 Locality

The quarry is located in Pottsville, NSW, and receivers in the locality surrounding the quarry are primarily rural/residential. The surroundings of the quarry generally consist of coastal bushland and elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

The attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Conditions of Consent. The measurements were carried out using a Svantek Type 1, 971 noise analyser on Thursday 21 June 2018. The acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2004-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

Measurements were conducted at each monitoring location during the day assessment period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source. Extraneous noise sources were excluded from the analysis as to calculate the $L_{Aeq}(15\text{-min})$ quarry noise contribution for comparison against the applicable noise criteria.

FIGURE 1

LOCALITY PLAN

REF: MAC170440

0 500m



KEY



RECEIVER LOCATION



SITE LOCATION



4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for the day survey period at R1 for Thursday 21 June 2018 are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/06/2018	09:55	78	54	42	Dir: S Wind Speed: 2 m/s Rain: Nil	Wind in grass 38-45 Local residential noise 42-78 Birds 44-63 Distant highway traffic 38-46
Dunloe Quarry L _{Aeq} (15-min) Contribution						Quarry Inaudible

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for the day survey period at R2 for Thursday 21 June 2018 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/06/2018	10:18	80	61	50	Dir: S Wind Speed: 1 m/s Rain: Nil	Highway traffic 51-55 Birds <51 Local traffic 51-80 Wind in trees <51
Dunloe Quarry L _{Aeq} (15-min) Contribution						Quarry Inaudible

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions for the day survey period at R3 for Thursday 21 June 2018 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/06/2018	10:38	76	51	42	Dir: S Wind Speed: 1 m/s Rain: Nil	Distant traffic 34-42 Wind in trees 38-48 Birds 38-45 Local traffic 46-76
Dunloe Quarry L _{Aeq} (15-min) Contribution						Quarry Inaudible

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for the day survey period at R4 for Thursday 21 June 2018 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/06/2018	10:59	67	49	39	Dir: S Wind Speed: 1 m/s Rain: Nil	Wind in trees 41-52 Birds 36-53 Aircraft 42-67
Dunloe Quarry L _{Aeq} (15-min) Contribution						Quarry Inaudible

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for day assessment periods.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	dBA, LAeq(15-min)	dBA, LAeq(15-min)	
R1	Nil	48	✓
R2	Nil	48	✓
R3	Nil	48	✓
R4	Nil	48	✓

This page has been intentionally left blank

6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise was inaudible at R1 during the June 2018 monitoring assessment, and therefore satisfies the relevant criteria of 48dBA LAeq(15-min). Extraneous noise sources included wind in grass, local residential noise, birds, distant highway traffic. All extraneous noises remained generally constant during the 15-minute measurement at R1.

6.2 Discussion of Results - Location R2

Quarry noise remained inaudible at R2 during the June 2018 monitoring assessment and therefore satisfied the relevant criteria of 48dBA LAeq(15-min). Highway and local traffic dominated the June 2018 measurements at R2 with birds and wind in trees also present.

6.3 Discussion of Results - Location R3

Quarry noise was inaudible during the June 2018 survey period at R3, satisfying the daytime criteria of 48dBA LAeq(15-min). Non-quarrying noise sources included distant highway traffic, wind in trees, birds and local traffic which remained constant during the 15-minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry emissions were inaudible throughout the June 2018 monitoring quarter at R4. Therefore, quarry emissions satisfied the relevant daytime noise limit of 48dBA LAeq(15-min). Extraneous non-quarrying sources include wind in trees, aircraft noise and birds.

This page has been intentionally left blank

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) for VGT Laboratories Pty Ltd on behalf of Holcim (Australia) Pty Ltd at the Dunloe Quarry, Pottsville, NSW. The assessment was completed to assess the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 2, June 2018 assessment.

Attended noise monitoring was undertaken on 21 June 2018 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry comply with relevant statutory noise criteria specified in the Project Approval at all assessed residential receivers.

This page has been intentionally left blank

Appendix A - Glossary of Terms

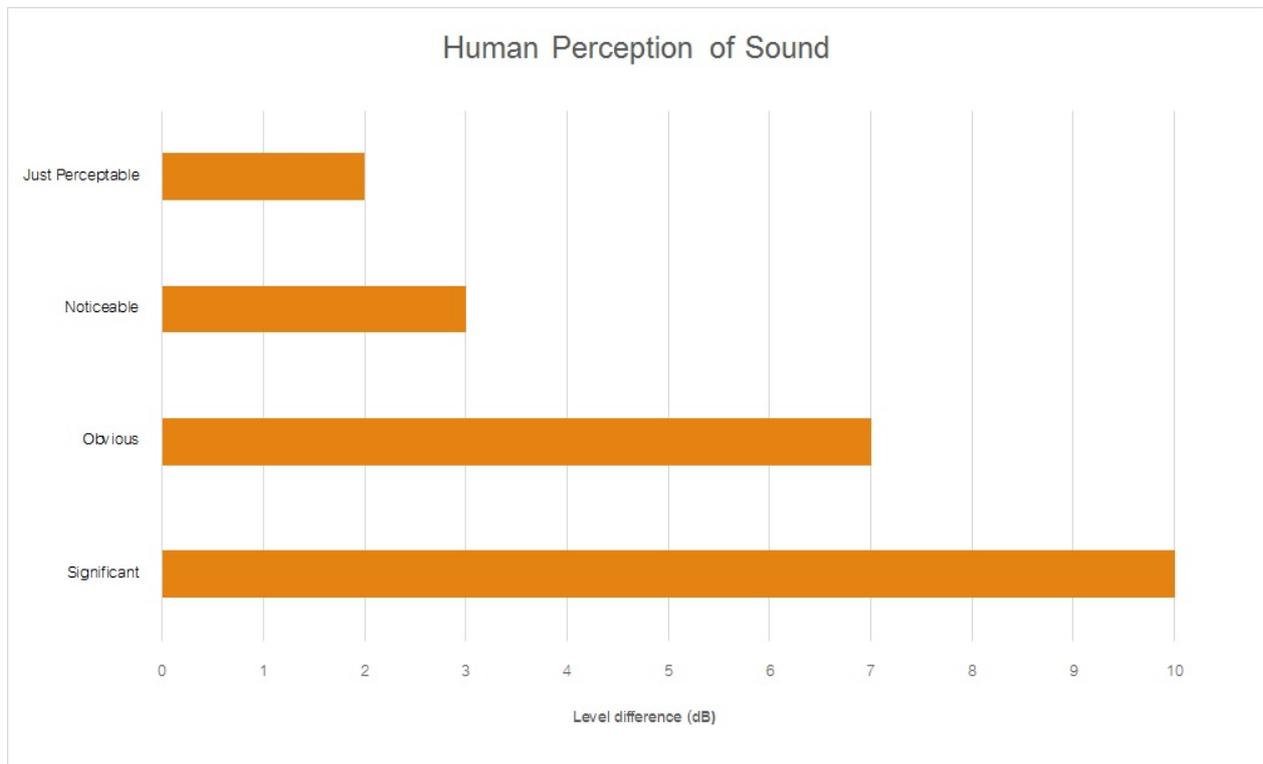
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com



Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW
Quarter 3 Ending September 2018.

Document Information

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

Quarter 3 Ending September 2018

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 262, Newcastle NSW 2300

ABN: 36 602 225 132

P: +61 2 4920 1833

www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-07RP1	Final	17 September 2018	Robin Heaton	<i>Robin Heaton</i>	Rod Linnett	<i>RM LA</i>

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1 INTRODUCTION5

2 NOISE CRITERIA7

3 METHODOLOGY9

 3.1 LOCALITY9

 3.2 NOISE MONITORING LOCATIONS9

 3.3 ASSESSMENT METHODOLOGY9

4 RESULTS 11

 4.1 ASSESSMENT RESULTS - LOCATION R1 11

 4.2 ASSESSMENT RESULTS - LOCATION R2 11

 4.3 ASSESSMENT RESULTS - LOCATION R3 12

 4.4 ASSESSMENT RESULTS - LOCATION R4 12

5 NOISE COMPLIANCE ASSESSMENT 13

6 DISCUSSION 15

 6.1 DISCUSSION OF RESULTS - LOCATION R1 15

 6.2 DISCUSSION OF RESULTS - LOCATION R2 15

 6.3 DISCUSSION OF RESULTS - LOCATION R3 15

 6.4 DISCUSSION OF RESULTS - LOCATION R4 15

7 CONCLUSION 17

APPENDIX A - GLOSSARY OF TERMS

This page has been intentionally left blank

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for the quarterly period ending September 2018 for Dunloe Quarry (the 'quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 3, September 2018 and forms part of the annual noise monitoring program to address conditions of the project approval.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Australian Standard AS 1055.1:1997 - Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

This page has been intentionally left blank

2 Noise Criteria

Schedule 3 Section 2 of the sites Project Approval, outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations with the site permitted to operate Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day LAeq(15min) Criteria ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the Project Approval.

This page has been intentionally left blank

3 Methodology

3.1 Locality

The quarry is approximately 2.5km south west of Pottsville, NSW. Receivers surrounding the quarry are primarily rural/residential situated in coastal bushland with elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

Attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055-1997, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Project Approval. Measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 11 September 2018. Acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2004-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

One measurement was conducted at each monitoring location during the daytime period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source.

Extraneous noise sources were excluded from the analysis to determine the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the relevant criteria. Where the quarry was inaudible, the contribution is estimated to be at least 10dB below the ambient noise level.

FIGURE 1

LOCALITY PLAN

REF: MAC180611-07



KEY



RECEIVER LOCATION



SITE LOCATION



4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for R1 for are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
11/09/2018	11:29	89	61	38	Dir: S Wind Speed: 2 m/s Rain: Nil	Wind in grass 40-46
						Cars in Drive 50-89
						Farm Activities 40-46
						Distant traffic 35-45
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for R2 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
11/09/2018	10:57	80	61	47	Dir: S Wind Speed: 1.5 m/s Rain: Nil	Highway traffic 51-55
						Birds 36-50
						Local traffic 41-80
						Wind in trees 40-48
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions R3 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
11/09/2018	10:36	58	42	38	Dir: S Wind Speed: 1.2 m/s Rain: Nil	Distant traffic 35-41
						Wind in trees 32-47
						Resident Noise 30-36
						Aircraft 41-46
						Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for R4 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
11/09/2018	10:15	70	46	37	Dir: S Wind Speed: 2.6m/s Rain: Nil	Wind in trees 40-51
						Birds 36-50
						Aircraft 40-52
						Truck on farm 43-46
						Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for day assessment periods.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	LAeq(15min)	LAeq(15min)	
R1	<30	48	✓
R2	<30	48	✓
R3	<30	48	✓
R4	<30	48	✓

This page has been intentionally left blank

6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 11 September 2018 at location R1, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included wind in trees, local residential noise, birds, distant highway traffic. All extraneous noises were generally constant during the 15 minute measurement at R1.

6.2 Discussion of Results - Location R2

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 11 September 2018 at location R2, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included wind in trees, highway and passing local traffic. All extraneous noises were generally constant during the 15 minute measurement at R2.

6.3 Discussion of Results - Location R3

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 11 September 2018 at location R3, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included distant highway traffic, wind in trees and birds. All extraneous noises were generally constant during the 15 minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 11 September 2018 at location R4, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included wind in trees, aircraft noise, birds, distant highway traffic. All extraneous noises were generally constant during the 15 minute measurement at R4.

This page has been intentionally left blank

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Holcim (Australia) Pty Ltd at Dunloe Quarry, Pottsville, NSW. The assessment was completed to determine the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 3 period ending September 2018.

Attended noise monitoring was undertaken on 11 September 2018 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry comply with relevant noise criteria specified in the Project Approval at all assessed residential receivers.

This page has been intentionally left blank

Appendix A - Glossary of Terms

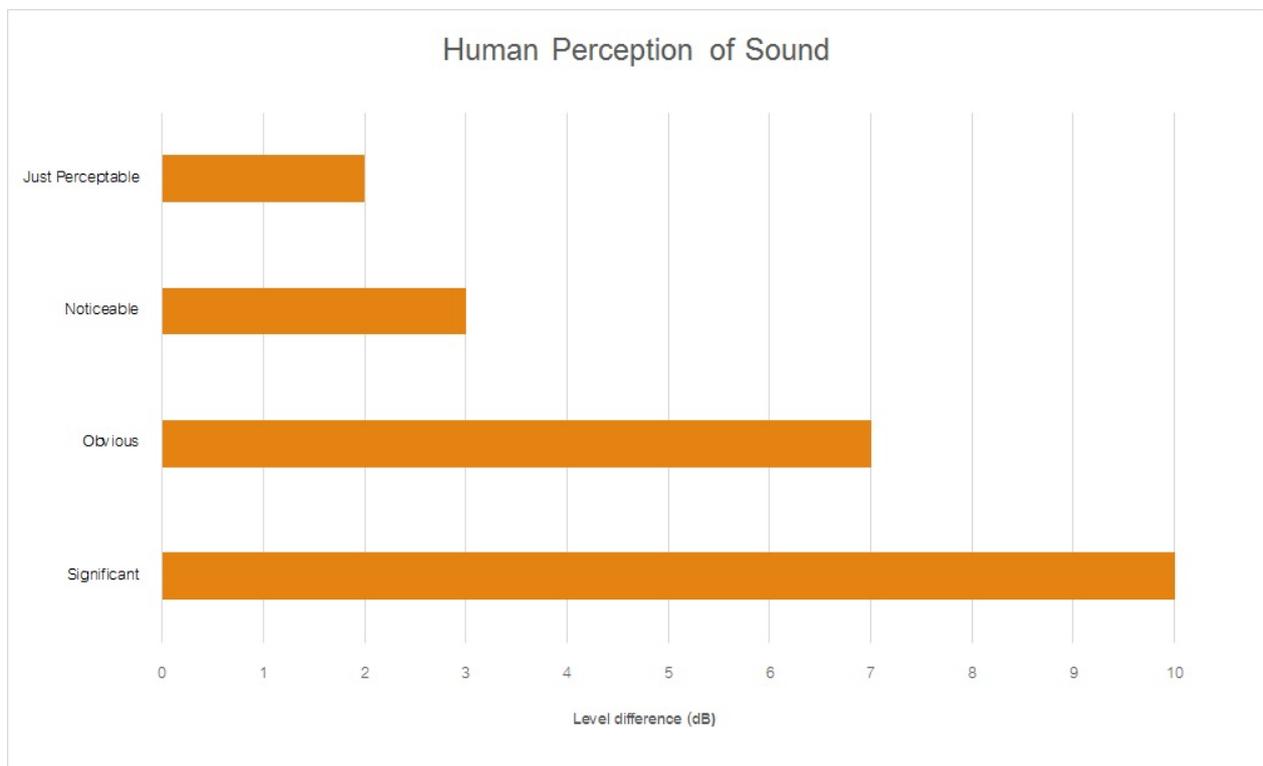
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com



Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW
Quarter 4 Ending December 2018.



Document Information

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

Quarter 4 Ending December 2018

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd

PO Box 262, Newcastle NSW 2300

ABN: 36 602 225 132

P: +61 2 4920 1833

www.mulleracoustic.com

Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-07RP2	Final	7 December 2018	Robin Heaton	<i>Robin Heaton</i>	Rod Linnett	<i>RM LA</i>

DISCLAIMER

All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

CONTENTS

1 INTRODUCTION5

2 NOISE CRITERIA7

3 METHODOLOGY9

 3.1 LOCALITY9

 3.2 NOISE MONITORING LOCATIONS9

 3.3 ASSESSMENT METHODOLOGY9

4 RESULTS 11

 4.1 ASSESSMENT RESULTS - LOCATION R1 11

 4.2 ASSESSMENT RESULTS - LOCATION R2 11

 4.3 ASSESSMENT RESULTS - LOCATION R3 12

 4.4 ASSESSMENT RESULTS - LOCATION R4 12

5 NOISE COMPLIANCE ASSESSMENT 13

6 DISCUSSION 15

 6.1 DISCUSSION OF RESULTS - LOCATION R1 15

 6.2 DISCUSSION OF RESULTS - LOCATION R2 15

 6.3 DISCUSSION OF RESULTS - LOCATION R3 15

 6.4 DISCUSSION OF RESULTS - LOCATION R4 15

7 CONCLUSION 17

APPENDIX A - GLOSSARY OF TERMS

This page has been intentionally left blank

1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for the quarterly period ending December 2018 for Dunloe Quarry (the 'quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 4, ending December 2018 and forms part of the annual noise monitoring program to address conditions of the project approval.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Australian Standard AS 1055:2018- Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

This page has been intentionally left blank

2 Noise Criteria

Schedule 3 Section 2 of the sites Project Approval, outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations with the site permitted to operate Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day LAeq(15min) Criteria ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the Project Approval.

This page has been intentionally left blank

3 Methodology

3.1 Locality

The quarry is approximately 2.5km south west of Pottsville, NSW. Receivers surrounding the quarry are primarily rural/residential situated in coastal bushland with elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

Attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Project Approval. Measurements were carried out using a Svantek Type 1, 971 noise analyser on Wednesday 21 November 2018. Acoustic instrumentation used carries current NATA calibration and complies with AS IEC 61672.1-2004-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

One measurement was conducted at each monitoring location during the daytime period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source.

Extraneous noise sources were excluded from the analysis to determine the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the relevant criteria. Where the quarry was inaudible, the contribution is estimated to be at least 10dB below the ambient noise level.

FIGURE 1
LOCALITY PLAN
REF: MAC180611-07



KEY

 RECEIVER LOCATION

 SITE LOCATION



*Imagery Source: reamaps

4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for R1 for are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/11/2018	12:44	78	56	44	WD: N WS: 1.5m/s Rain: Nil	Wind in trees 42-78 Birds 42-50 Distant traffic 40-44 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for R2 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/11/2018	13:05	82	63	52	WD: N WS: 2.0m/s Rain: Nil	Wind in trees 48-56 Traffic 48-82 Aircraft 48-56 Insects 45-52 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions R3 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/11/2018	13:23	71	57	52	WD: N WS: 2.0m/s Rain: Nil	Wind in trees 52-58 Insects 50-63 Traffic 52-71 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for R4 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
21/11/2018	13:43	67	57	51	WD: N WS: 2.0m/s Rain: Nil	Wind in trees 52-67 Traffic 45-51 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for day assessment periods.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	LAeq(15min)	LAeq(15min)	
R1	<30	48	✓
R2	<30	48	✓
R3	<30	48	✓
R4	<30	48	✓

This page has been intentionally left blank

6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise emissions were inaudible during noise monitoring conducted on Wednesday 21 November 2018 at location R1, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included wind in trees, birds, distant highway traffic and were generally constant throughout the measurement.

6.2 Discussion of Results - Location R2

Quarry noise emissions were inaudible during noise monitoring conducted on Wednesday 21 November 2018 at location R2, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included the continuous noise of the wind in trees, insects, distant highway traffic and intermittent sources such as passing local traffic and aircraft passing overhead.

6.3 Discussion of Results - Location R3

Quarry noise emissions were inaudible during noise monitoring conducted on Wednesday 21 November 2018 at location R3, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included distant highway and local traffic, wind in trees and insects. All extraneous noises were generally constant during the 15 minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry noise emissions were inaudible during noise monitoring conducted on Wednesday 21 November 2018 at location R4, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included wind in trees, and distant highway traffic were generally constant throughout the measurement.

This page has been intentionally left blank

7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Holcim (Australia) Pty Ltd at Dunloe Quarry, Pottsville, NSW. The assessment was completed to determine the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 4, ending December 2018.

Attended noise monitoring was undertaken on Wednesday 21 November 2018 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry comply with relevant noise criteria specified in the Project Approval at all assessed residential receivers.

This page has been intentionally left blank

Appendix A - Glossary of Terms

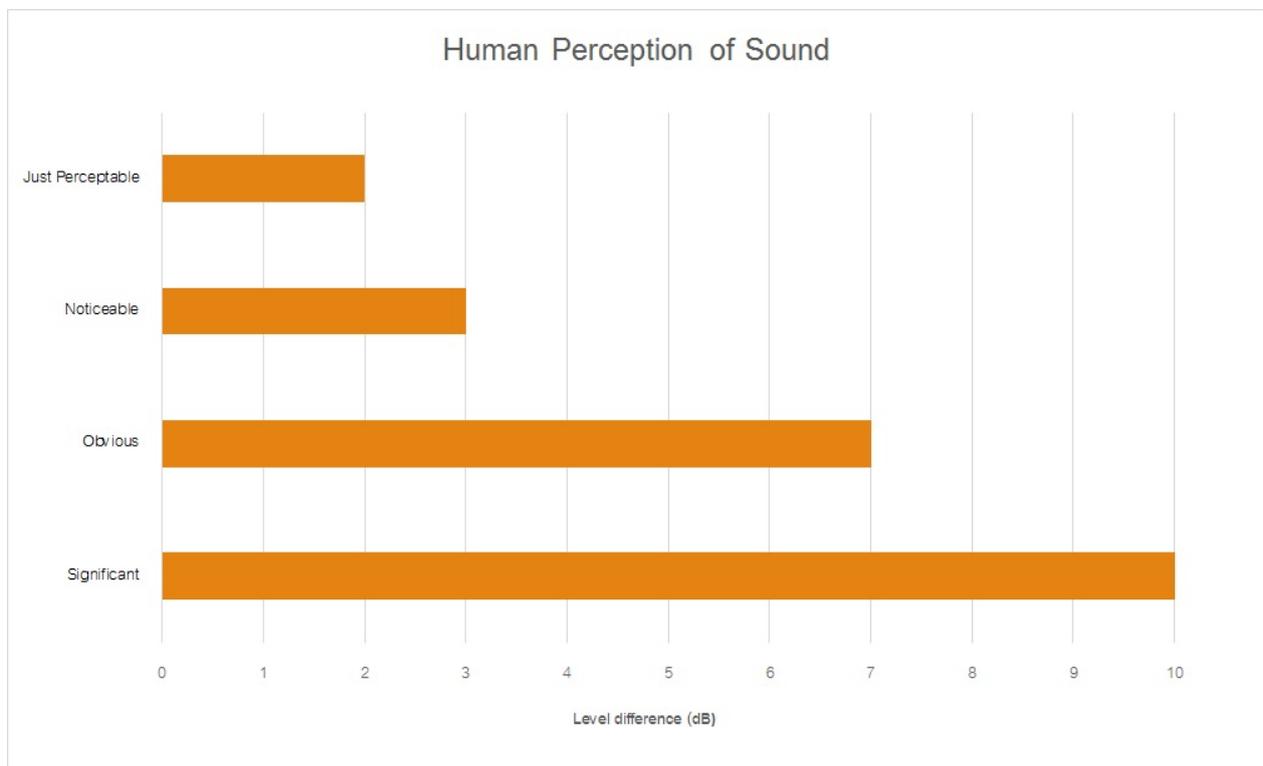
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



Muller Acoustic Consulting Pty Ltd
PO Box 262, Newcastle NSW 2300
ABN: 36 602 225 132
P: +61 2 4920 1833
www.mulleracoustic.com



APPENDIX 2

DUNLOE SAND QUARRY LONGTERM ENVIRONMENTAL MONITORING

Longterm Depositional Dust Monitoring at Dunloe Sands Quarry

Data located	Date	Location	D1	D2	D3	D4
			g/m2/month	g/m2/month	g/m2/month	g/m2/month
Appendix of 2015 AEMR	17-07-2015	Dunloe Sands	0.3	0.2	0.7	0.4
Appendix of 2015 AEMR	19-08-2015	Dunloe Sands	0.3	0.3	0.2	0.2
Appendix of 2015 AEMR	17-09-2015	Dunloe Sands	0.5	1.6	0.4	0.5
Appendix of 2015 AEMR	21-10-2015	Dunloe Sands	0.1	0.6	0.2	0.1
Appendix of 2015 AEMR	25-11-2015	Dunloe Sands	0.3	1.7	0.6	0.5
Appendix of 2015 AEMR	16-12-2015	Dunloe Sands	0.7	0.8	0.4	0.6
2016 AEMR	Jan-16	Dunloe Sands	0.3	0.4	0.5	0.6
2016 AEMR	Feb-16	Dunloe Sands	0.4	0.6	0.5	0.5
2016 AEMR	Mar-16	Dunloe Sands	0.2	4.7	0.3	0.5
2016 AEMR	Apr-16	Dunloe Sands	0.2	1.6	0.2	0.8
2016 AEMR	May-16	Dunloe Sands	0.3	1.2	0.3	1.6
2016 AEMR	Jun-16	Dunloe Sands	0.3	1.1	1.6	0.5
2016 AEMR	Jul-16	Dunloe Sands	0.13	0.52	0.41	0.39
2016 AEMR	Aug-16	Dunloe Sands	0.6	0.5	0.3	0.4
2016 AEMR	Sep-16	Dunloe Sands	0.8	0.5	0.4	0.3
2016 AEMR	Oct-16	Dunloe Sands	0.8	0.5	0.4	0.3
2016 AEMR	Nov-16	Dunloe Sands	0.4	1.9	0.3	0.4
2016 AEMR	Dec-16	Dunloe Sands	0.5	1.7	0.6	0.5
2017 Q1 Env Mon report	30-01-2017	Dunloe Sands	0.3	0.2	0.5	0.3
2017 Q1 Env Mon report	27-02-2017	Dunloe Sands	0.3	0.2	0.2	0.3
2017 Enviro Monitoring	22-03-2017	Dunloe Sands	0.2	0.1	2.4	0.3
2017 Enviro Monitoring	19-04-2017	Dunloe Sands	0.2	0.9	1	0.3
2017 Enviro Monitoring	17-05-2017	Dunloe Sands	0.8	0.8	1.4	0.7
2017 Enviro Monitoring	14-06-2017	Dunloe Sands	0.2	0.2	0.2	0.2
2017 Enviro Monitoring	12-07-2017	Dunloe Sands	0.3	0.1	0.2	0.3
2017 Enviro Monitoring	09-08-2017	Dunloe Sands	0.1	0.1	0.2	0.5
2017 Enviro Monitoring	06-09-2017	Dunloe Sands	0.5	0.2	0.5	0.5
2017 Enviro Monitoring	04-10-2017	Dunloe Sands	0.7	0.6	2.4	0.9
2017 Enviro Monitoring	01-11-2017	Dunloe Sands	0.5	0.3	0.8	0.5
2017 Enviro Monitoring	29-11-2017	Dunloe Sands	0.1	0.2	0.3	0.1
2017 Enviro Monitoring	28-12-2017	Dunloe Sands	0.4	0.3	0.2	0.2
2018 Enviro Monitoring	24-01-2018	Dunloe Sands	0.1	0.1	0.1	0.1
2018 Enviro Monitoring	21-02-2018	Dunloe Sands	2.7	0.7	1.6	0.6
2018 Enviro Monitoring	21-03-2018	Dunloe Sands	0.4	4.9c	11.8c	7.1c
2018 Enviro Monitoring	18-04-2018	Dunloe Sands	0.4	0.1	0.3	0.2
2018 Enviro Monitoring	16-05-2018	Dunloe Sands	0.2	0.4	0.6	0.3
2018 Enviro Monitoring	13-06-2018	Dunloe Sands	0.3	0.2	5.2c	0.4
2018 Enviro Monitoring	11-07-2018	Dunloe Sands	0.5	0.4	0.5	0.2
2018 Enviro Monitoring	08-08-2018	Dunloe Sands	0.4	0.5	0.3	0.2
2018 Enviro Monitoring	05-09-2018	Dunloe Sands	NS	NS	NS	NS
2018 Enviro Monitoring	05-10-2018	Dunloe Sands	0.1	0.4	0.3	0.7
2018 Enviro Monitoring	06-11-2018	Dunloe Sands	0.1	0.1	1.5	0.7
2018 Enviro Monitoring	07-12-2018	Dunloe Sands	1	0.2	1.6	0.3
Minimum			0.1	0.1	0.1	0.1
Maximum			2.7	1.9	2.4	1.6
Average			0.45	0.53	0.70	0.44

Longterm Surrounding Surface Water Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	Turbidity	TSS	Total Phosphorus-P	Total-N	Calcium	Magnesium	Potassium	Sulfur as Sulfate	Arsenic (Total)	Iron (Total)	Manganese (Total)
			pH	µScm-1	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2011/2012 AEMR	Dec-11	SW3	6	253	8.4		8	0.03	0.05							
2011/2012 AEMR	Mar-12	SW3	5.4	227	5.5		11	0.02	0.96							
2011/2012 AEMR	Jun-12	SW3	6	314	7.8	36	12	0.05	0.7	8.2						
2011/2012 AEMR	27-09-2012	SW3	6.7	17676	7.6	10	5.2	0.03	0.52							
2012/2013 AEMR	Dec-12	SW3	6.7	25765	6		14	0.04	0.7							
2012/2013 AEMR	Mar-13	SW3	6.7	3489	6.8		8.4	0.03	0.53							
2012/2013 AEMR	Jun-13	SW3	6	692	7.2		48									
2012/2013 AEMR	Sep-13	SW3	7	17686	7.3		14	0.02	0.38							
2013/2014 AEMR	12-12-2013	SW3	7.1	25681	5.8		13	0.02	0.34							
2013/2014 AEMR	Mar-14	SW3	3.7	1753	2.9		42	0.05	1.54							
2013/2014 AEMR	31-03-2014	SW3	3.7	1753	2.9	77	42	0.05	1.54							
2013/2014 AEMR	25-06-2014	SW3	5.7	19911	8.9	14	9	<0.02	0.76							
2013/2014 AEMR	Aug-14	SW3	7.9	41455	8.4		5.8	<0.02	0.2							
2013/2014 AEMR	29-09-2014	SW3	7.9	41455	8.4	6.2	5.8	<0.02	0.2	123	16	7	505	<0.005	11	106
Appendix of 2015 AEMR	15-12-2014	SW3	7.7	30732	7.9	9.9	35	0.03	0.36							
Appendix of 2015 AEMR	26-03-2015	SW3	3.7	1834	4.8	54	23	0.04	1.32							
Appendix of 2015 AEMR	24-04-2015	SW3	6.5	12467	7.2	7.8	4.0	0.15	0.46							
Appendix of 2015 AEMR	17-09-2015	SW3	6.7	15704	7.3	33	20	0.02	0.45							
Appendix of 2015 AEMR	11-12-2015	SW3	6.5	15038	6.8	13	24	<0.02	0.41							
Appendix of 2016 AEMR	24-03-2016	SW3	3.8	2548	3.6	54	24	0.06	1.16							
Appendix of 2016 AEMR	30-06-2016	SW3	5.5	1501.6	6.8	31	25	0.03	0.87							
Appendix of 2016 AEMR	29-09-2016	SW3	6.7	38914	6.1		5.6	0.02	0.23							
Appendix of 2016 AEMR	20-12-2016	SW3	7.4	36425	7.1		6.2	<0.02	0.31							
Number of Samples			23	23	23	12	23	17	22	2	1	1	1	0	1	1
Minimum			3.7	227	2.9	6.2	4	0.05	8.2	16	7	505			11	106
Maximum			7.9	41455	8.9	77	48	1.54	123	16	7	505			11	106
Average			6.13	15359.72	6.59	28.83	17.61	0.64	65.60	16.00	7.00	505.00			11.00	106.00
2011/2012 AEMR	Dec-11	SW4	6.4	1504	5.3		12	0.03	0.63							
2011/2012 AEMR	Mar-12	SW4	6	458	6.8		6.7	0.03	0.81							
2011/2012 AEMR	Jun-12	SW4	6.2	805	8.6	26	7.7	0.04	0.78	10						
2011/2012 AEMR	27-09-2012	SW4	7	23790	7	5.1	10	<0.02	0.27							
2012/2013 AEMR	Dec-12	SW4	7	30543	5.7		9.4	<0.02	0.39							
2012/2013 AEMR	Mar-13	SW4	7.6	29821	7		9.6	0.02	0.54							
2012/2013 AEMR	Jun-13	SW4	5.9	890	7.4		16									
2012/2013 AEMR	Sep-13	SW4	6.8	16825	7.2		8.8	0.02	0.41							
2013/2014 AEMR	12-12-2013	SW4	6.7	17021	5.5		15	0.03	0.51							
2013/2014 AEMR	Mar-14	SW4	3.8	1354	2.5		41	0.04	1.43							
2013/2014 AEMR	31-03-2014	SW4	3.8	1354	2.5	76	41	0.04	1.43							
2013/2014 AEMR	25-06-2014	SW4	6.5	25363	8.4	12	8	<0.02	0.5							
2013/2014 AEMR	Aug-14	SW4	7.1	22190	8.4		6	<0.02	0.31							
2013/2014 AEMR	29-09-2014	SW4	7.1	22190	8.4	9.8	6	<0.02	0.31							
Appendix of 2015 AEMR	15-12-2014	SW4	8	29257	10	11	33	0.05	0.86							
Appendix of 2015 AEMR	26-03-2015	SW4	3.7	1426	4.7	48	24	0.1	1.15							
Appendix of 2015 AEMR	24-04-2015	SW4	6.4	12416	7.4	22	18	0.02	0.45							
Appendix of 2015 AEMR	17-09-2015	SW4	6.7	8008	7.3	19	11	0.02	0.48							
Appendix of 2015 AEMR	11-12-2015	SW4	7.7	39859	7.5	4.2	9.5	0.02	0.24							
Appendix of 2016 AEMR	24-03-2016	SW4	3.8	2721	5.5	54	25	0.06	1.15							
Appendix of 2016 AEMR	30-06-2016	SW4	6.5	3468.2	8.4	14	10	0.02	0.7							
Appendix of 2016 AEMR	29-09-2016	SW4	6.9	37551	9.6		66	0.02	0.34							
Appendix of 2016 AEMR	20-12-2016	SW4	6.9	17005	6.9		8.5	0.03	0.49							
Number of Samples			23	23	23	12	23	17	22	1						
Minimum			3.7	23	2.5	4.2	6	0.24	1							
Maximum			8	39859	10	76	66	1.43	10							
Average			6.28	15035.62	6.87	25.09	17.49	0.64	10.00							

Longterm Surrounding Surface Water Quality Monitoring at Dunloe Sands Quarry

2011/2012 AEMR	Dec-11	SW9	6.4	657	7.8		13	0.03	0.53								
2011/2012 AEMR	Mar-12	SW9	6.1	704	6.5		36	0.09	1.31								
2011/2012 AEMR	Jun-12	SW9	6.1	575	5.4	25	10	0.04	0.6	32							
2011/2012 AEMR	27-09-2012	SW9	7.3	13557	9.4	4.8	13	0.02	0.53								
2012/2013 AEMR	Dec-12	SW9	6.8	17219	6.9		9.4	0.04	0.76								
2012/2013 AEMR	Mar-13	SW9	6.7	3708	7.3		6.8	0.03	0.43								
2012/2013 AEMR	Jun-13	SW9	4.9	305	6.5		27										
2012/2013 AEMR	Sep-13	SW9	7	2753	9.9		29	0.13	1.34								
2013/2014 AEMR	12-12-2013	SW9	6.8	10096	5.2		20	0.05	0.81								
2013/2014 AEMR	Mar-14	SW9	4.6	1431	2.1		40	0.13	1.64								
2013/2014 AEMR	31-03-2014	SW9	4.6	1431	2.1	30	40	0.13	1.64								
2013/2014 AEMR	25-06-2014	SW9	6.6	18376	7.9	60	16	0.05	0.67								
2013/2014 AEMR	Aug-14	SW9	7.1	10705	9.3		20	0.03	0.6								
2013/2014 AEMR	29-09-2014	SW9	7.1	10705	9.3	36	20	0.03	0.6								
Appendix of 2015 AEMR	15-12-2014	SW9	8	26966	10	33	37	0.05	1.52								
Appendix of 2015 AEMR	26-03-2015	SW9	4.2	763	5.2	16	5.8	0.02	1.04								
Appendix of 2015 AEMR	24-04-2015	SW9	6.2	4344	6.8	29	14	0.03	0.86								
Appendix of 2015 AEMR	17-09-2015	SW9	6.6	7381	6.8	34	14	0.03	0.83								
Appendix of 2015 AEMR	11-12-2015	SW9	7.1	5694	5.2	22	28	0.05	0.81								
Appendix of 2016 AEMR	24-03-2016	SW9	6.1	4157	6.5	13	10	0.04	0.88								
Appendix of 2016 AEMR	30-06-2016	SW9	6.6	2577.4	7.6	19	6.3	0.02	0.78								
Appendix of 2016 AEMR	29-09-2016	SW9	6.8	35815	7.4		35	<0.02	0.26								
Appendix of 2016 AEMR	20-12-2016	SW9	6.9	21421	6.9		6.4	0.04	0.82								
Number of Samples			23	23	23	12	23		22	1							
Minimum			4.2	23	2.1	4.8	5.8		0.26	1							
Maximum			8	35815	10	60	40		1.64	32							
Average			6.37	8753.93	6.87	26.82	19.86		0.88	32.00							
2011/2012 AEMR	Dec-11	SW10	6.2	492	7.5		23	0.04	0.54								
2011/2012 AEMR	Mar-12	SW10	5.7	546	4.3		31	0.03	0.73								
2011/2012 AEMR	Jun-12	SW10	6.4	805	6.7	45	22	0.07	0.86	35							
2011/2012 AEMR	27-09-2012	SW10	7.4	12749	9.4	7.7	14	0.04	0.84								
2012/2013 AEMR	Dec-12	SW10	6.7	19403	6.9		7.4	0.03	0.71								
2012/2013 AEMR	Mar-13	SW10	6.8	1025	5.6		16	0.05	0.77								
2012/2013 AEMR	Jun-13	SW10	4.8	302	5.7		30										
2012/2013 AEMR	Sep-13	SW10	7.8	2870	15		45	0.29	2.15								
2013/2014 AEMR	12-12-2013	SW10	6.8	15775	5		10	0.03	0.56								
2013/2014 AEMR	Mar-14	SW10	4.6	1454	2.2		40	0.13	1.63								
2013/2014 AEMR	31-03-2014	SW10	4.6	1454	2.2	32	40	0.13	1.63								
2013/2014 AEMR	25-06-2014	SW10	6.5	17312	7.6	37	15	0.04	0.72								
2013/2014 AEMR	Aug-14	SW10	7.2	9164	11		30	0.11	1.06								
2013/2014 AEMR	29-09-2014	SW10	7.2	9164	11	46	30	0.11	1.06								
Appendix of 2015 AEMR	15-12-2014	SW10	7.6	26936	12	33	44	0.07	1.38								
Appendix of 2015 AEMR	26-03-2015	SW10	4.2	779	5.6	14	8.0	0.06	1.08								
Appendix of 2015 AEMR	24-04-2015	SW10	6.2	4381	6.5	25	15	0.03	0.87								
Appendix of 2015 AEMR	17-09-2015	SW10	6.5	6756	7	37	21	0.04	0.98								
Appendix of 2015 AEMR	11-12-2015	SW10	6.8	17660	5.7	5.4	9	<0.02	0.33								
Appendix of 2016 AEMR	24-03-2016	SW10	5.3	2967	7.1	7.4	4.8	0.04	0.77								
Appendix of 2016 AEMR	30-06-2016	SW10	6.7	4893.3	7.1	7.1	4.8	0.02	0.61								
Appendix of 2016 AEMR	29-09-2016	SW10	6.9	35928	6.9		36	0.02	0.58								
Appendix of 2016 AEMR	20-12-2016	SW10	6.9	7210	7.8		10	0.04	0.81								
Number of Samples			23	23	23	12	23		22	1							
Minimum			4.2	23	2.2	5.4	4.8		0.33	1							
Maximum			7.8	35928	15	46	45		2.15	35							
Average			6.34	8696.75	7.21	24.72	22.00		0.94	35.00							

Longterm Pond Water Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Alkalinity as CaCO3	Bicarbonate as CaCO3	Chloride	Turbidity	TSS	Chlorophyll 'a'	Oil and Grease	Total Phosphorus-P	Total-N	Ammonia	Calcium	Magnesium	Sodium	Potassium	Sulfur as Sulfate	Aluminium (Total)	Arsenic (Total)	Iron (Total)	Manganese (Total)	
			pH	µScm-1	mg/L	mV	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2011/2012 AEMR	30-05-2012	Lake	5.8	133	8.9					190	84		<2	0.09	0.66											
2011/2012 AEMR	27-06-2012	Lake	6	143	9.4		3	2	8	34	23		4	0.04	0.38		13	1.5	6.3	<5	41	1.21	<0.005	1.01	0.03	
2011/2012 AEMR	26-07-2012	Lake	7	164	9.4					18	15		<2	0.02	0.33											
2011/2012 AEMR	27-08-2012	Lake	5.7	188	9.3	168				100	70		2	0.04	0.44											
2011/2012 AEMR	27-09-2012	Lake 1	4.6	214	8.2		<1	<1	10	7.8	11		<2	0.02			22	1.9	9	<5	65	0.47	<0.005	0.41	0.05	
2011/2012 AEMR	29-10-2012	Lake	4.2	246	8.5					2.9	4		<2	<0.02	0.09											
2012/2013 AEMR	25-11-2013	Lake	5.9	478	7					18	26		<2	0.04	0.33											
2013/2014 AEMR	12-12-2013	Lake	4.7	568	7.7	160	2	1	22	33	54		<2	0.06	0.48		75	8.6	15	5	244	8.92	<0.005	3.49	0.64	
2013/2014 AEMR	30-01-2014	Lake	4.4	650	7.9					31	41		<2	0.03	0.37											
2013/2014 AEMR	24-02-2014	Lake	4.4	780	7.7					40	45		<2	0.04	0.25											
2013/2014 AEMR	31-03-2014	Lake	4.9	800	7.5					70	63		<2	0.04	0.55											
2013/2014 AEMR	28-04-2014	Lake	4.4	874						33	30		<2	0.03	0.17											
2013/2014 AEMR	28-05-2014	Lake	4.1	895	9.2					42	30		<2	<0.02	0.27											
2013/2014 AEMR	25-06-2014	Lake	3.8	916	9.4		<1	<1	35	72	53		<2	0.08	0.37		109	16	23	6	413	26	<0.005	12	1.05	
2013/2014 AEMR	30-07-2014	Lake	4.3	917						79	44		<2	0.02	0.44											
2013/2014 AEMR	29-08-2014	Lake	4.5	960						138	187		5	0.05	0.81											
2013/2014 AEMR	29-09-2014	Lake	3.8	971	8		<1	<1		68	58			0.03	0.58											
Appendix of 2015 AEMR	28-11-2014	Lake	4	998	8.3					70	101		<2	0.07	0.5											
Appendix of 2015 AEMR	15-12-2014	Lake	4.4	1005	8		NP	<1	40	119	167		<2	0.14	0.31		159	18	29	7	394	33	0.008	11	1.23	
Appendix of 2015 AEMR	22-01-2015	Lake 1	4.4	1029	7.4	204				78	96		<2	0.05	0.32											
Appendix of 2015 AEMR	25-02-2015	Lake 1	4.2	960	7					85	89		<2	0.08	0.6											
Appendix of 2015 AEMR	26-03-2015	Lake 1	4.1	853	7.5		NP	NP	38	34	55		<2	0.25	0.42		92	12	22	6	369	24.2	0.003	5.61	1.03	
Appendix of 2015 AEMR	24-04-2015	Lake	4.3	963	8.5					59	95		<2	0.1	0.73											
Appendix of 2015 AEMR	28-05-2015	Lake	4.4	927	9					52	85		<2	0.22	0.44											
Appendix of 2015 AEMR	17-09-2015	Lake	4.5	928	8.9		NP		35	56	61	6	<2	0.1	0.43	0.08	117	13	25	8	361	19.3	0.003	6.7	0.953	
Appendix of 2015 AEMR	21-10-2015	Lake	4.4	955	7.8					56	100		<2	0.08	0.28											
Appendix of 2015 AEMR	25-11-2015	Lake	3.7	996	7.7					5.1	4		<2	0.03	0.16											
Appendix of 2015 AEMR	11-12-2015	Lake 1	4.2	956	6.8		<1	<1	45	20	39		<2	0.39	0.57		111	13	29	9	429	14.3	0.004	2.54	0.896	
Appendix of 2016 AEMR	25-01-2016	Pond	3.9	1002	7.3					7.9			6													
Appendix of 2016 AEMR	24-02-2016	Pond	4	1021	7.4					6.1			2													
Appendix of 2016 AEMR	24-03-2016	Pond	3.9	1060	7.9					7.2			2	0.07	0.12		112.71	14.14	43.28	9.32	382.38	10.93	0.002	1.24	0.88	
Appendix of 2016 AEMR	29-04-2016	Pond	4.4	1037	8.6					7.7			2													
Appendix of 2016 AEMR	24-05-2016	Pond	4.9	1029	8.4					4			4													
Appendix of 2016 AEMR	30-06-2016	Pond	4.7	518.9	9.8					4		16	2	0.02	0.31	<0.02	57.45	7.218	24.38	5.39	185.14	4.51	0.002	0.41	0.56	
Appendix of 2016 AEMR	21-07-2016	Pond	4.5	546.4	9.3					1.2			0													
Appendix of 2016 AEMR	31-08-2016	Pond	4	618	9.1					2			2													
Appendix of 2016 AEMR	29-09-2016	Pond	4.1	651	8.7					2.6		10	2			<0.02		7.9	27	6	220	2.83	0.002	0.41	0.39	
Appendix of 2016 AEMR	27-10-2016	Pond	4	684	8.4					7.2			2													
Appendix of 2016 AEMR	29-11-2016	Pond	3.8	714	8					1.7			2													
Appendix of 2016 AEMR	20-12-2016	Pond	3.5	742	7.3					2.8		2	2	<0.02	0.19	0.03		9.3	29	7	251	4.01	0.001	0.71	0.48	
2017 Q1 Env Mon report	30-01-2017	Pond	3.6	758	7.2					2.6			<2													
2017 Q1 Env Mon report	27-02-2017	Pond	3.5	858	7.7					2.4			<2													
2017 Env Monitoring	22-03-2017	Pond	3.4	979	8.2		<5		67	2.2			<5.0	<0.05	0.01	0.013		10	46	7	260	5.6	<0.001	1.7	0.57	
2017 Env Monitoring	19-04-2017	Pond	6.5	84	7.6					400			<5.0													
2017 Env Monitoring	17-05-2017	Pond	5.9	101	8.1					230			<5.0													
2017 Env Monitoring	14-06-2017	Pond	4.8	115	9.5		<5		8	100			<5.0	0.07	0.07	0.03		2	7	2	25	0.17	<0.001	0.04	0.12	
2017 Env Monitoring	12-07-2017	Pond	4.3	153	9.2					5.5			<5.0													
2017 Env Monitoring	09-08-2017	Pond	4.2	171	9.9					3.4			<5.0													
2017 Env Monitoring	06-09-2017	Pond	4.2	183	6.6		<5		11	3.2			<5.0	<0.05	0.3	<0.005		2	8	2	47	0.35	<0.001	0.085	0.18	
2017 Env Monitoring	04-10-2017	Pond	4.3	229	8.6					1.6			<5.0													
2017 Env Monitoring	01-11-2017	Pond	4.1	271	8					2.9			<5.0													
2017 Env Monitoring	29-11-2017	Pond	4.3	303	7.6					4			<5.0													
2017 Env Monitoring	28-12-2017	Pond	4.1	339	7.8				16	1			<5.0	<0.05	<0.1	<0.005		3.7	11	3	84	0.6	<0.001	0.12	0.23	
2018 Env Monitoring	24-01-2018	Dam 1	4.02	361	8.3					2.1		<1	<5													
2018 Env Monitoring	21-02-2018	Dam 1	3.96	367	8.74					2.1		<1	<5													
2018 Env Monitoring	21-03-2018	Dam 1	4.05	395	8.61		<5		21	2.42		<1	<5	<0.05	<0.1	<0.005		5	14	3.6	99	0.88	<0.001	0.088	0.25	
2018 Env Monitoring	18-04-2018	Dam 1	4.6	373	8.18					4.64		1	<5													
2018 Env Monitoring	16-05-2018	Dam 1	4.12	346	8.38					2.27		<1	<5													
2018 Env Monitoring	13-06-2018	Dam 1	4.21	366	9.18		<5		21	2.87		<1	<5	<0.05	<0.1	<0.005		4.9	14	3.6	110	0.62	<0.001	0.1	0.25	
2018 Env Monitoring	11-07-2018	Dam 1	4.13	324	9.69					4.17		<1	<5													
2018 Env Monitoring	08-08-2018	Dam 1	4.08	384	9.38					5.3		<1	<5													
2018 Env Monitoring	05-09-2018	Dam 1	6.73	382	99.2	138				21		<1	<5	0.02		0.04										
2018 Env Monitoring	05-10-2018	Dam 1																								
2018 Env Monitoring	06-11-2018	Dam 1	4.25	560	104	3520				0.2	<5															
2018 Env Monitoring	07-12-2018	Dam 1	4.42	540	99.8	350	1			86		<1	<5	0.18		0.01		9	45	4	135	0.72	<0.002	0.07	0.243	
		Minimum	3.4	84	6.6	138	1	1	8	0.2	4	1	0	0.02	0.01	0.01	13	1.5	6.3	2	25	0.17	0.001	0.04	0.03	
		Maximum	7	1060	104	3520	3	2	86	400	187	16	6	0.39	33	0.08	159									

Longterm Pond Water Layer Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Turbidity	TSS	Total Phosphorus-P	Total-N
			pH	µScm-1	mg/L	mV	NTU	mg/L	mg/L	mg/L
2011/2012 AEMR	27-06-2012	Lake 2m	6.1	144	9.4	257				
2011/2012 AEMR	27-09-2012	Lake 2m	4.6	214	8.2		2.2	4.5	0.02	
Appendix of 2015 AEMR	26-03-2015	Lake 2m	4.0	859	7.6	280				
Appendix of 2015 AEMR	17-09-2015	Lake 2m	4.5	915	8.8	185				
Appendix of 2015 AEMR	11-12-2015	Lake 2m	4.2	952	7.2		19	44	0.13	0.13
Appendix of 2016 AEMR	24-03-2016	Lake 2m	4.3	1011	8					
Appendix of 2016 AEMR	30-06-2016	Lake 2m	4.8	527.6	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 2m	4.1	647	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 2m	3.5	742	7.4					
No of Samples			9	9	9	3	2	2	2	1
Minimum			3.5	144	7.2	185	2.2	4.5	0.02	0.13
Maximum			6.1	1011	9.9	280	19	44	0.13	0.13
Average			4.46	667.96	8.37	240.67	10.60	24.25	0.08	0.13
2011/2012 AEMR	27-06-2012	Lake 3m	6.1	144	9.5	267				
2011/2012 AEMR	27-09-2012	Lake 3m	4.6	214	8.2		14	30	0.03	
Appendix of 2015 AEMR	26-03-2015	Lake 3m	4.0	859	7.5	297				
Appendix of 2015 AEMR	17-09-2015	Lake 3m	4.5	915	8.7	200				
Appendix of 2015 AEMR	11-12-2015	Lake 3m	4.2	949	7.2		19	96	0.07	0.07
Appendix of 2016 AEMR	24-03-2016	Lake 3m	4.4	1014	8.1					
Appendix of 2016 AEMR	30-06-2016	Lake 3m	4.9	510.8	9.8					
Appendix of 2016 AEMR	29-09-2016	Lake 3m	4.1	650	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 3m	3.6	742	7.7					
No of Samples			9	9	9	3	2	2	2	1
Minimum			3.6	144	7.2	200	14	30	0.03	0.07
Maximum			6.1	1014	9.8	297	19	96	0.07	0.07
Average			4.49	666.42	8.39	254.67	16.50	63.00	0.05	0.07
2011/2012 AEMR	27-06-2012	Lake 4m	6.2	144	9.6	264				
2011/2012 AEMR	27-09-2012	Lake 4m	4.6	213	8.2		5.8	9.2	0.02	
Appendix of 2015 AEMR	26-03-2015	Lake 4m	4.0	860	7.5	312				
Appendix of 2015 AEMR	17-09-2015	Lake 4m	4.5	915	8.7	200				
Appendix of 2015 AEMR	11-12-2015	Lake 4m	4.2	952	7.5		16	102	0.06	0.06
Appendix of 2016 AEMR	24-03-2016	Lake 4m	4.3	1.11	7.9					
Appendix of 2016 AEMR	30-06-2016	Lake 4m	4.8	517.4	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 4m	4	648	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 4m	3.6	742	7.7					
No of Samples			9	9	9	3	2	2	2	1
Minimum			3.6	1.11	7.5	200	5.8	9.2	0.02	0.06
Maximum			6.2	952	9.9	312	16	102	0.06	0.06
Average			4.47	554.72	8.42	258.67	10.90	55.60	0.04	0.06
2011/2012 AEMR	27-06-2012	Lake 5m	6.5	144	9.5	261				
Appendix of 2015 AEMR	26-03-2015	Lake 5m	4.0	864	7.5	316				
Appendix of 2015 AEMR	17-09-2015	Lake 5m	4.4	913	8.7	210				
Appendix of 2015 AEMR	11-12-2015	Lake 5m	4.1	954	7.7		12	22	0.06	0.06
Appendix of 2016 AEMR	24-03-2016	Lake 5m	4.7	1019	8.1					
Appendix of 2016 AEMR	30-06-2016	Lake 5m	4.8	515.5	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 5m	4	647	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 5m	3.6	742	7.6					
No of Samples			8	8	8	3	1	1	1	1
Minimum			3.6	144	7.5	210	12	22	0.06	0.06
Maximum			6.5	1019	9.9	316	12	22	0.06	0.06
Average			4.51	724.81	8.48	262.33	12.00	22.00	0.06	0.06
Appendix of 2016 AEMR	30-06-2016	Lake 6m	5.2	516.6	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 6m	4.5	627	8.4					
Appendix of 2016 AEMR	20-12-2016	Lake 6m	3.6	740	7.4					
No of Samples			3	3	3					
Minimum			3.6	516.6	7.4					
Maximum			5.2	740	9.9					
Average			4.43	627.87	8.57					

Longterm Algae Monitoring at Dunloe Sands Quarry

Data located	Date	Location	Cyanophyta (Blue Green Algae)	Chlorophyta (Total Algae Count)	Diatoms (Bacillariophyta)	Dinophyta (Dinoflagellates)	Euglenophyta (Euglenoids)
			cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
2011/2012 AEMR	30-11-2011	Extraction Pond	240				
2011/2012 AEMR	22-12-2012	Extraction Pond	800				
2011/2012 AEMR	02-02-2012	Extraction Pond	<100				
2011/2012 AEMR	20-02-2012	Extraction Pond	700				
2011/2012 AEMR	28-02-2012	Extraction Pond	14375				
2011/2012 AEMR	27-03-2012	Extraction Pond	1200				
2011/2012 AEMR	30-05-2012	Extraction Pond	<100				
2011/2012 AEMR	27-06-2012	Extraction Pond	130	0.01			
2011/2012 AEMR	26-07-2012	Extraction Pond	16360	2520			
2011/2012 AEMR	27-08-2012	Extraction Pond	24640	3720			
2011/2012 AEMR	27-09-2012	Extraction Pond	68000	35000			
2011/2012 AEMR	29-10-2012	Extraction Pond	<100	7900			
2012/2013 AEMR	28-11-2012	Extraction Pond	<100	80670			
2012/2013 AEMR	24-12-2012	Extraction Pond	<100				
2012/2013 AEMR	17-01-2013	Extraction Pond	<100				
2012/2013 AEMR	01-02-2013	Extraction Pond	<100				
2012/2013 AEMR	15-02-2013	Extraction Pond	<100				
2012/2013 AEMR	08-03-2013	Extraction Pond	<100	215			
2012/2013 AEMR	30-05-2013	Extraction Pond	<100	880			
2012/2013 AEMR	30-06-2013	Extraction Pond	<100				
2012/2013 AEMR	30-07-2013	Extraction Pond	<100	34000			
2012/2013 AEMR	28-08-2013	Extraction Pond	<100	205			
2012/2013 AEMR	30-09-2013	Extraction Pond	<100				
2012/2013 AEMR	25-10-2013	Extraction Pond	<100	17430			
2013/2014 AEMR	25-11-2013	Extraction Pond				480	
2013/2014 AEMR	12-12-2013	Extraction Pond	1150	39500			
2013/2014 AEMR	19-12-2013	Extraction Pond		22000			
2013/2014 AEMR	09-01-2014	Extraction Pond		123000			
2013/2014 AEMR	29-01-2014	Extraction Pond		34000			
2013/2014 AEMR	31-03-2014	Extraction Pond			295		
2013/2014 AEMR	28-04-2014	Extraction Pond		7700	45		
2013/2014 AEMR	29-05-2014	Extraction Pond	ND	7600			
2013/2014 AEMR	26-06-2014	Extraction Pond	ND	52000			
2013/2014 AEMR	31-07-2014	Extraction Pond	ND	28000			
2013/2014 AEMR	28-10-2014	Extraction Pond	ND	168000			
Appendix of 2015 AEMR	28-11-2014	Extraction Pond	ND	123000	260	60	
Appendix of 2015 AEMR	16-12-2014	Extraction Pond	ND	106500	220	35	
Appendix of 2015 AEMR	22-01-2015	Extraction Pond	ND	37000			
Appendix of 2015 AEMR	26-02-2015	Extraction Pond	ND				
Appendix of 2015 AEMR	26-03-2015	Extraction Pond	ND	8750			
Appendix of 2015 AEMR	24-04-2015	Extraction Pond	ND	8000			
Appendix of 2015 AEMR	29-05-2015	Extraction Pond	ND	76000	4200		
Appendix of 2015 AEMR	29-06-2015	Extraction Pond	ND	211000	6300		
Appendix of 2015 AEMR	21-10-2015	Extraction Pond	ND	18330	65	35	155
Appendix of 2015 AEMR	26-11-2015	Extraction Pond	ND	4850		5	
Appendix of 2015 AEMR	11-12-2015	Extraction Pond	ND	11900	30	10	
2016 AEMR	25-01-2016	Extraction Pond	ND	34000			
2016 AEMR	08-02-2016	Extraction Pond	ND	0			
2016 AEMR	24-02-2016	Extraction Pond	ND	3700			
2016 AEMR	10-03-2016	Extraction Pond	ND	1575			
2016 AEMR	24-03-2016	Extraction Pond	ND	7600			
2016 AEMR	07-04-2016	Extraction Pond	ND	9700			
2016 AEMR	29-04-2016	Extraction Pond	ND	11800			
2016 AEMR	24-05-2016	Extraction Pond	ND	5700			
2016 AEMR	30-06-2016	Extraction Pond	ND	28930			
2016 AEMR	31-08-2016	Extraction Pond	840	61500			
2016 AEMR	30-09-2016	Extraction Pond	ND	920			
2016 AEMR	04-10-2016	Extraction Pond	ND	920			
2016 AEMR	28-10-2016	Extraction Pond	ND	29000			
2016 AEMR	21-12-2016	Extraction Pond	ND	10830			
2017 Q1 Env Mon report	30-01-2017	Extraction Pond	ND	1480			
2017 Q1 Env Mon report	27-02-2017	Extraction Pond	ND	640			
2017 Env Monitoring	22-03-2017	Extraction Pond	ND	175			
2017 Env Monitoring	19-04-2017	Extraction Pond	ND	600			
2017 Env Monitoring	17-05-2017	Extraction Pond	ND	2820			
2017 Env Monitoring	14-06-2017	Extraction Pond	ND	1830			
2017 Env Monitoring	12-07-2017	Extraction Pond	ND	5260			
2017 Env Monitoring	09-08-2017	Extraction Pond	ND	41500			
2017 Env Monitoring	06-09-2017	Extraction Pond	ND	99800			
2017 Env Monitoring	04-10-2017	Extraction Pond	ND	128000			
2017 Env Monitoring	01-11-2017	Extraction Pond	ND	38600			
2017 Env Monitoring	29-11-2017	Extraction Pond	ND	8150			
2017 Env Monitoring	28-12-2017	Extraction Pond	ND	1890			
2018 Env Monitoring	24-01-2018	Extraction Pond	<5	350			
2018 Env Monitoring	21-02-2018	Extraction Pond	<5	100			
2018 Env Monitoring	21-03-2018	Extraction Pond	<5	3,960			
2018 Env Monitoring	18-04-2018	Extraction Pond	<5	4,580			
2018 Env Monitoring	16-05-2018	Extraction Pond	<5	250			
2018 Env Monitoring	13-06-2018	Extraction Pond	<5	5,820			
2018 Env Monitoring	11-07-2018	Extraction Pond	<5	16,100			
2018 Env Monitoring	08-08-2018	Extraction Pond	<5	13,800			
2018 Env Monitoring	05-09-2018	Extraction Pond	ND	ND			
2018 Env Monitoring	05-10-2018	Extraction Pond	<5	ND			
2018 Env Monitoring	06-11-2018	Extraction Pond	ND	ND			
2018 Env Monitoring	07-12-2018	Extraction Pond	ND	ND			
Number of Samples			11	65	8	6	1
Minimum			130	0	30	5	155
Maximum			68000	211000	6300	480	155
Average			11675.9	28485.4	1426.9	104.2	155.0

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

2011/2012 AEMR	Dec-11	DPL3							2300				72	119	842	72	136		<0.005	0.74	0.53
2011/2012 AEMR	Mar-12	DPL3							2400				66	109	1081	<5	126		<0.005	1.25	0.51
2011/2012 AEMR	30-05-2012	DPL3	6.6	7074	2.3	317															
2011/2012 AEMR	Jun-12	DPL3	6.7	7057	6.6	315	150	94	2220				70	112	1119	48	143		<0.005	1.94	0.53
2011/2012 AEMR	26-07-2012	DPL3	6.6	7093	3.6	284															
2011/2012 AEMR	27-08-2012	DPL3	6.7	7343	1.8	193															
2011/2012 AEMR	27-09-2012	DPL3	6.4	7130	2.4	249	120	75	2280				63	100	1060	50	147		<0.005	2.11	0.51
2011/2012 AEMR	29-10-2012	DPL3	6.3	7177	4.8	146															
2012/2013 AEMR	Dec-12	DPL3							2270				68	103	946	61	132		<0.005	2.46	0.52
2012/2013 AEMR	Mar-13	DPL3							2280				74	115	1296	48	149		<0.005	1.78	0.58
2012/2013 AEMR	Jun-13	DPL3							2310				66	105	66	44	169		<0.005	1.63	0.52
2012/2013 AEMR	Sep-13	DPL3							2280				60	93	1003	38			<0.005	3.05	0.52
2013/2014 AEMR	12-12-2013	DPL3	6.2	7140	2.4	116	120	73	2340				66	104	104	43	168		<0.005	3.16	0.57
2013/2014 AEMR	29-01-2014	DPL3	6.3	6964	4.4	201															
2013/2014 AEMR	24-02-2014	DPL3	6.3	6677	3.6	245															
2013/2014 AEMR	31-03-2014	DPL3	6.4	7234	4.2	118	120	74	120				63	109	109	43	175		<0.005	2.86	0.56
2013/2014 AEMR	24-04-2014	DPL3	6.5	7448		136															
2013/2014 AEMR	28-05-2014	DPL3	6.6	7484		318															
2013/2014 AEMR	25-06-2014	DPL3	6.6	7370	5.9	260	110	70	2290				82	125	1320	44	180		<0.005	6.47	0.93
2013/2014 AEMR	30-07-2014	DPL3	6.6	7431	4.9	122	110	66	2420				74	114	1200	46	177	0.03	<0.005	3.97	0.58
2013/2014 AEMR	29-08-2014	DPL3	6.5	7643	3.9	184	110	68	2370				71	110	1140	43	168		<0.005	4.22	0.56
2013/2014 AEMR	29-09-2014	DPL3	6.1	7558	3	188															
Appendix of 2015 AEMR	28-11-2014	DPL3	6.1	7491	4.2	100															
Appendix of 2015 AEMR	15-12-2014	DPL3	6.2	7280	2.6	130	130	77	2370				82	118	1240	48	146	0.04	<0.005	3.53	0.59
Appendix of 2015 AEMR	22-01-2015	DPL3	6.1	7473	2.2	136															
Appendix of 2015 AEMR	25-02-2015	DPL3	6.4	7478	3.2	150															
Appendix of 2015 AEMR	26-03-2015	DPL3	6.1	7542	2.9	195	130	128													
Appendix of 2015 AEMR	24-04-2015	DPL3	6.6	7540	4.8	246															
Appendix of 2015 AEMR	28-05-2015	DPL3	6.5	7483	5.2	182															
Appendix of 2015 AEMR	17-09-2015	DPL3	6.4	7422	3.7	150	120		2380	0.04			68	102	1220	41	152	0.22	<0.001	3.09	0.641
Appendix of 2015 AEMR	21-10-2015	DPL3	6.2	7310	2.4	157															
Appendix of 2015 AEMR	25-11-2015	DPL3	6.2	7562	6.9	205															
Appendix of 2015 AEMR	11-12-2015	DPL3	6.3	7321	2.6	182	120	120	2370				68	108	1220	40	181	0.13	0.001	2.99	6.23
Appendix of 2016 AEMR	25-01-2016	DPL3	6.1	7395	2.8	147															
Appendix of 2016 AEMR	24-02-2016	DPL3	6.2	7372	5.7	58															
Appendix of 2016 AEMR	24-03-2016	DPL3	6.4	7406	3.5	155	123	123	2650				78.03	117.11	1284.98	44.19	176.114	0.07	0.001	2.183	0.625
Appendix of 2016 AEMR	29-04-2016	DPL3	6.4	7417	6.4	196															
Appendix of 2016 AEMR	24-05-2016	DPL3	6.5	7394	5.4	180															
Appendix of 2016 AEMR	30-06-2016	DPL3	6.6	7250.2	6.4	180															
Appendix of 2016 AEMR	21-07-2016	DPL3	6.5	6868.2	6.6	262															
Appendix of 2016 AEMR	31-08-2016	DPL3	6.5	7281	5.8	170	121		2650				78	121	1350	46	170		0.001	3.33	0.541
Appendix of 2016 AEMR	29-09-2016	DPL3	6.1	7313	2.5	221															
Appendix of 2016 AEMR	27-10-2016	DPL3	6.1	7313	3.99	1738															
Appendix of 2016 AEMR	29-11-2016	DPL3	6.1	7376	1.8	67															
Appendix of 2016 AEMR	20-12-2016	DPL3	6	7673	4	315.9	121		2700				75	114	1.28	43	182		0.001	2.4	0.541
Q1 2017 Env mon report	30-01-2017	DPL3	6.1	7119																	
Q1 2017 Env mon report	27-02-2017	DPL3	6.1	7013																	
2017 Env Monitoring	22-03-2017	DPL3	5.9	7570			130		2300	0.1	4.1	2.9		130	1500	54	230	0.04	<0.001	15	0.67
2017 Env Monitoring	19-04-2017	DPL3	5.9	7660																	
2017 Env Monitoring	17-05-2017	DPL3	5.9	7410																	
2017 Env Monitoring	14-06-2017	DPL3																			
2017 Env Monitoring	12-07-2017	DPL3	6.2	7060																	
2017 Env Monitoring	09-08-2017	DPL3	6.2	7490																	
2017 Env Monitoring	06-09-2017	DPL3	6.1	7490			140		2000	<0.05	3	2		120	1600	55	140	0.04	<0.001	2.8	0.6
2017 Env Monitoring	04-10-2017	DPL3	6	7530																	
2017 Env Monitoring	01-11-2017	DPL3	5.9	7970																	
2017 Env Monitoring	29-11-2017	DPL3	5.9	7680																	
2017 Env Monitoring	28-12-2017	DPL3	6	7570			130		2400	0.05	3.8	2.8		130	1700	53	190	0.09	<0.001	13	0.62
2018 Env Monitoring	24-01-2018	DPL3	5.94	7640																	
2018 Env Monitoring	21-02-2018	DPL3	5.94	7240																	
2018 Env Monitoring	21-03-2018	DPL3	5.87	8230			140		2500	<0.05	3.7	2.9		150	1400	53	200	0.09	<0.001	9.9	0.64
2018 Env Monitoring	18-04-2018	DPL3	5.94	7580																	
2018 Env Monitoring	16-05-2018	DPL3	5.97	7670																	
2018 Env Monitoring	13-06-2018	DPL3	6.02	7930			130		2300	<0.05	4.1	2.7		120	1500	56	180	0.08	<0.001	11	0.61
2018 Env Monitoring	11-07-2018	DPL3	6.18	7280																	
2018 Env Monitoring	08-08-2018	DPL3	6.1	7880																	
2018 Env Monitoring	05-09-2018	DPL3	5.38	3760	69.8	211	134		2760			2.46		137	1380	49	191	0.66	0.002	24	0.715
2018 Env Monitoring	05-10-2018	DPL3	5.87	7540	7.8																
2018 Env Monitoring	06-11-2018	DPL3	5.81	7580																	
2018 Env Monitoring	07-12-2018	DPL3	5.82	7520	3.4		151		2470			2.29		118	130	45	158	0.32	<0.001	12.9	0.658
No of Samples			63	63	40	40	21	11	26	2	5	8	19	26	26	25	25	12	5	26	26
Minimum			5.38	3760	1.8	58	110	66	120	0.05	3	0.04	60	93	1.28	38	126	0.03	0.001	0.74	0.51
Maximum			6.7	8230	399	1738	151	128	2760	0.1	4.1	2.9	82	150	1700	72	230	0.66	0.002	24	6.23
Average			6.21	7352.31	15.64	228.15	126.67	88.00	2297.31	0.08	3.74	2.26	70.74	115.50	1031.24	48.29	166.64	0.15	0.00	5.45	0.81

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

2011/2012 AEMR	Dec-11	DPL5																			
2011/2012 AEMR	Mar-12	DPL5						14				0.5	1	9.1	<5	5.9		<0.005	2.51	<0.01	
2011/2012 AEMR	30-05-2012	DPL5	4.7	92	4.6	386															
2011/2012 AEMR	Jun-12	DPL5	4.8	81	6.6	347	2	1	17			0.6	1.3	9.2	<5	4.3		<0.005	1.01	<0.01	
2011/2012 AEMR	26-07-2012	DPL5	4.7	92	3.7	313															
2011/2012 AEMR	27-08-2012	DPL5	4.6	103	3.4	292															
2011/2012 AEMR	27-09-2012	DPL5	4.5	102	2.6	266	<1	<1	19			0.7	1.4	10	<5	8.5		<0.005	0.89	<0.01	
2011/2012 AEMR	29-10-2012	DPL5	4.4	108	2.2	288															
2012/2013 AEMR	Dec-12	DPL5							18			0.6	1.2	5.9	<5	3.5		<0.005	2.16	<0.01	
2012/2013 AEMR	Mar-13	DPL5							12			0.5	1.3	8.2	<5	4		<0.005	0.09	<0.01	
2012/2013 AEMR	Jun-13	DPL5							30			0.7	1.9	0.7	<5	8.2		<0.005	0.31	<0.01	
2012/2013 AEMR	Sep-13	DPL5							640			13	40	243	9			<0.005	15	0.14	
2013/2014 AEMR	12-12-2013	DPL5	4.8	334	2.3	106	3	2	89			2.3	7.2	7.2	<5	15		<0.005	4.81	0.04	
2013/2014 AEMR	29-01-2014	DPL5	4.9	314	4.2	161															
2013/2014 AEMR	24-02-2014	DPL5	4.1	337	4.1	255															
2013/2014 AEMR	31-03-2014	DPL5	5	359	3.3	107	2	1	110			2.4	6.3	6.3	<5	12		<0.005	3.52	<0.01	
2013/2014 AEMR	24-04-2014	DPL5	4.7	110		84															
2013/2014 AEMR	28-05-2014	DPL5	4	239		313															
2013/2014 AEMR	25-06-2014	DPL5	3.6	566	2.1	375	<1	<1	140			4.2	9.9	64	<5	9.8		<0.005	1.73	0.05	
2013/2014 AEMR	30-07-2014	DPL5	3.7	639	4.6	238	<1	<1	140			13	11	69	<5	47	3.96	<0.005	2	0.11	
2013/2014 AEMR	29-08-2014	DPL5	3.9	678	2.7	215	NP	NP	170			4.9	12	75	<5	16		<0.005	11	0.03	
2013/2014 AEMR	29-09-2014	DPL5	3.8	942	1.8	247															
Appendix of 2015 AEMR	28-11-2014	DPL5	4.9	706	2.7	105															
Appendix of 2015 AEMR	15-12-2014	DPL5	5.2	801	2	115	5	3	220			6.2	15	110	<5	11	0.3	<0.005	14	0.08	
Appendix of 2015 AEMR	22-01-2015	DPL5	5	811	3.8	160															
Appendix of 2015 AEMR	25-02-2015	DPL5	4	433	6.2	178															
Appendix of 2015 AEMR	26-03-2015	DPL5	4.8	1066	3.9	144	2	2													
Appendix of 2015 AEMR	24-04-2015	DPL5	3.7	963	4.8	257															
Appendix of 2015 AEMR	28-05-2015	DPL5	3.8	611	2.5	325															
Appendix of 2015 AEMR	17-09-2015	DPL5	3.9	844	2.4	205	NP		220	0.18		5.5	9.6	113	<5	23	0.67	<0.001	1.4	0.055	
Appendix of 2015 AEMR	21-10-2015	DPL5	4.3	676	5.4	189															
Appendix of 2015 AEMR	25-11-2015	DPL5	5.2	390	6	135															
Appendix of 2015 AEMR	11-12-2015	DPL5	5.4	310	2.3	151	7	7	80			2.2	3.9	41	<5	12	0.13	<0.001	7.21	0.027	
Appendix of 2016 AEMR	25-01-2016	DPL5	5.6	376	3.1	113															
Appendix of 2016 AEMR	24-02-2016	DPL5	5.6	335	2.9	76															
Appendix of 2016 AEMR	24-03-2016	DPL5	5.3	412	2.4	186	6	6	112			2.99	3.88	42.05	<5	13.372	0.148	<0.001	4.597	0.022	
Appendix of 2016 AEMR	29-04-2016	DPL5	4.6	285	6.2	259															
Appendix of 2016 AEMR	24-05-2016	DPL5	4.5	300	4.7	195															
Appendix of 2016 AEMR	30-06-2016	DPL5	4.3	385.7	2.9	271															
Appendix of 2016 AEMR	21-07-2016	DPL5	4.4	321.5	5.2	297															
Appendix of 2016 AEMR	31-08-2016	DPL5	4.4	348	4.4	230	<1		89			2.2	2.8	57	<5	28		0.001	11.2	0.012	
Appendix of 2016 AEMR	29-09-2016	DPL5	4.4	399	2.5	285															
Appendix of 2016 AEMR	27-10-2016	DPL5	4.4	399	2.5	285															
Appendix of 2016 AEMR	29-11-2016	DPL5	5.4	5.4	1.6	74															
Appendix of 2016 AEMR	20-12-2016	DPL5	5.2	298	3.3	244.5	5		50			2.3	2.8	47	<5	21		0.001	4.55	0.012	
Q1 2017 Env mon report	30-01-2017	DPL5	5.2	260																	
Q1 2017 Env mon report	27-02-2017	DPL5	5.5	244																	
2017 Env Monitoring	22-03-2017	DPL5	5.1	300			<5		63	0.1	1	0.1		2	55	1	22	0.2	<0.001	1.5	0.009
2017 Env Monitoring	19-04-2017	DPL5	5.1	203																	
2017 Env Monitoring	17-05-2017	DPL5	5.1	226																	
2017 Env Monitoring	14-06-2017	DPL5																			
2017 Env Monitoring	12-07-2017	DPL5	5.2	189																	
2017 Env Monitoring	09-08-2017	DPL5	5.1	200																	
2017 Env Monitoring	06-09-2017	DPL5	5.2	179			8		26	<0.05	1.3	0.055		<0.5	35	0.7	18	0.54	<0.001	0.23	<0.005
2017 Env Monitoring	04-10-2017	DPL5	5.3	188																	
2017 Env Monitoring	01-11-2017	DPL5	5.3	197																	
2017 Env Monitoring	29-11-2017	DPL5	5	480																	
2017 Env Monitoring	28-12-2017	DPL5	4.5	2200			<5		640	<0.05	0.6	0.24		41	450	6.8	79	2.4	<0.001	7.2	0.11
2018 Env Monitoring	24-01-2018	DPL5	4.42	2470																	
2018 Env Monitoring	21-02-2018	DPL5	4.53	1392																	
2018 Env Monitoring	21-03-2018	DPL5	4.58	1461			11		370	<0.05	0.4	0.14		25	230	5.1	59	1.2	<0.001	4.2	0.066
2018 Env Monitoring	18-04-2018	DPL5	4.88	266																	
2018 Env Monitoring	16-05-2018	DPL5	4.78	486																	
2018 Env Monitoring	13-06-2018	DPL5	4.69	406			<5		96	<0.05	0.4	0.098		4.8	66	2.1	15	0.28	<0.001	2.1	0.019
2018 Env Monitoring	11-07-2018	DPL5	4.73	623																	
2018 Env Monitoring	08-08-2018	DPL5	4.61	252																	
2018 Env Monitoring	05-09-2018	DPL5	4.67	1880			4		112			0.12		7	58	2	14	0.36	<0.001	3.11	0.0029
2018 Env Monitoring	05-10-2018	DPL5	4.96	201																	
2018 Env Monitoring	06-11-2018	DPL5	4.99	296																	
2018 Env Monitoring	07-12-2018	DPL5	4.84	437																	
		No of Samples	63	63	37	40	12	7	25	1	5	8	18	24	25	8	24	12	2	25	17
		Minimum	3.6	5.4	1.6	-112.6	2	1	12	0.1	0.4	0.055	0.5	1	0.7	0.7	3.5	0.13	0.001	0.09	0.0029
		Maximum	5.6	2470	6.6	386	11	7	640	0.1	1.3	0.24	13	41	450	9	79	3.96	0.001	15	0.14
		Average	4.71	501.71	3.56	209.00	4.75	3.14	145.32	0.10	0.74	0.14	3.60	9.18	75.67	3.59	19.57	0.87	0.00	4.40	0.05

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

2011/2012 AEMR	Dec-11	DPL6						14				2.7	3.6	4.9	<5	37		<0.005	9.48	0.02	
2011/2012 AEMR	Mar-12	DPL6						14				3.3	4.5	8.4	<5	42		<0.005	17	0.02	
2011/2012 AEMR	30-05-2012	DPL6	3.8	302	1	464															
2011/2012 AEMR	Jun-12	DPL6	4	324	2.8	345	<1	<1	14			7.3	12	10	<5	104		<0.005	17	0.11	
2011/2012 AEMR	26-07-2012	DPL6	4.6	331	3.3	14															
2011/2012 AEMR	27-08-2012	DPL6	4.4	419	2	84															
2011/2012 AEMR	27-09-2012	DPL6	4.3	363	2.2	279	<1	<1	15			11	14	12	<5	130		<0.005	24	0.16	
2011/2012 AEMR	29-10-2012	DPL6	4.4	425	4.9	127															
2012/2013 AEMR	Dec-12	DPL6						15				4.7	4.7	13	<5	63		<0.005	15	0.07	
2012/2013 AEMR	Mar-13	DPL6						14				3.6	2.5	11	<5	34		<0.005	20	0.07	
2012/2013 AEMR	Jun-13	DPL6						18				3.1	2.1	3.1	<5	40		<0.005	15	0.04	
2012/2013 AEMR	Sep-13	DPL6						16				2.4	1.6	11	<5			<0.005	10	0.04	
2013/2014 AEMR	12-12-2013	DPL6	5.2	162	4.4	42	10	6	20			4.5	1.5	1.5	<5	30		<0.005	10	0.06	
2013/2014 AEMR	29-01-2014	DPL6	4.2	210	5.3	269															
2013/2014 AEMR	24-02-2014	DPL6	4.2	228	4.5	268															
2013/2014 AEMR	31-03-2014	DPL6	4.8	165	2.5	130	3	2	22			5.6	1.8	1.8	<5	34		<0.005	10.5	0.06	
2013/2014 AEMR	24-04-2014	DPL6	5	156		162															
2013/2014 AEMR	28-05-2014	DPL6	3.8	198		343															
2013/2014 AEMR	25-06-2014	DPL6	3.2	497	6.1	440	<1	<1	17			7	4.5	16	<5	119		<0.005	13	0.2	
2013/2014 AEMR	29-08-2014	DPL6	4.1	1764	4.9	191	NP	NP	40			45	23	16	9	958		<0.005	388	2.01	
2013/2014 AEMR	29-09-2014	DPL6	3.5	1699	<1	302															
Appendix of 2015 AEMR	28-11-2014	DPL6	4.5	1622	2.6	90															
Appendix of 2015 AEMR	15-12-2014	DPL6	3.5	1700	<0.1	290	NP	<1	<3			134	26	24	10	768	10	<0.005	322	1.91	
Appendix of 2015 AEMR	22-01-2015	DPL6	4.1	1216	3.4	230															
Appendix of 2015 AEMR	25-02-2015	DPL6	3.7	951	1.6	213															
Appendix of 2015 AEMR	26-03-2015	DPL6	4.2	1600	5.1	177	NP	NP													
Appendix of 2015 AEMR	24-04-2015	DPL6	4.0	1558	2.5	226															
Appendix of 2015 AEMR	28-05-2015	DPL6	3.9	2153	5.3	279															
Appendix of 2015 AEMR	17-09-2015	DPL6	3.8	2219	2	220	NP		100		1.13	22	24	16	9	1490	147	<0.001	580	3.65	
Appendix of 2015 AEMR	21-10-2015	DPL6	3.6	2189	2	284															
Appendix of 2015 AEMR	25-11-2015	DPL6	3.3	2264	1.7	226															
Appendix of 2015 AEMR	11-12-2015	DPL6	3.4	2164	0.9	342	<1	<1	40			50	23	18	10	1520	104	0.011	291	3	
Appendix of 2016 AEMR	25-01-2016	DPL6	4.5	2056	1.1	52															
Appendix of 2016 AEMR	24-02-2016	DPL6	4.4	2056	2.3	78															
Appendix of 2016 AEMR	24-03-2016	DPL6	4.1	2031	1.5	183	<1	<1	23			55.48	23.88	17.76	10.27	1382.076	94.142	0.026	428	3.75	
Appendix of 2016 AEMR	29-04-2016	DPL6	3.9	1997	1.9	183															
Appendix of 2016 AEMR	24-05-2016	DPL6	3.8	1974	2.8	199															
Appendix of 2016 AEMR	30-06-2016	DPL6	4.2	1810.2	3.3	275															
Appendix of 2016 AEMR	21-07-2016	DPL6	3.5	1731.9	1.3	338															
Appendix of 2016 AEMR	31-08-2016	DPL6	3.7	1783	3.8	262	<1		790			24	22	14	<5	1100		0.001	241	1.96	
Appendix of 2016 AEMR	29-09-2016	DPL6	3.8	1738	1.9	189															
Appendix of 2016 AEMR	27-10-2016	DPL6	3.8	1738	1.9	189															
Appendix of 2016 AEMR	29-11-2016	DPL6	3.8	3.8	2.3	182															
Appendix of 2016 AEMR	20-12-2016	DPL6	3.7	1752	2.1	274.7	<1		<1			21	33	16	9	1080		0.001	259	1.96	
Q1 2017 Env mon report	30-01-2017	DPL6	3.6	1745																	
Q1 2017 Env mon report	27-02-2017	DPL6	3.8	1653																	
2017 Env Monitoring	22-03-2017	DPL6	3.8	1710			<5		17	0.3	2.5	0.54		21	14	10	1200	59	0.004	370	1.9
2017 Env Monitoring	19-04-2017	DPL6	3.9	1540																	
2017 Env Monitoring	17-05-2017	DPL6	3.8	1580																	
2017 Env Monitoring	14-06-2017	DPL6	3.7	1380			<5		17	0.2	1.6	0.59		17	14	11	990	43	0.003	300	1.4
2017 Env Monitoring	12-07-2017	DPL6	3.9	1100																	
2017 Env Monitoring	09-08-2017	DPL6	3.9	1050																	
2017 Env Monitoring	06-09-2017	DPL6	3.7	977			<5		16	<0.05	1.6	0.51		11	12	8	370	17	0.002	180	0.93
2017 Env Monitoring	04-10-2017	DPL6	3.9	1030																	
2017 Env Monitoring	01-11-2017	DPL6	3.9	1000																	
2017 Env Monitoring	29-11-2017	DPL6	3.9	919																	
2017 Env Monitoring	28-12-2017	DPL6	3.9	822			<5		18	0.1	1.6	0.41		8.8	11	8	540	12	0.001	150	0.67
2018 Env Monitoring	24-01-2018	DPL6	3.88	866																	
2018 Env Monitoring	21-02-2018	DPL6	3.84	822																	
2018 Env Monitoring	21-03-2018	DPL6	3.94	655			<5		20	11	1.3	0.3		7.1	11	7.3	410	8.2	0.001	120	0.45
2018 Env Monitoring	18-04-2018	DPL6	4.03	472																	
2018 Env Monitoring	16-05-2018	DPL6	3.98	469																	
2018 Env Monitoring	13-06-2018	DPL6	3.89	533			<5		25	11	1.4	0.52		5.2	11	6.5	320	6.7	<0.001	74	0.4
2018 Env Monitoring	11-07-2018	DPL6	3.92	463																	
2018 Env Monitoring	08-08-2018	DPL6	3.93	517																	
2018 Env Monitoring	05-09-2018	DPL6	3.82	600	6.82	14.5	<1		20	11		0.25		7	11	6	205	9.31	0.001		0.498
2018 Env Monitoring	05-10-2018	DPL6	3.99	641	8.8																
2018 Env Monitoring	06-11-2018	DPL6	4.02	634	14.1																
2018 Env Monitoring	07-12-2018	DPL6	4.01	618	3.2		<1		17	11		0.28		8	11	6	328	12.1	0.001	123	0.659
No of Samples			63	63	38	39	2	2	24	7	6	9	18	26	26	14	25	12	11	25	26
Minimum			3.2	3.8	0.9	14	3	2	14	0.1	1.3	0.25	2.4	1.5	1.5	6	30	6.7	0.001	9.48	0.02
Maximum			5.2	2264	14.1	464	10	6	790	11	2.5	1.13	134	33	24	11	1520	147	0.026	580	3.75
Average			3.96	1132.47	3.42	216.83	6.50	4.00	55.08	6.37	1.67	0.50	22.59	12.03	11.90	8.58	531.76	43.54	0.00	159.48	1.00

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

2011/2012 AEMR	Dec-11	DPL7							680				16	39	451	36	207		<0.005	0.34	0.04
2011/2012 AEMR	Mar-12	DPL7							710				17	37	649	28	210		<0.005	0.28	0.03
2011/2012 AEMR	30-05-2012	DPL7	7.4	3451	3.6	241															
2011/2012 AEMR	Jun-12	DPL7	7.5	3446	5	249	550	336	700				17	36	561	30	214		<0.005	0.32	0.05
2011/2012 AEMR	26-07-2012	DPL7	7.4	3434	3.4	-15															
2011/2012 AEMR	27-08-2012	DPL7	7.6	3492	2.5	24															
2011/2012 AEMR	27-09-2012	DPL7	7.4	3385	2.1	154	430	256	730				15	32	530	28	226		<0.005	1.11	0.02
2011/2012 AEMR	29-10-2012	DPL7	7.2	3416	1.7	52															
2012/2013 AEMR	Dec-12	DPL7							730				16	34	673	29	203		<0.005	0.56	0.02
2012/2013 AEMR	Mar-13	DPL7							750				18	38	610	27	223		<0.005	0.72	0.05
2012/2013 AEMR	Jun-13	DPL7							740				16	36	16	25	274		<0.005	1.56	0.03
2012/2013 AEMR	Sep-13	DPL7							750				16	34	543	23			<0.005	1.2	0.05
2013/2014 AEMR	12-12-2013	DPL7	7.2	3341	4.1	52	390	238	750				18	38	38	26	249		<0.005	1.33	0.08
2013/2014 AEMR	29-01-2014	DPL7	7.3	3243	3.9	154															
2013/2014 AEMR	24-02-2014	DPL7	7.2	3151	2.4	231															
2013/2014 AEMR	31-03-2014	DPL7	7.2	3358	2.8	-2	410	250	720				19	39	39	26	253		<0.005	1.52	0.04
2013/2014 AEMR	24-04-2014	DPL7	7.5	3452		116															
2013/2014 AEMR	28-05-2014	DPL7	7.3	3468		297															
2013/2014 AEMR	25-06-2014	DPL7	4.6	69	2.3	320	1	<1	15				0.3	0.2	9.9	<5	4.2		<0.005	0.85	<0.01
2013/2014 AEMR	30-07-2014	DPL7	7.5	3414	3.5	126	390	240	760				19	41	656	27	261	0.41	<0.005	1.42	0.02
2013/2014 AEMR	29-08-2014	DPL7	7.5	3477	2.8	128	400	245	740				17	37	611	25	236		<0.005	1.88	0.01
2013/2014 AEMR	29-09-2014	DPL7	7.2	3436	4.9	173															
Appendix of 2015 AEMR	28-11-2014	DPL7	7.1	3416	4.9	75															
Appendix of 2015 AEMR	15-12-2014	DPL7	7.2	3340	2.3	100	400	243	780				22	43	685	29	211	0.34	<0.005	1.62	0.06
Appendix of 2015 AEMR	22-01-2015	DPL7	7.1	3404	2.6	77															
Appendix of 2015 AEMR	25-02-2015	DPL7	7.4	3396	4.5	30															
Appendix of 2015 AEMR	26-03-2015	DPL7	7.1	3446	3.1	78	420	423	780				18	38	651	26	250	0.51	<0.001	2.62	0.077
Appendix of 2015 AEMR	24-04-2015	DPL7	7.5	3438	5.5	53															
Appendix of 2015 AEMR	28-05-2015	DPL7	7.5	3417	6	161															
Appendix of 2015 AEMR	17-09-2015	DPL7	7.3	3323	2.8	110	380		760		0.06		18	39	644	25	250	0.62	<0.001	2.53	0.025
Appendix of 2015 AEMR	21-10-2015	DPL7	7.2	3330	3.5	144															
Appendix of 2015 AEMR	25-11-2015	DPL7	7.2	3500	5.8	100															
Appendix of 2015 AEMR	11-12-2015	DPL7	7.2	3371	2.7	214	380	380	770				17	37	644	24	272	0.04	0.0002	2.44	0.084
Appendix of 2016 AEMR	25-01-2016	DPL7	7.1	3344	1.8	-36.00															
Appendix of 2016 AEMR	24-02-2016	DPL7	7.2	3444	5.5	-60.00															
Appendix of 2016 AEMR	24-03-2016	DPL7	7.2	3399	4.1	-9.00	363	363	738				18.21	38.01	637.38	26.08	260.218	0.356	<0.001	1.772	0.084
Appendix of 2016 AEMR	29-04-2016	DPL7	7.4	3374	6.4	26.00															
Appendix of 2016 AEMR	24-05-2016	DPL7	7.4	3382	5.5	-57.00															
Appendix of 2016 AEMR	30-06-2016	DPL7	7.4	3404.7	5.7	98.00															
Appendix of 2016 AEMR	21-07-2016	DPL7	7.5	3159	6.5	-31.00															
Appendix of 2016 AEMR	31-08-2016	DPL7	7.3	3364	3.7	-22.00	369		760				24	35	604	24	217		0.001	2.07	0.082
Appendix of 2016 AEMR	29-09-2016	DPL7	7.2	3558	2.4	44.00															
Appendix of 2016 AEMR	27-10-2016	DPL7	7.2	3558	2.4	44.00															
Appendix of 2016 AEMR	29-11-2016	DPL7	7.1	7.1	2.4	20.00															
Appendix of 2016 AEMR	20-12-2016	DPL7	6.9	3527	4.5	229.3	372		372				18	38	648	25	263		0.001	1.85	0.082
Q1 2017 Env mon report	30-01-2017	DPL7	6.9	3471																	
Q1 2017 Env mon report	27-02-2017	DPL7	7.1	3174																	
2017 Env Monitoring	22-03-2017	DPL7	7	3430			350		360	0.1	2.1	0.19		36	830	29	710	0.33	<0.001	1.8	0.076
2017 Env Monitoring	19-04-2017	DPL7																			
2017 Env Monitoring	17-05-2017	DPL7	6.9	3440																	
2017 Env Monitoring	14-06-2017	DPL7																			
2017 Env Monitoring	12-07-2017	DPL7	7	3360																	
2017 Env Monitoring	09-08-2017	DPL7	7	3480																	
2017 Env Monitoring	06-09-2017	DPL7	7	3380			390		640	0.1	2.9	0.67		38	940	31	350	0.33	<0.001	1.3	0.065
2017 Env Monitoring	04-10-2017	DPL7	7	3450																	
2017 Env Monitoring	01-11-2017	DPL7	6.9	3440																	
2017 Env Monitoring	29-11-2017	DPL7	6.8	344																	
2017 Env Monitoring	28-12-2017	DPL7	6.9	3410			380		720	0.1	3.6	2.4		38	930	30	250	0.33	<0.001	1.4	0.063
2018 Env Monitoring	24-01-2018	DPL7	6.84	3450																	
2018 Env Monitoring	21-02-2018	DPL7	6.83	3310																	
2018 Env Monitoring	21-03-2018	DPL7	6.78	3650			400		710	0.2	3.7	2.3		41	750	30	250	0.37	<0.001	1.3	0.065
2018 Env Monitoring	18-04-2018	DPL7	6.88	3500																	
2018 Env Monitoring	16-05-2018	DPL7	6.89	3480																	
2018 Env Monitoring	13-06-2018	DPL7	6.89	3570			380		680	0.1	3.9	2.3		37	840	31	260	0.35	<0.001	1.6	0.072
2018 Env Monitoring	11-07-2018	DPL7	7.08	3220																	
2018 Env Monitoring	08-08-2018	DPL7	7.01	3510																	
2018 Env Monitoring	05-09-2018	DPL7	3.9	2680	57.6	391	393		783		2.06			40	651	26	232	0.49	<0.001		0.074
2018 Env Monitoring	05-10-2018	DPL7	6.88	3340	7.5																
2018 Env Monitoring	06-11-2018	DPL7	6.73	3530	4																
2018 Env Monitoring	07-12-2018	DPL7	6.76	3310	2.3	-112.6	395		749		2.08			39	635	25	278	0.5	<0.001	1.7	0.659
No of Samples			62	62	41	41	21	10	27	5	5	8	20	27	27	26	26	13	3	26	26
Minimum			3.9	7.1	1.7	-112.6	1	238	15	0.1	2.1	0.06	0.3	0.2	9.9	23	4.2	0.04	0.0002	0.28	0.01
Maximum			7.6	3650	57.6	391	550	423	783	0.2	3.9	2.4	24	43	940	36	710	0.62	0.001	2.62	0.659
Average			7.06	3239.74	5.15	96.75	378.24	297.40	680.63	0.12	3.24	1.51	16.98	36.23	573.20	27.35	254.36	0.38	0.00	1.43	0.08

Longterm Groundwater Depth Monitoring at Dunloe Sands Quarry

Date	DPL1	DPL3	DPL5	DPL6	DPL7
Nov-13	0.61	0.57	0.67	0.59	0.61
Apr-14	0.61	0.58	0.68	0.61	0.62
Nov-14	1.30	1.90	1.20	1.40	1.90
Dec-14	1.20	1.80	1.20	1.40	1.80
Jan-15	1.10	1.40	0.90	1.20	1.40
Feb-15	0.30	1.00	0.20	0.80	1.50
Mar-15	0.70	1.00	0.40	1.00	1.20
Apr-15	0.90	1.00	0.80	1.20	1.40
May-15	1.10	1.70	0.80	1.40	1.20
Jun-15	1.40	1.40	0.80	1.20	1.30
Jul-15	1.00	1.50	1.10	1.10	1.00
Aug-15	1.30	1.50	0.90	1.10	1.60
Sep-15	1.30	1.80	1.30	1.20	1.70
Oct-15	1.40	1.70	1.10	1.20	1.80
Nov-15	1.20	1.40	1.20	1.30	1.70
Dec-15	1.10	1.20	0.90	1.20	1.60
22-03-2017	1.58	1.28	1.38	1.95	1.20
19-04-2017	1.53	1.46	1.51	1.26	
17-05-2017	1.64	1.44	1.54	1.51	1.51
14-06-2017	0.89			1.08	
12-07-2017	1.69	1.52	1.60	1.54	1.47
09-08-2017	1.83	1.60	1.68	1.77	1.69
06-09-2017	1.90	1.61	1.67	1.85	1.80
04-10-2017	1.91	1.54	1.61	1.81	1.69
01-11-2017	1.92	1.64	1.72	1.81	1.72
29-11-2017	1.93	1.65	1.74	1.81	1.77
28-12-2017	1.94	1.66	1.74	1.97	1.78
24-01-2018	2.03	1.70	1.77	1.88	1.9
21-02-2018	1.94	1.52	1.62	1.87	1.89
21-03-2018	1.68	1.38	1.49	1.62	1.4
18-04-2018	1.6	1.33	1.41	1.52	1.24
16-05-2018	1.62	1.23	1.36	1.65	1.37
13-06-2018	1.74	1.42	1.56	1.78	1.55
11-07-2018	1.78	1.48	1.56	1.71	1.62
08-08-2018	1.98	1.72	1.80	1.78	1.78
05-09-2018		1.36	1.74	1.6	1.78
05-10-2018	1.73	1.39	1.39	1.73	1.64
06-11-2018	1.74	1.74	1.54	1.62	1.52
07-12-2018		1.39	1.46	1.58	1.34
Minimum	0.3	0.57	0.2	0.59	0.61
Maximum	2.03	1.9	1.8	1.97	1.9
Average	1.44	1.43	1.29	1.45	1.51

APPENDIX 3

DUNLOE SAND QUARRY REHABILITATION AND ECOLOGICAL MONITORING 2018

This report has been prepared by Sasha Peterson BSusEnv&Plan for inclusion in the 2018 AEMR for the Holcim Dunloe Park Sand Quarry.

As per the comments provided by the Department this sub-report has been prepared to satisfy the outstanding actions from previous AMER reviews. This report contains the following:

1. Year-on-year comparison of monitoring results for 2017-2018
2. Comparison of 2018 monitoring results against rehabilitation and revegetation objectives
3. Summary of nest box monitoring results for 2018
4. Mapping identifying monitoring location photograph points

1.0 – 2017 and 2018 Comparison of Monitoring Results

The 2012 Revised EMP for Dunloe Park Sand Quarry states “the success of a regeneration project can be assessed by systematic visual monitoring of rehabilitation areas”. The project site has three vegetation monitoring forms to be completed for each rehabilitation zone at various intervals throughout the year, these are:

- Form A: Routine Quarterly Rehabilitation Monitoring Sheet
- Form B: Proforma for Assessing Site Condition (Six Monthly)
- Form C: Revegetation/Forest Structure (Annually)
- Form D: Proforma for Monitoring Floristic Composition (Annually)

In addition to the above forms, photo points and photographs taken at quarterly intervals are undertaken as per the requirements of the EMP.

1.1 – The following section provides a year-on-year comparison (2017-2018) of monitoring data collected under for each of the three rehabilitation zones under Form A of the EMP.

1.1.1 Zone 1: Form A

General Management: No fires, rubbish dumping, plant theft or utilization of Zone 1 for cattle grazing, vehicle parking or stockpiling occurred in 2018 or 2017. It is noted that during March 2017 monitoring Zone 1C was not accessible due to weather, however work performed across the rehabilitation zones to remove flood debris from fences that occurred during April showed no indication that Zone 1C had been used for cattle grazing, rubbish dumping etc. Record of slashing of bushfire trails and adjacent pastures can be accessed in the 2018 Work Log (Appendix 1).

Biodiversity: An array of native fauna was noted throughout the routine quarterly monitoring in Zone 1 during 2018, these included tadpoles, mud crab, koala and crow. Native fauna was also noted within Zone 1 during 2017, including a wallaby, snakes (brown and tree snake), lorikeet, fairy wrens and finches. Presence of fauna year on year demonstrates that Zone 1 is utilized by a range of native wildlife.

Weeds: No areas of weeds established within Zone 1 during 2018 – single plant infestations were noted in June with 1 small camphor laurel and 1 small lantana bush noted along the maintenance track. During monitoring in 2017 one instance of single plant infestations was noted along the maintenance track in December (1 x lantana and 2 x camphor laurel), these were poisoned in 2018. Year on year comparison demonstrates that there is a trend for weed occurrence along the maintenance track – this is likely due to the track being maintained and kept clear allowing for weeds to occur due to an opening in the canopy and little to no competition from native plants.

Modifications: No structural modifications or illegal modifications were made within Zone 1 during 2018 and fences were noted to be in a good condition. During 2017, no structural modification or illegal modifications were made within Zone 1, the need for fencing repairs were noted during the 2017 period and these improvements were undertaken in January 2018.

Vegetation Regeneration: Table 1 below displays a year on year comparison of the natural regeneration of tree, shrub and groundcover species and their respective heights. The monitoring requires a visual estimate of vegetation, due to the size of the rehabilitation zone different areas of the zone are traversed each quarter – as such there can be significant differences in recorded heights due to different trees being inspected during the visits. It is also noted that although majority of the zone has been rehabilitated some existing native trees were present which is reflective of the higher height range estimates.

Table 2 below displays a year on year comparison of the dominant species noted during quarterly inspections within each canopy layer. Due to the size of the rehabilitation zone different areas of the zone are traversed each quarter – as such there can be differences in the recorded species. Seasonal influences as well as the maturity of the rehabilitation zone also influence the species that are noted during inspection.

	2017	2018
Tree	8metres	15metres
Shrub	2metres	5metres
Groundcover	1metre	2metres

Table 1: Natural regeneration heights 2017 and 2018 within Zone 1

	2017	2018
Tree	<ul style="list-style-type: none"> • Paperbark • Banksia • Sheoak 	<ul style="list-style-type: none"> • Paperbark • Banksia • Eucalyptus • Sheoak
Shrub	<ul style="list-style-type: none"> • Mangrove 	<ul style="list-style-type: none"> • Mangrove • Coast geebung • Coast wattle
Groundcover	<ul style="list-style-type: none"> • Bracken Fern 	<ul style="list-style-type: none"> • Bracken fern • Salt couch • Flat sedge

		• Twigrush
--	--	------------

Table 2: Dominant species within each canopy layer 2017 and 2018 within Zone 1

1.1.2 Zone 2: Form A

General Management: No fires, rubbish dumping, plant theft or utilization of Zone 2 for cattle grazing, vehicle parking or stockpiling occurred in 2017 or 2018. Slashing of trails within Zone 2 occurred in 2018 as detailed in Appendix 1.

Biodiversity: A number of native fauna was noted during 2018, this included fairy wrens, willy wag tails, a butcher bird, cicada, finch and bees. Native fauna was also spotted during 2017 monitoring, species included willy wag tail, eastern rosella, lorikeet, finches, wallaby, tree snake and kookaburra. Presence of fauna year on year demonstrates that Zone 2 is utilized by a range of native wildlife.

Weeds: No areas of weeds re-established within Zone 2 during the 2017 or 2018 period. Although there are still gaps in vegetation as this rehabilitation are continues to mature, groundcover from grasses is near 100% restricting weeds from establishing.

Modifications: No structural modifications or illegal modifications were made within Zone 2 during 2017 or 2018 and fences were noted to be in good condition.

Vegetation Regeneration: Table 3 below displays a year on year comparison of the natural regeneration of tree, shrub and groundcover species and their respective heights. Table 4 presents the dominant species within each canopy layer. As noted in the discussion of Tables 1 and 2 the same considerations of recorded heights as well as species must be applied to both Table 3 and 4.

	2017	2018
Tree	8metres	13metres
Shrub	3metres	3metres
Groundcover	1metre	2metres

Table 3: Natural regeneration heights 2017 and 2018 within Zone 2

	2017	2018
Tree	<ul style="list-style-type: none"> • Paperbark • Banksia • Sheoak 	<ul style="list-style-type: none"> • Sheoak • Paperbark • Banksia
Shrub		<ul style="list-style-type: none"> • Coast wattle • Coast geebung
Groundcover	<ul style="list-style-type: none"> • Grass 	<ul style="list-style-type: none"> • Bracken fern • Common reed • Common rush

Table 4: Dominant species within each canopy layer 2017 and 2018 within Zone 2

1.1.3 Zone 3: Form A

General Management: No fires, rubbish dumping, plant theft or utilization of Zone 3 for cattle grazing, vehicle parking or stockpiling occurred in 2017 or 2018.

Biodiversity: No native fauna was noted during the quarterly monitoring during 2018. However, during 2017 monitoring native fauna including an eagle and goanna. Monitoring results indicate this zone is used less by native fauna in comparison to Zones 1 and 2, however it must be considered that Zone 3 is significantly smaller than these other zones.

Weeds: During the 2017 period single plant infestations were noted in June (1 x tobacco bush). No areas of weeds established during Zone 3 during 2018 – single plant infestations were noted in March (1 x tobacco bush), June (1 x lantana bush, 1 x camphor laurel) and in December (1 x camphor laurel). This data suggests that weed occurrence has increased in the 2018 period when compared to 2017 levels. However, infestation rates are still extremely low – however, due to this occurrence continuation of routine monitoring and maintenance is especially important to ensure the success of this rehabilitation zone.

Modifications: No structural modification or illegal modifications were made within Zone 1 during 2017 or 2018. Fencing improvements occurred in Zone 3 during the 2017 period with none being required in 2018.

Vegetation Regeneration: Table 4 and 5 below display natural regeneration heights for trees, shrubs and groundcovers as well as the dominant species within each canopy layer for both 2017 and 2018. As noted in the discussion of Tables 1 and 2 the same considerations of recorded heights as well as species must be applied to both Table 5 and 6.

	2017	2018
Tree	6metres	13metres
Shrub	2metres	4metres
Groundcover	1metre	1metre

Table 5: Natural regeneration heights 2017 and 2018 within Zone 3

	2017	2018
Tree	<ul style="list-style-type: none"> • Banksia 	<ul style="list-style-type: none"> • Banksia • Sheoak
Shrub		<ul style="list-style-type: none"> • Coastal geebung
Groundcover	<ul style="list-style-type: none"> • Bracken fern • Leaf litter 	<ul style="list-style-type: none"> • Bracken fern

Table 6: Dominant species within each canopy layer 2017 and 2018 within Zone 3

1.2 - The following section provides a year-on-year comparison (2017-2018) of monitoring data collected under for each of the three rehabilitation zones under Form B of the EMP.

1.2.1 Zone 1: Form B

2017 Summary

Canopy cover very strong within Zone 1A and B, with ample leaf litter providing almost 100% groundcover within the site. The previously planted supplementary plantings within

the zone have established very well and are beginning to achieve good height. Zone 1C is tidal and as such is wet almost year-round, this directly influences the vegetation that occurs here – e.g. sedges and mangroves. No weeds were noted during the inspections. Despite the significant flooding in 2017 the whole of the site fared extremely well. The entire Zone 1 was rated as A (OK on track towards target).

2017 Summary

The thickness in plant coverage is noted to be continually improving, especially in regard to the occurrence and variety of shrubs and groundcovers. The entire Zone 1 was rated as A (OK on track towards target) – routine maintenance is recommended to continue to manage any potential weed infestations as well as preserve access tracks into the site.

1.2.2 Zone 2: Form B

2017 Summary

Supplementary plantings in Zone 2 are doing very well, however there were some small losses in numbers due to salt water inundation during King and High tide events. These supplementary plantings are beginning to move toward the 2metre height mark. Natural regeneration is occurring in zone with vegetation reaching up to 1metre in height. Grass in this zone is very thick, creating difficult conditions for weeds to establish within the zone. Despite the significant flooding in 2017 the whole of the site fared extremely well. The entire Zone 2 was rated as A (OK on track towards target) during both June and December monitoring in 2017.

2018 Summary

The same tidal influences still impact upon this zone and is an environmental factor that influences the outcomes of this zone. Zone 2B being a fresh water wetland is also another factor that influences the outcomes of this zone. The canopy is continuing to close in this zone, supplementary plantings are doing well, and no weeds were noted. Groundcover continues to be strong, restricting weeds from establishing. The entire Zone 2 was rated as A (OK on track towards target) during both June and December monitoring in 2018.

1.2.3 Zone 3: Form B

2017 Summary

No supplementary plantings have occurred in Zone 3. Good growth has been noted, while an area of grass remains in the centre of the zone, natural regeneration is occurring and this grassed area continues to become smaller as the zone progresses over time. Ground cover is strong, with little to no bare ground - leaf and branch litter are the predominant covers. Three tobacco bushes were recorded during the 2017 monitoring period – which were removed in accordance with the EMP. The entire Zone 3 was rated as A (OK on track towards target) during both June and December monitoring in 2017.

2018 Summary

No supplementary plantings have occurred in Zone 3. Grass gap in vegetation still present but continues to close as natural regeneration progresses. The previously poisoned tobacco bushes noted in 2017 had not re-established during the 2018 period. One camphor laurel was noted during 2018 Form B monitoring which was cut down with its stump painted to

prevent grow back. The entire Zone 3 was rates as A (OK on track towards target) during both June and December monitoring in 2018.

1.3 - The following section provides a year-on-year comparison (2017-2018) of monitoring data collected under for each of the three rehabilitation zones under Form C and D of the EMP. Form C (revegetation/forest structure) is surveyed on a 50m x 20m plot, as is Form D (floristic composition).

A 50 m x 20 m monitoring plot is the extent of the area assessed to complete both forms C and D. The 50 m x 20 m monitoring plot within each rehabilitation zone are semi-permanent fixtures to allow for year-on-year monitoring of the same area, allowing for better data collection and understanding of how it is progressing through the rehabilitation process. If necessary, these plots can be moved into a new area within the zone or removed completely if the current location of the plot or entire rehabilitation zone is deemed to be successfully rehabilitated.

Ground cover, canopy cover and canopy height are surveyed at 5m, 25m and 45m points within the monitoring plot. A 1m x 1m quadrant is used to conduct the groundcover survey. Canopy cover, canopy height and special life forms are assessed within a 10m x 10m quadrant. It is important to note that the results of these assessments are subjective as it is a visual assessment.

1.3.1 Zone 1: Form C

2017 Summary

Groundcover was strong within Zone 1, with only 5% bare soil noted at the 5m quadrant and 0% at 25m and 45m. Ferns and leaf litter and fine woody debris <10cm diameter were the dominant forms of groundcover across all quadrants. Visual estimates of the canopy cover ranged from 40% at 45m through to 50% at 5m. While canopy height estimates across all three points were 8m to 10m. Special life forms were noted within each quadrant, with vines (slender stem <5cm diameter) and ground ferns recorded.

2018 Summary

Groundcover was strong, with no bare soil recorded within any of the quadrants. Leaf litter and ferns were again the dominant forms of ground cover. Visual estimates of canopy cover ranged from 30% at the 45m point to 60% at the 5m point. Canopy height estimates ranged from 10m to 13m. Special life forms were noted within the 25m quadrant, being vines (slender stem <5cm diameter).

Similar results were obtained during the 2017 and 2018 monitoring period, with no major declines across groundcover, canopy height or cover noted. This indicates that the monitoring plot has not deteriorated in condition and continues to be on good track for rehabilitation.

Zone 2: Form C

2017 Summary

Groundcover was strong within the Zone 2 monitoring plot; no bare soil was noted within any quadrant. Grass, tree seedlings and shrubs, leaf litter and fine woody debris <10cm diameter were the dominant forms of groundcover. Canopy foliage was estimated to be between 40% and 50% across the plot and canopy height reaching up to 10m. Special life forms were noted within each quadrant, this was limited to ground ferns.

2018 Summary

Groundcover was strong, with no bare soil noted within any quadrant. Grass was the dominant form of groundcover. Canopy foliage was estimated to be 30% while canopy height was reaching up to 10m. No special life forms were noted within the quadrants.

Results from the 2017 period differ to those of 2018, a key influencer of these results is the assisted plantings beginning to establish within the zone. As these plants have begun to mature, they are no longer recorded as seedlings. The reduction in leaf litter and perceived increase in grass cover should not greatly influence the strike rate of tree and shrub seedlings. It is noted that the area has a strong seedbank and together with previous and potential future assisted plantings will continue to ensure the uptake of a range of species of trees and shrubs. Groundcovers will continue to diversify into the future as the layers of the rehabilitation begin to mature and change the conditions on the ground level of the forest structure.

Zone 3: Form C

2017 Summary

Groundcover was strong within Zone 3; no bare soil was recorded within any quadrant. Grass and leaf litter were the dominant forms of groundcover. Canopy cover was estimated to range between 45% to 60%, with canopy height reaching up to 15m. Special life forms were noted within each quadrant, including vines (slender <5cm diameter) and ground ferns.

2018 Summary

Groundcover was strong during the 2018 monitoring, with no bare soil noted within any quadrant. Grass was the dominant form of groundcover. Canopy foliage was estimated to be 60% within the 25m and 45m plots. While canopy height was estimated to be between 9m to 12m. Vines (slender stem <5cm diameter) were the special life form noted within each quadrant.

Results from the 2017 and 2018 period demonstrate that rehabilitation zone 3 continues to mature. Although data suggests canopy cover and height have decline from 2017 to 2018, it is imperative to note that the data is only an estimate as such the results are subjective.

Zone 1: Form D

Paperbarks and swamp mahogany were noted to be the largest trees within the canopy. While coast geebung and wattle are present within the mid-story. A brown kurrajong was noted within the mid-story during 2018 monitoring. Bracken fern and leaf litter are dominant in the understory/groundcover. Recruitment of swamp mahogany and banksia are common to the site. Two weeds were noted (1 x lantana and 1 x camphor) within the site.

Zone 2: Form D

Sheoak and banksia are noted to be the two most dominant trees within Zone 2. The trees planted in the assisted generation effort (assorted variety of gum trees) are currently the mid-story, along with coast geebungs – however as these plantings continue to mature, they will move into the canopy layer. Grass was the dominant ground cover with regular occurrences of bracken fern. Banksia and coastal wattles are the most common recruits within the site. No weed or maintenance issues were noted.

Zone 3: Form D

Sheoak and banksia are noted to be the two most dominant trees, with coast geebung occurring within the mid-story. A cheese tree was also noted within the mid-story during 2018 monitoring. The understory and ground covers within Zone 3 are dominated by grass and bracken fern, with good levels of leaf litter and little to no bare dirt noted. No major weed or Maintenance issues were noted, with one camphor laurel found and removed during the inspection.

2.0 - Comparison of 2018 monitoring results against rehabilitation and revegetation objectives

Performance Requirements: Assisted Natural Regeneration Areas

There are four performance requirements (canopy coverage, diversity and groundcover coverage) for the rehabilitation zones as set out in the EMP. If these performance requirements are not achieved, supplementary plantings are triggered within the according zone.

1. Canopy Coverage

Requirement:

'Canopy coverage will not be considered achieved for any one area if it does not contain a canopy or small tree typical to the community (refer Section 4.3.1 modules) within an area equal or greater than 4sqm'.

Response:

Monitoring indicates that each of the rehabilitation zones have achieved this performance requirement in 2018, an example of a canopy or small tree that is present within each zone that is listed within the modules for each respective zone is detailed in Table 7 below.

Zone	Canopy or Small Tree
1A	Paperbark
1B	Swamp Mahogany
1C	Paperbark
2A	Coastal Banksia
2B	N/A - Wetland Community
2C	Coastal Banksia
3	Black Sheoak

Table 7: Canopy or Small Trees that occur within each of the Rehabilitation Zones at the Dunloe Park Sand Project

2. Diversity

Requirement:

*'Diversity within the upper strata (trees, small trees and shrubs) of natural regeneration shall be required to achieve the following' *note coastal wetland communities (zones 1A and 2B) are exempt from this requirement.*

Community Type	Canopy Tree minimum diversity per 100sqm	Small Tree/Shrubs minimum diversity per 100sqm	Applicable Rehabilitation Zones
Swamp Sclerophyll	3	3	1B, 1C, 2C
Swamp Sclerophyll, Swamp She-oak, Banksia	3	3	2A
Swamp Sclerophyll, Swamp Oak	3	3	3

Table 8: Diversity requirements as included in the Dunloe Park Sand Project Environmental Management Plan Revision July 2012

Response:

Table 9 displays examples of canopy and small trees found within each respective rehabilitation zone during the 2018 monitoring period. An in-depth biodiversity study was voluntarily undertaken for the whole of Zone 1 (A, B and C) in 2016 – this has previously been provided to the Department of Planning and Environment but has again been included in Appendix Two provide supporting evidence of the rehabilitation area meeting the diversity requirements of the EMP.

Zone 1C is strongly influenced by tidal and freshwater flooding inundation, influencing the occurrence and uptake of trees and species in the area. It has not met the canopy tree minimum diversity, as such appropriately placed supplementary plantings should be explored in this area. Zone 3 has also not achieved the canopy and small tree diversity, again supplementary plantings should be planned for this zone during the 2019 period.

Zone	Canopy Tree	Small Tree/Shrub
1A	N/A - Wetland Community	N/A
1B	Swamp Mahogany Paper Bark Pink Bloodwood	Casuarina Brown Kurrajong Coastal Banksia
1C	Paperbark	Mangrove Coast Wattle Casuarina
2A	Paperbark Coastal Banksia Eucalyptus Robusta	Broad-leaved Lillipilli Coast Wattle Black Sheoak
2B	N/A - Wetland Community	N/A
2C	Paperbark Coastal Banksia Swamp Box	Black Sheoak
3	Paperbark	Coast Geebung Cheese Tree

Table 9: Data on diversity within the Dunloe Sand Park Project Rehabilitation Zones 2018

3. Groundcover Coverage

Requirement:

'Groundcover coverage will not be considered achieved for any one area if it does not contain native ground cover or leaf litter from the upper state within an area equal to or great than 2.25sqm... this performance requirement does not apply to Rehabilitation Zones 1A and 2B'.

Response:

No areas equal or greater than 2.25sqm without native ground cover or leaf litter noted during monitoring in any of the zones.

4. General Coverage/Success of Natural Regeneration

Requirement:

'Coverage will not be considered achieved for any one area if it contains a bare or denuded area greater than 6.25sqm'.

Response:

No areas greater than 6.25sqm denude of any general coverage noted within any areas of the rehabilitation zones during monitoring.

Maintenance Objectives

Table 10: Maintenance Requirements for the Dunloe Park Sand Project as Detailed in the EMP Section 4.4 displays the maintenance objectives for the rehabilitation zones and how these were achieved during the 2018 monitoring period.

Table 10: Maintenance

Requirement	Notes
Planting areas are to be regularly watered for a period of twelve weeks. If during quarterly routine inspections of the rehabilitation zones there is evidence of plant poor health due to drought stress than additional watering shall be undertaken;	No plantings were undertaken in the 2018 period across the 3 rehabilitation and revegetation zones. Monitoring of previous years (2016) plantings continued to occur, no plants exhibited signs of poor health due to drought stress due to consistent rainfall throughout the year therefore no watering was undertaken or required.
Recurrent weeds within rehabilitation zones are to be removed as they occur quarterly for the first five years of assisted regeneration for each rehabilitation stage and quarterly thereafter for the life of the development;	Any weeds identified during quarterly monitoring are recorded on <i>Form A: Routine Quarterly Rehabilitation Monitoring Sheet</i> . Following any identification of weeds management occurs – all weed maintenance work has been recorded within the <i>Rehabilitation and Revegetation Work Log 2018</i> which is attached in Appendix 1 of this report.
Fences (where required due to cattle grazing in adjacent paddocks) are to be inspected quarterly for structural integrity and maintained as necessary;	Fence inspection occurs quarterly alongside routine monitoring. Fence repairs did occur during the 2018 period and all works of these have been recorded within the <i>Rehabilitation and Revegetation Work Log 2018</i> which is attached in Appendix 1 of this report.
Location survey pegs of the rehabilitation zones boundaries are to be inspected quarterly and maintained/replaces as necessary;	N.C White and Associated Land and Engineering Surveyors re-surveyed the area in 2016. Copies of this have been previously provided to the Department in relation to the establishment of covenants over the rehabilitation and revegetation zones.
Replacement planting of stock loss;	No plantings occurred during the 2018 period, as such no stock loss occurred and no replacement planting was required.
Existing 4WD tracks within the environmental protection zones are to be maintained quarterly to allow	Inspection and assessment of 4WD tracks occur quarterly alongside routine monitoring. Slashing of 4WD tracks did occur during the

continued vehicle access for maintenance and emergency rural fire brigade vehicles;	2018 period and all works have been recorded within the <i>Rehabilitation and Revegetation Work Log 2018</i> which is attached in Appendix 1 of this report.
A slashed/grazed zone of 25-30m is to be maintained on the development side of the rehabilitation zones to reduce risk of bushfire spread from the pasture grasslands.	Areas adjacent to rehabilitation zones are constantly grazed year-round and slashed when required. No slashing of these areas was deemed necessary during the 2018 period.

3.0 - Summary of Nest Box Monitoring Results

In accordance with the Project Approval, 11 fauna nest boxes have been installed across the rehabilitation zones in a bid to increase potential nesting options for fauna. Routine fauna box monitoring forms are completed for each nest box on an annual basis. During the 2018 monitoring period, one nest box was being actively utilized at the time of inspection. A mountain brushtail possum was inspected within a cockatoo box located in Zone 1B. A photograph of the possum is included below. No other animals were located within the remaining nest boxes. All boxes were noted to be in a good condition. Spider webs covering the entrance hole of the glider box within Zone 1B were removed. The possum box located within Zone 2C was found to have minor exterior damage – with evidence of pecking around the entrance hole, however no signs of bird or other fauna use was noted inside of the box.



4.0 - Mapping identifying monitoring location photograph points

The Map below displays the location of the permanent monitoring locations for the 3 rehabilitation zones of the Dunloe Park Sand Project.



Appendix One: Work Log 2018

Date: 05/01/2018

Activities Performed:

- Maintenance slashing of Zone 1 Northern access trail
- Removal of fallen debris from Zone 1 Northern access trail

Work Performed By:

Sasha Peterson – Ramtech Pty Ltd

Date: 08/01/2018

Activities Performed:

- Repair of Northern boundary fence in Zone 1
- Stem Injection of 2 small camphor laurel trees identified during December 2017 monitoring.
- Spot spray of 1 lantana bush identified during December 2017 monitoring

Work Performed By:

Kiiandra Kearney – Ramtech Pty Ltd

Date: 22/01/2018

Activities Performed:

- Maintenance on Zone 1C boundary fencing

Work Performed By:

Kiiandra Kearney – Ramtech Pty Ltd

Date: 26/04/2018

Activities Performed:

- Removal of guards from suitable trees in Zone 2
- Installing guards on suitable trees in Zone 2
- Attaching trees to stakes where needed in Zone 2

Work Performed By:

Sasha Peterson – Ramtech Pty Ltd
Casual Employee – Ramtech Pty Ltd

Date: 31/07/2018

Activities Performed:

- Slashing of access trails in Zone 1A and 1B

Work Performed By:

Sasha Peterson – Ramtech Pty Ltd

Date: 28/11/2018

Activities Performed:

- Slashing of trails in Zone 2A and B

Work Performed By:

Contractor – Ramtech Pty Ltd

Date: 28/12/2018

Activities Performed:

- Slashing of access trails in Zone 1A, 1B and 1C

Work Performed By:

Sasha Peterson – Ramtech Pty Ltd

Biodiversity Study

PROPERTY:

DUNLOEPARK LOT 1
POTTSVILLE MOOBALL RD NSW

STUDY CONDUCTED - 06/02/2016

BY DAVE WOODLEE FROM BUSH TO SEA

E: bushatsea@gmail.com P: 0488 626 502

BIODIVERSITY STUDY OF REHABILITATION ZONE 1

A TOTAL OF **55 TREES AND SHRUBS SPECIES** WERE RECORDED AS WELL AS **10 SPECIES OF GRASSES AND SEDGES AND 4 SPECIES OF VINES 1 FERN SPECIES**

THE STUDY FOUND THAT 80% OF THE AREA WAS MADE UP MAINLY OF 8 SPECIES WITH THE OTHER 47 SPECIES DESPERSED THROUGHT THE ZONE .

AMOUNG THE 8 PROMINENT SPECIES, OTHER REGENERATING SPECIES WERE FOUND TO RANGE IN HEIGHT FROM 300MM TO 1500MM. THIS SHOWS THAT THE BIRDS ARE BRINGING IN SEEDS FROM AROUND THE AREA AND DISPERSING THEM THROUGH OUT THE REHABILITATION ZONE.

NOW THAT THE AREA IS FENCED AND ALLOWED TO NATURALLY REGENERATE, THE COASTAL LITERAL RAINFOREST AND MELALUCA SWAMP SPECIES ARE COMING UP IN ABUNDANCE.

WE RECORDED:

3140 INDIVIDUAL NATIVE PLANTS IN REHABILITATION ZONE 1

SPECIES RECORDED:

TREES AND SHRUBS

ACACIA FALCATA ACACIA MELANOXYLON ACACIA SUAVEOLENS ACACIA SOPHORA
ACMENA SMITHI ACMENA HEMILAMPRA
ACRONYCHIA IMPERFIRATA ALPHITONIA EXCELSA AUSTROMYRTUSDULCIS

BANKSIA INTEGRIFOLIA BREYNIAOBLONGIFOILA

CALLISTEMON PACHYPHYLLUS CALLISTEMON SALIGNUS CASSINE AUSTRALIS
CASUARINA GLAUCA CLERODENDRON TOMENTOSUM COMMERSONIA BARTRAMIA
CUPANIOPSISANACARDIOIDES

DUBOISIA MYOPOROIDES

ELAEOCARPUS OBOVATUS ELAEOCARPUS RETICULATUS ENDIANDRA SIEBERI
EUCALYPTUS INTERMEDIA EUCALYPTUS MACULATA EUCALYPTUS RESINIFERA
EUCALYPTUS ROBUSTA EUCALYPTUS TERICORNIS EUROSCHINUS FALCATA

GLOCHIDION FERDINANDI GLOCHIDION SUMATRANUM GUIOASEMIGLAUCA

HIBISCUS DIVERSIFOLIUS HOVEAACUTIFOLIA

JAGERA PSEUDORHUS

LEPTOSPERMUM LIVERSAIDGEI LEPTOSPERMUM POLYGALIFOLIUM LEPTOSPERMUM
SEMIBACCATUM

LITSEA AUSTRALIS LOPHOSTEMON CONFERTUS LOPHOSTEMON SUAVEOLENS

MACARANGA TANARIUS MAYTENUS SILVESTRIS MELALEUCA QUINQUINERVIA
MELASTOMA AFFINE

NOTELAEA LONGIFOLIA

PERSOONIA CORNIFOLIA PITTOSPORUM REVOLUTUM PITTOSPORUM UNDULATUM
POLYSCIAS ELEGANS POUTERIA CHARTACEA PULTENAEA VILLOSA

RHODOMYRTUS PSIDIOIDES

SYMPLOCUS THWAITESII SYNCARPIA GLOMULIFERA

ZIERIA SMITHII

GRASSES AND SEDGES

BAUMEA RUBIGINOSA CYMBOPOGON REFACTUS DIANELLA CERULEA IMPERATA
CYLINDRICA JUNCUS USITATUS JUNCUS POLYANTHEMOS LEPIRONIAARTICUTA
PHILYDRUM LANUGINOSUM SCHOENOPLECTUS MUCRONATUS THEMEDAAUSTRALIS

FERNS AND VINES

BLECHNUM CARTLAGINEUM DROSERA PYGMAEA

CISSUS ANTRACTICA EUSTREPHUS LATIFOLIUS SMILAX AUSTRALIS STEPHANIA
JAPONICA

APPENDIX 4

DUNLOE SAND QUARRY TRUCK MOVEMENT SUMMARY

Date	Total Truck Movements per day	Max Truck Visits per hour	Operational Hours	Max Truck Visits per day
Monday, 1 January 2018	0	0	0	0
Tuesday, 2 January 2018	0	4	10	40
Wednesday, 3 January 2018	0	4	10	40
Thursday, 4 January 2018	0	4	10	40
Friday, 5 January 2018	0	4	10	40
Saturday, 6 January 2018	0	4	5	20
Sunday, 7 January 2018	0	0	0	0
Monday, 8 January 2018	17	4	10	40
Tuesday, 9 January 2018	22	4	10	40
Wednesday, 10 January 2018	8	4	10	40
Thursday, 11 January 2018	13	4	10	40
Friday, 12 January 2018	8	4	10	40
Saturday, 13 January 2018	6	4	5	20
Sunday, 14 January 2018	0	0	0	0
Monday, 15 January 2018	21	4	10	40
Tuesday, 16 January 2018	17	4	10	40
Wednesday, 17 January 2018	22	4	10	40
Thursday, 18 January 2018	16	4	10	40
Friday, 19 January 2018	16	4	10	40
Saturday, 20 January 2018	4	4	5	20
Sunday, 21 January 2018	0	0	0	0
Monday, 22 January 2018	22	4	10	40
Tuesday, 23 January 2018	18	4	10	40
Wednesday, 24 January 2018	23	4	10	40
Thursday, 25 January 2018	18	4	10	40
Friday, 26 January 2018	0	0	0	0
Saturday, 27 January 2018	0	4	5	20
Sunday, 28 January 2018	0	0	0	0
Monday, 29 January 2018	20	4	10	40
Tuesday, 30 January 2018	16	4	10	40
Wednesday, 31 January 2018	13	4	10	40
Thursday, 1 February 2018	17	4	10	40
Friday, 2 February 2018	8	4	10	40
Saturday, 3 February 2018	0	4	5	20
Sunday, 4 February 2018	0	0	0	0
Monday, 5 February 2018	19	4	10	40
Tuesday, 6 February 2018	17	4	10	40
Wednesday, 7 February 2018	18	4	10	40
Thursday, 8 February 2018	19	4	10	40
Friday, 9 February 2018	18	4	10	40
Saturday, 10 February 2018	5	4	5	20
Sunday, 11 February 2018	0	0	0	0
Monday, 12 February 2018	23	4	10	40
Tuesday, 13 February 2018	21	4	10	40
Wednesday, 14 February 2018	16	4	10	40
Thursday, 15 February 2018	15	4	10	40
Friday, 16 February 2018	22	4	10	40
Saturday, 17 February 2018	0	4	5	20
Sunday, 18 February 2018	0	0	0	0
Monday, 19 February 2018	29	4	10	40
Tuesday, 20 February 2018	17	4	10	40
Wednesday, 21 February 2018	20	4	10	40
Thursday, 22 February 2018	18	4	10	40
Friday, 23 February 2018	4	4	10	40
Saturday, 24 February 2018	0	4	5	20
Sunday, 25 February 2018	0	0	0	0
Monday, 26 February 2018	17	4	10	40
Tuesday, 27 February 2018	21	4	10	40
Wednesday, 28 February 2018	14	4	10	40
Thursday, 1 March 2018	18	4	10	40
Friday, 2 March 2018	18	4	10	40
Saturday, 3 March 2018	0	4	5	20
Sunday, 4 March 2018	0	0	0	0
Monday, 5 March 2018	20	4	10	40
Tuesday, 6 March 2018	14	4	10	40
Wednesday, 7 March 2018	7	4	10	40
Thursday, 8 March 2018	8	4	10	40
Friday, 9 March 2018	12	4	10	40
Saturday, 10 March 2018	0	4	5	20
Sunday, 11 March 2018	0	0	0	0
Monday, 12 March 2018	23	4	10	40

Tuesday, 13 March 2018	15	4	10	40
Wednesday, 14 March 2018	15	4	10	40
Thursday, 15 March 2018	22	4	10	40
Friday, 16 March 2018	23	4	10	40
Saturday, 17 March 2018	0	4	5	20
Sunday, 18 March 2018	0	0	0	0
Monday, 19 March 2018	26	4	10	40
Tuesday, 20 March 2018	15	4	10	40
Wednesday, 21 March 2018	21	4	10	40
Thursday, 22 March 2018	18	4	10	40
Friday, 23 March 2018	12	4	10	40
Saturday, 24 March 2018	0	4	5	20
Sunday, 25 March 2018	0	0	0	0
Monday, 26 March 2018	29	4	10	40
Tuesday, 27 March 2018	27	4	10	40
Wednesday, 28 March 2018	26	4	10	40
Thursday, 29 March 2018	17	4	10	40
Friday, 30 March 2018	0	0	0	0
Saturday, 31 March 2018	0	0	0	0
Sunday, 1 April 2018	0	0	0	0
Monday, 2 April 2018	0	0	0	0
Tuesday, 3 April 2018	18	4	10	40
Wednesday, 4 April 2018	13	4	10	40
Thursday, 5 April 2018	25	4	10	40
Friday, 6 April 2018	12	4	10	40
Saturday, 7 April 2018	0	4	5	20
Sunday, 8 April 2018	0	0	0	0
Monday, 9 April 2018	16	4	10	40
Tuesday, 10 April 2018	21	4	10	40
Wednesday, 11 April 2018	19	4	10	40
Thursday, 12 April 2018	17	4	10	40
Friday, 13 April 2018	25	4	10	40
Saturday, 14 April 2018	0	4	5	20
Sunday, 15 April 2018	0	0	0	0
Monday, 16 April 2018	21	4	10	40
Tuesday, 17 April 2018	26	4	10	40
Wednesday, 18 April 2018	13	4	10	40
Thursday, 19 April 2018	29	4	10	40
Friday, 20 April 2018	16	4	10	40
Saturday, 21 April 2018	0	4	5	20
Sunday, 22 April 2018	0	0	0	0
Monday, 23 April 2018	13	4	10	40
Tuesday, 24 April 2018	18	4	10	40
Wednesday, 25 April 2018	0	0	0	0
Thursday, 26 April 2018	26	4	10	40
Friday, 27 April 2018	23	4	10	40
Saturday, 28 April 2018	4	4	5	20
Sunday, 29 April 2018	0	0	0	0
Monday, 30 April 2018	25	4	10	40
Tuesday, 1 May 2018	26	4	10	40
Wednesday, 2 May 2018	20	4	10	40
Thursday, 3 May 2018	21	4	10	40
Friday, 4 May 2018	20	4	10	40
Saturday, 5 May 2018	0	4	5	20
Sunday, 6 May 2018	0	0	0	0
Monday, 7 May 2018	15	4	10	40
Tuesday, 8 May 2018	18	4	10	40
Wednesday, 9 May 2018	20	4	10	40
Thursday, 10 May 2018	27	4	10	40
Friday, 11 May 2018	27	4	10	40
Saturday, 12 May 2018	0	4	5	20
Sunday, 13 May 2018	0	0	0	0
Monday, 14 May 2018	23	4	10	40
Tuesday, 15 May 2018	21	4	10	40
Wednesday, 16 May 2018	25	4	10	40
Thursday, 17 May 2018	37	4	10	40
Friday, 18 May 2018	23	4	10	40
Saturday, 19 May 2018	0	4	5	20
Sunday, 20 May 2018	0	0	0	0
Monday, 21 May 2018	18	4	10	40
Tuesday, 22 May 2018	20	4	10	40
Wednesday, 23 May 2018	21	4	10	40
Thursday, 24 May 2018	25	4	10	40

Friday, 25 May 2018	27	4	10	40
Saturday, 26 May 2018	0	4	5	20
Sunday, 27 May 2018	0	0	0	0
Monday, 28 May 2018	19	4	10	40
Tuesday, 29 May 2018	28	4	10	40
Wednesday, 30 May 2018	24	4	10	40
Thursday, 31 May 2018	27	4	10	40
Friday, 1 June 2018	25	4	10	40
Saturday, 2 June 2018	6	4	5	20
Sunday, 3 June 2018	0	0	0	0
Monday, 4 June 2018	24	4	10	40
Tuesday, 5 June 2018	22	4	10	40
Wednesday, 6 June 2018	22	4	10	40
Thursday, 7 June 2018	16	4	10	40
Friday, 8 June 2018	27	4	10	40
Saturday, 9 June 2018	5	4	5	20
Sunday, 10 June 2018	0	0	0	0
Monday, 11 June 2018	0	0	0	0
Tuesday, 12 June 2018	19	4	10	40
Wednesday, 13 June 2018	28	4	10	40
Thursday, 14 June 2018	22	4	10	40
Friday, 15 June 2018	14	4	10	40
Saturday, 16 June 2018	6	4	5	20
Sunday, 17 June 2018	0	0	0	0
Monday, 18 June 2018	32	4	10	40
Tuesday, 19 June 2018	32	4	10	40
Wednesday, 20 June 2018	30	4	10	40
Thursday, 21 June 2018	31	4	10	40
Friday, 22 June 2018	40	4	10	40
Saturday, 23 June 2018	0	4	5	20
Sunday, 24 June 2018	0	0	0	0
Monday, 25 June 2018	29	4	10	40
Tuesday, 26 June 2018	25	4	10	40
Wednesday, 27 June 2018	26	4	10	40
Thursday, 28 June 2018	29	4	10	40
Friday, 29 June 2018	17	4	10	40
Saturday, 30 June 2018	0	4	5	20
Sunday, 1 July 2018	0	0	0	0
Monday, 2 July 2018	35	4	10	40
Tuesday, 3 July 2018	22	4	10	40
Wednesday, 4 July 2018	28	4	10	40
Thursday, 5 July 2018	40	4	10	40
Friday, 6 July 2018	27	4	10	40
Saturday, 7 July 2018	0	4	5	20
Sunday, 8 July 2018	0	0	0	0
Monday, 9 July 2018	26	4	10	40
Tuesday, 10 July 2018	22	4	10	40
Wednesday, 11 July 2018	23	4	10	40
Thursday, 12 July 2018	20	4	10	40
Friday, 13 July 2018	15	4	10	40
Saturday, 14 July 2018	0	4	5	20
Sunday, 15 July 2018	0	0	0	0
Monday, 16 July 2018	19	4	10	40
Tuesday, 17 July 2018	22	4	10	40
Wednesday, 18 July 2018	26	4	10	40
Thursday, 19 July 2018	27	4	10	40
Friday, 20 July 2018	16	4	10	40
Saturday, 21 July 2018	0	4	5	20
Sunday, 22 July 2018	0	0	0	0
Monday, 23 July 2018	28	4	10	40
Tuesday, 24 July 2018	25	4	10	40
Wednesday, 25 July 2018	22	4	10	40
Thursday, 26 July 2018	24	4	10	40
Friday, 27 July 2018	24	4	10	40
Saturday, 28 July 2018	0	4	5	20
Sunday, 29 July 2018	0	0	0	0
Monday, 30 July 2018	19	4	10	40
Tuesday, 31 July 2018	20	4	10	40
Wednesday, 1 August 2018	28	4	10	40
Thursday, 2 August 2018	33	4	10	40
Friday, 3 August 2018	16	4	10	40
Saturday, 4 August 2018	0	4	5	20
Sunday, 5 August 2018	0	0	0	0

Monday, 6 August 2018	24	4	10	40
Tuesday, 7 August 2018	20	4	10	40
Wednesday, 8 August 2018	21	4	10	40
Thursday, 9 August 2018	22	4	10	40
Friday, 10 August 2018	20	4	10	40
Saturday, 11 August 2018	4	4	5	20
Sunday, 12 August 2018	0	0	0	0
Monday, 13 August 2018	15	4	10	40
Tuesday, 14 August 2018	12	4	10	40
Wednesday, 15 August 2018	23	4	10	40
Thursday, 16 August 2018	22	4	10	40
Friday, 17 August 2018	22	4	10	40
Saturday, 18 August 2018	6	4	5	20
Sunday, 19 August 2018	0	0	0	0
Monday, 20 August 2018	25	4	10	40
Tuesday, 21 August 2018	18	4	10	40
Wednesday, 22 August 2018	15	4	10	40
Thursday, 23 August 2018	25	4	10	40
Friday, 24 August 2018	23	4	10	40
Saturday, 25 August 2018	0	4	5	20
Sunday, 26 August 2018	0	0	0	0
Monday, 27 August 2018	24	4	10	40
Tuesday, 28 August 2018	24	4	10	40
Wednesday, 29 August 2018	38	4	10	40
Thursday, 30 August 2018	25	4	10	40
Friday, 31 August 2018	11	4	10	40
Saturday, 1 September 2018	0	4	5	20
Sunday, 2 September 2018	0	0	0	0
Monday, 3 September 2018	38	4	10	40
Tuesday, 4 September 2018	23	4	10	40
Wednesday, 5 September 2018	15	4	10	40
Thursday, 6 September 2018	15	4	10	40
Friday, 7 September 2018	22	4	10	40
Saturday, 8 September 2018	0	4	5	20
Sunday, 9 September 2018	0	0	0	0
Monday, 10 September 2018	25	4	10	40
Tuesday, 11 September 2018	28	4	10	40
Wednesday, 12 September 2018	29	4	10	40
Thursday, 13 September 2018	32	4	10	40
Friday, 14 September 2018	19	4	10	40
Saturday, 15 September 2018	8	4	5	20
Sunday, 16 September 2018	0	0	0	0
Monday, 17 September 2018	25	4	10	40
Tuesday, 18 September 2018	21	4	10	40
Wednesday, 19 September 2018	27	4	10	40
Thursday, 20 September 2018	24	4	10	40
Friday, 21 September 2018	24	4	10	40
Saturday, 22 September 2018	2	4	5	20
Sunday, 23 September 2018	0	0	0	0
Monday, 24 September 2018	23	4	10	40
Tuesday, 25 September 2018	24	4	10	40
Wednesday, 26 September 2018	18	4	10	40
Thursday, 27 September 2018	14	4	10	40
Friday, 28 September 2018	22	4	10	40
Saturday, 29 September 2018	0	4	5	20
Sunday, 30 September 2018	0	0	0	0
Monday, 1 October 2018	0	0	0	0
Tuesday, 2 October 2018	23	4	10	40
Wednesday, 3 October 2018	20	4	10	40
Thursday, 4 October 2018	21	4	10	40
Friday, 5 October 2018	23	4	10	40
Saturday, 6 October 2018	2	4	5	20
Sunday, 7 October 2018	0	0	0	0
Monday, 8 October 2018	31	4	10	40
Tuesday, 9 October 2018	13	4	10	40
Wednesday, 10 October 2018	18	4	10	40
Thursday, 11 October 2018	17	4	10	40
Friday, 12 October 2018	18	4	10	40
Saturday, 13 October 2018	0	4	5	20
Sunday, 14 October 2018	0	0	0	0
Monday, 15 October 2018	9	4	10	40
Tuesday, 16 October 2018	8	4	10	40
Wednesday, 17 October 2018	13	4	10	40

Thursday, 18 October 2018	13	4	10	40
Friday, 19 October 2018	19	4	10	40
Saturday, 20 October 2018	0	4	5	20
Sunday, 21 October 2018	0	0	0	0
Monday, 22 October 2018	18	4	10	40
Tuesday, 23 October 2018	18	4	10	40
Wednesday, 24 October 2018	22	4	10	40
Thursday, 25 October 2018	23	4	10	40
Friday, 26 October 2018	21	4	10	40
Saturday, 27 October 2018	0	4	5	20
Sunday, 28 October 2018	0	0	0	0
Monday, 29 October 2018	29	4	10	40
Tuesday, 30 October 2018	27	4	10	40
Wednesday, 31 October 2018	17	4	10	40
Thursday, 1 November 2018	24	4	10	40
Friday, 2 November 2018	38	4	10	40
Saturday, 3 November 2018	0	4	5	20
Sunday, 4 November 2018	0	0	0	0
Monday, 5 November 2018	26	4	10	40
Tuesday, 6 November 2018	25	4	10	40
Wednesday, 7 November 2018	14	4	10	40
Thursday, 8 November 2018	24	4	10	40
Friday, 9 November 2018	24	4	10	40
Saturday, 10 November 2018	0	4	5	20
Sunday, 11 November 2018	0	0	0	0
Monday, 12 November 2018	22	4	10	40
Tuesday, 13 November 2018	23	4	10	40
Wednesday, 14 November 2018	25	4	10	40
Thursday, 15 November 2018	18	4	10	40
Friday, 16 November 2018	19	4	10	40
Saturday, 17 November 2018	0	4	5	20
Sunday, 18 November 2018	0	0	0	0
Monday, 19 November 2018	23	4	10	40
Tuesday, 20 November 2018	24	4	10	40
Wednesday, 21 November 2018	24	4	10	40
Thursday, 22 November 2018	22	4	10	40
Friday, 23 November 2018	23	4	10	40
Saturday, 24 November 2018	0	4	5	20
Sunday, 25 November 2018	0	0	0	0
Monday, 26 November 2018	24	4	10	40
Tuesday, 27 November 2018	16	4	10	40
Wednesday, 28 November 2018	29	4	10	40
Thursday, 29 November 2018	23	4	10	40
Friday, 30 November 2018	13	4	10	40
Saturday, 1 December 2018	6	4	5	20
Sunday, 2 December 2018	0	0	0	0
Monday, 3 December 2018	24	4	10	40
Tuesday, 4 December 2018	35	4	10	40
Wednesday, 5 December 2018	24	4	10	40
Thursday, 6 December 2018	20	4	10	40
Friday, 7 December 2018	30	4	10	40
Saturday, 8 December 2018	0	4	5	20
Sunday, 9 December 2018	0	0	0	0
Monday, 10 December 2018	40	4	10	40
Tuesday, 11 December 2018	32	4	10	40
Wednesday, 12 December 2018	27	4	10	40
Thursday, 13 December 2018	27	4	10	40
Friday, 14 December 2018	21	4	10	40
Saturday, 15 December 2018	0	4	5	20
Sunday, 16 December 2018	0	0	0	0
Monday, 17 December 2018	24	4	10	40
Tuesday, 18 December 2018	32	4	10	40
Wednesday, 19 December 2018	24	4	10	40
Thursday, 20 December 2018	15	4	10	40
Friday, 21 December 2018	6	4	10	40
Saturday, 22 December 2018	0	4	5	20
Sunday, 23 December 2018	0	0	0	0
Monday, 24 December 2018	0	4	10	40
Tuesday, 25 December 2018	0	0	0	0
Wednesday, 26 December 2018	0	0	0	0
Thursday, 27 December 2018	0	4	10	40
Friday, 28 December 2018	0	4	10	40
Saturday, 29 December 2018	0	4	5	20

Sunday, 30 December 2018	0	0	0	0
Monday, 31 December 2018	0	4	10	40

APPENDIX 5

DUNLOE SAND QUARRY ACID SULPHATE SOIL MONITORING RESULTS

CHROMIUM SUITE TEST REPORT

Client:	Holcim (Australia)	Report Number:	3740/S/95070CRS
Client Address:	Level 2, 18 Little Cribb Street, Milton QLD 4064	Project No:	3740/P/1333
Project:	Ballina NSW - Holcim Dunloe Sands	Lot Number:	-
Sub Project:	-	Internal Test Request:	3740/T/18957
Location:	Supplied Sample	Client Reference:	22373/CC/185
Component:	-	Purchase Order No:	-
Area Description:	-	Date Sampled:	5/02/2018
Sampled by:	Construction Sciences-Ballina	Date Tested:	20/02/2018
Sampling Method:	AS1141.3.1 Cl 8.4.3	Report Date:	21/02/2018
Test Procedures:	AS 4969.0, .1, .2, .4, .7, .8, .11, .13, .14		

Laboratory Number	Sample Location	pH _{KCl} units: LOR: 0.1	TAA (H ⁺ mol/l)	TAA (% S) 0.001	S _{KCl} (% S) ^a 0.007	S _{Cr} (% S) 0.02	S _{NAS} (% S) 0.001	ANC _{BT} (%CaCO ₃) [#] 0.01	ANC _{BT} (%S) [#] 0.01	Net Acidity (H ⁺ mol/l) 1	Net Acidity (% S) 0.001	Recommended Liming Rate (kg of lime per cubic metre) 0.1
3740/S/95070	553524.42 E 6855631.56 S MGA94 White Sand Location 1	6.5	0	0.000	0.018	0.021	nr	0.05	0.02	6	0.010	No Liming Required
3740/S/95071	553505.13 E 6855632.54 S MGA94 White Sand Location 2	6.6	0	0.000	0.029	0.026	nr	0.07	0.02	7	0.011	No Liming Required
3740/S/95072	553564.42 E 6855619.64 S MGA94 Loam Location 1	8.8	0	0.000	0.011	<0.02	nr	0.24	0.08	-32	-0.051	No Liming Required
3740/S/95073	553483.80 E 6855595.30 S MGA94 Concrete Sand Location 1	9.3	0	0.000	0.014	0.027	nr	0.47	0.15	-46	-0.073	No Liming Required
3740/S/95074	553472.77 E 6855581.06 S MGA94 Concrete Sand Location 2	9.4	0	0.000	<0.007	0.025	nr	0.57	0.18	-60	-0.096	No Liming Required
Blank		6.4	2.0	0.003								

Notes:

nr: not required, pH trigger not met.

LOR: Limit of Reporting

[#] if pH_{KCl} <6.5 it must be assumed that effective ANC is zero.

 Effective ANC is ANC_{BT}/Fineness Factor of 1.5.

^a S_{KCl} determined as sulfate by turbidimetric method.

Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.

Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus

 Potential Acidity (S_{Cr}) plus Retained Acidity (S_{NAS}) minus effective ANC; with a factor of safety of 1.5.

Any recommended liming rate is based on the 0.03%S action criteria.

A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.

The recommended liming rate is derived from a mathematical equation and will need to be field validated.

Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.

The test results contained within this report relate only to the samples as they were received.



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing

 Accreditation No.: 1986
 Corporate Site Number: 3740



APPROVED SIGNATORY: Paul Mayes

Form Number: REP CRS-Holcim-1 29/06/17

CHROMIUM SUITE TEST REPORT

Client:	Holcim (Australia)	Report Number:	3740/S/105666CRS
Client Address:	Level 2, 18 Little Cribb Street, Milton QLD 4064	Project No:	3740/P/1333
Project:	Ballina NSW - Holcim Dunloe Sands	Lot Number:	-
Sub Project:	-	Internal Test Request:	3740/T/20564
Location:	Supplied Sample	Client Reference:	22373/CC/226
Component:	-	Purchase Order No:	-
Area Description:	-	Date Sampled:	21/06/2018
Sampled by:	Construction Sciences - Ballina	Date Tested:	5/07/2018
Sampling Method:	AS1141.3.1 CI 8.4.3	Report Date:	5/07/2018
Test Procedures:	AS 4969.0, .1, .2, .4, .7, .8, .11, .13, .14		

Laboratory Number	Sample Location	pH _{KCl} units: LOR: 0.1	TAA (H ⁺ mol/t) 1	TAA (% S) 0.001	S _{KCl} (% S) ^a 0.007	S _{Cr} (% S) 0.02	S _{NAS} (% S) 0.001	ANC _{BT} (%CaCO ₃) [#] 0.01	ANC _{BT} (%S) [#] 0.01	Net Acidity (H ⁺ mol/t) 1	Net Acidity (% S) 0.001	Recommended Liming Rate (kg of lime per cubic metre) 0.1
3740/S/105666	Sand #1	9.1	0	0.000	0.007	0.047	nr	0.66	0.21	-59	-0.095	No Liming Required
3740/S/105667	Sand #2	9.3	0	0.000	0.007	0.035	nr	0.72	0.23	-74	-0.119	No Liming Required
3740/S/105668	Sand #1	6.8	0	0.000	0.022	0.020	nr	0.11	0.03	-2	-0.003	No Liming Required
3740/S/105669	Sand #2	6.8	0	0.000	0.007	<0.02	nr	0.03	0.01	-4	-0.006	No Liming Required
3740/S/105670	Sand	7.7	0	0.000	<0.007	<0.02	nr	0.23	0.07	-30	-0.049	No Liming Required
Blank		5.7	5.0	0.008								

Notes:

nr: not required, pH trigger not met.

LOR: Limit of Reporting

[#] if pH_{KCl} < 6.5 it must be assumed that effective ANC is zero.

Effective ANC is ANC_{BT}/Fineness Factor of 1.5.

^a S_{KCl} determined as sulfate by turbidimetric method.

Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.

Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus

Potential Acidity (S_{Cr}) plus Retained Acidity (S_{NAS}) minus effective ANC; with a factor of safety of 1.5.

Any recommended liming rate is based on the 0.03%S action criteria.

A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.

The recommended liming rate is derived from a mathematical equation and will need to be field validated.

Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.

The test results contained within this report relate only to the samples as they were received.



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No.: 1986
Corporate Site Number: 3740



APPROVED SIGNATORY: Paul Mayes

Form Number: REP CRS 29/06/2017 Revision 11

CHROMIUM SUITE TEST REPORT

Client:	Holcim (Australia)	Report Number:	3740/S/111409CRS
Client Address:	Level 2, 18 Little Cribb Street, Milton QLD 4064	Project No:	3740/P/1333
Project:	Ballina NSW - Holcim Dunloe Sands	Lot Number:	N/A
Sub Project:	-	Internal Test Request:	3740/T/21413
Location:	Supplied Sample	Client Reference:	22373/CC/238
Component:	Holcim Dunloe Sands	Purchase Order No:	-
Area Description:	Dunloe Sand Quarry, Pottsville	Date Sampled:	28/08/2018
Sampled by:	Construction Sciences - Ballina	Date Tested:	4/09/2019
Sampling Method:	AS1141.3.1 CI 8.4.3	Report Date:	4/09/2018

Test Procedures: AS 4969.0, .1, .2, .4, .7, .8, .11, .13, .14

Laboratory Number	Sample Location	pH _{KCl} units: LOR: 0.1	TAA (H ⁺ mol/t) 1	TAA (% S) 0.001	S _{KCl} (% S) ^a 0.007	S _{Cr} (% S) 0.02	S _{NAS} (% S) 0.001	ANC _{BT} (%CaCO ₃) [#] 0.01	ANC _{BT} (%S) [#] 0.01	Net Acidity (H ⁺ mol/t) 1	Net Acidity (% S) 0.001	Recommended Liming Rate (kg of lime per cubic metre) 0.1
3740/S/111409	Concrete Sand #1	9.6	0	0.000	0.007	0.032	nr	0.60	0.19	-60	-0.095	No Liming Required
3740/S/111410	Concrete Sand #2	9.2	0	0.000	<0.007	0.028	nr	0.52	0.17	-52	-0.083	No Liming Required
3740/S/111411	White Sand #1	7.2	0	0.000	0.019	0.038	nr	0.12	0.04	7	0.012	No Liming Required
3740/S/111412	White Sand #2	7.2	0	0.000	0.011	0.037	nr	0.21	0.07	-4	-0.007	No Liming Required
3740/S/111413	Brickies Loam	7.6	0	0.000	0.011	<0.02	nr	0.24	0.08	-32	-0.052	No Liming Required
Blank		6.3	1.6	0.002								

Notes:

nr: not required, pH trigger not met.

LOR: Limit of Reporting

[#] if pH_{KCl} < 6.5 it must be assumed that effective ANC is zero.

 Effective ANC is ANC_{BT}/Fineness Factor of 1.5.

^a S_{KCl} determined as sulfate by turbidimetric method.

Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.

Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus

 Potential Acidity (S_{Cr}) plus Retained Acidity (S_{NAS}) minus effective ANC; with a factor of safety of 1.5.

Any recommended liming rate is based on the 0.03%S action criteria.

A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.

The recommended liming rate is derived from a mathematical equation and will need to be field validated.

Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.

The test results contained within this report relate only to the samples as they were received.



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing

 Accreditation No.: 1986
 Corporate Site Number: 3740



APPROVED SIGNATORY: Paul Mayes

Form Number: REP CRS-Holcim-1 29/06/17