Strength. Performance. Passion.

Dunloe Sands Quarry
Annual Review 2017

Holcim (Australia) Pty Ltd

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SITE DETAILS

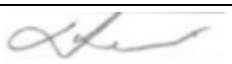
Name of operation	Dunloe Sand Quarry
Name of operator	Holcim (Australia) Pty Ltd
Development consent / project approval #	Project Approval 06- 0030
Name of holder of development consent / project approval	Holcim (Australia) Pty Ltd
Annual review start date	January 1, 2017
Annual review end date	December 31, 2017

I, **Daniel Dwyer**, certify that this audit report is a true and accurate record of the compliance status of the **DUNLOE SAND QUARRY** for the period of **JANUARY 2017- DECEMBER 2017** and that I am authorised to make this statement on behalf of **HOLCIM (AUSTRALIA) PTY LTD**.

Note.

a) *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.*

b) *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).*

Name of authorised reporting officer	Daniel Dwyer
Title of authorised reporting officer	Quarry Supervisor
Signature of authorised reporting officer	
Date	29 March 2018

Revision	2	**Purpose**	DPE Review Comments
Author	Victoria Musgrove	**Date**	11/10/18

1 STATEMENT OF COMPLIANCE

The statement of commitments for the 2017 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 2017 reporting period.

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: ● 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: ● 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 2017

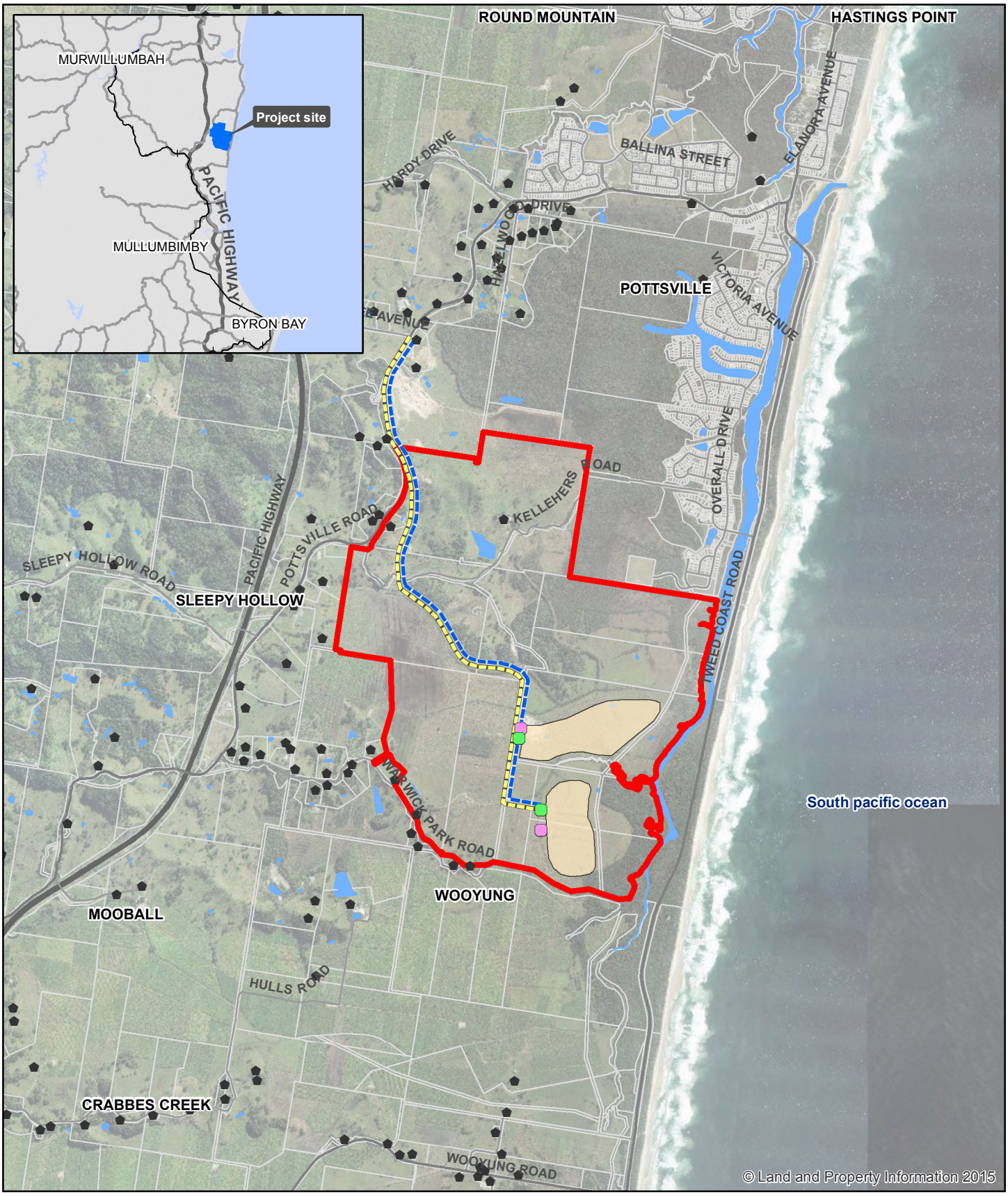
<table>
<tr><th>Relevant approval</th><th>Condition</th><th>Condition Description</th><th>Compliance Status</th><th>Section addressed in Annual Review</th></tr>
<tr><td>PA 06_ 0030</td><td>Schedule 3, Condition 6</td><td>The Proponent shall ensure that dust generated by the project does not cause additional exceedances of the criteria listed in Tables 3 to 5 at any privately owned land.
<table><tr><th>Pollutant</th><th>Averaging period</th><th>Criterion</th></tr><tr><td>Particulate matter < 10 µm (PM_{10})</td><td>24 hour</td><td>50 µg/m^3</td></tr></table>Table 3: Short Term Impact Assessment Criteria for Particulate Matter
<table><tr><th>Pollutant</th><th>Averaging period</th><th>Criterion</th></tr><tr><td>Total suspended particulate (TSP) matter</td><td>Annual</td><td>90 µg/m^3</td></tr><tr><td>Particulate matter < 10 µm (PM_{10})</td><td>Annual</td><td>β0 µg/m^3</td></tr></table>Table 4: Long Term Impact Assessment Criteria for Particulate Matter
<table><tr><th>Pollutant</th><th>Averaging period</th><th>Maximum increase in deposited dust level</th><th>Maximum total deposited dust level</th></tr><tr><td>Deposited dust</td><td>Annual</td><td>2 g/m^2/month</td><td>4 g/m^2/month</td></tr></table>Table 5: Long Term Impact Assessment Criteria for Deposited Dust
Note: Deposited dust is assessed as insoluble solids as defined by Standards Australia, 1991, AS/NZS 3580.10.1-2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.</td><td>Non- compliant</td><td>Section 6.2 (Air Quality) and
Section 11.</td></tr>
<tr><td>PA 06_ 0030</td><td>Schedule 3, Condition 7</td><td>The Proponent shall prepare and implement a Dust Monitoring Program for the project to the satisfaction of the Director-General.</td><td>Non- compliant</td><td>Section 6.2 (Air Quality) and
Section 11.</td></tr>
</table>

2 INTRODUCTION

The Dunloe Sand Quarry was granted Project Approval (PA06_0030) Quarry 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.

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 2016, located at Dunloe Park, Pottsville.



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 1994
Grid: GDA 1994 MGA Zone 56

N

Holcim (Australia) Pty Ltd
Dunloe Sand Modification

Job Number	22-18823
Revision	A
Date	10 Apr 2017

Site location and layout

Figure 2

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

N:\AU\Sydney\Projects\22\18823\GIS\Maps\Deliverables\22-18823-Z001_SiteLocation.mxd

Data source: Aerial Imagery: Sixmaps (2017 - NSW LPI), LPI DCDB: Cadastre, 2012; LPI DTDB: Topo base data, 2012. Created by:mking3

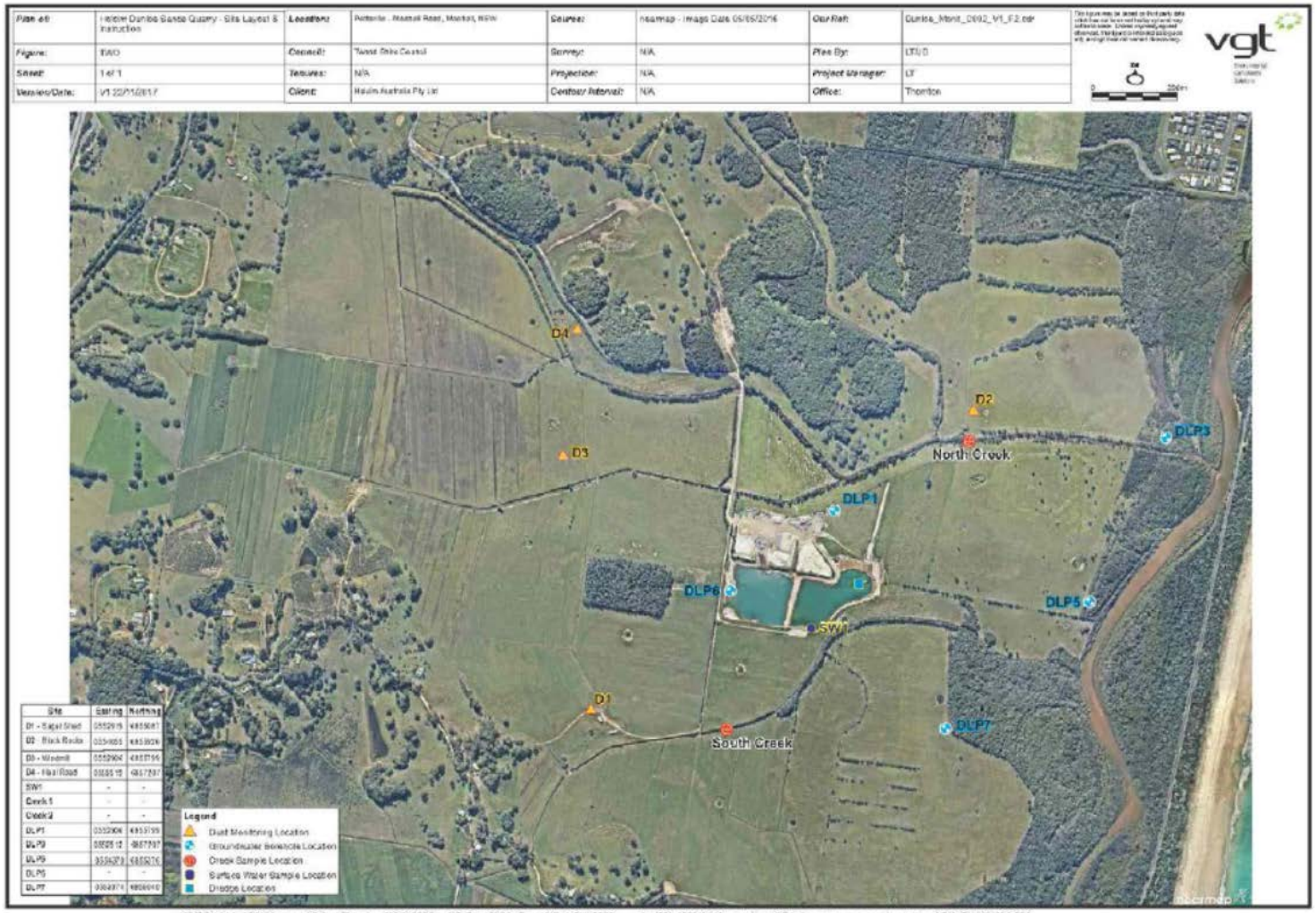


Figure 3: Environmental Monitoring Locations

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

This Annual Review has also been prepared in accordance with the *Annual Review Guideline: post approvals requirements for state significance mining developments* (October 2015). This report documents the environmental performance of the site from January to December 2017.

2.1 Name and Contact Details

The key contact details for the site are outlined below:

Quarry Supervisor

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0411 795 060
daniel.dwyer@lafargeholcim.com

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Quarry Manager

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Planning & Environment Coordinator NSW/ACT

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amy.nelson@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 DPE
EPL No. 13077	NSW EPA
Bore Licence 30BL183076, 30BL183077, 30BL183078, 30BL183079, 30BL183080, 30BL183081, 30BL183082, 30BL183084 and 30BL183086	NSW DPI Water

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

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 2017 reporting period.

4.2 Land Preparation

During the 2017 reporting period there was some clearing of grassland and paddocks (approximately 1 Ha) within the existing extraction limit boundary in preparation for quarrying. There was no vegetation removal during 2017 (removal of trees).

4.3 Construction Activities

There were no construction activities undertaken at the Dunloe Sand Quarry during the 2017 reporting period.

4.4 Quarry Operations

The Dunloe Sand Quarry officially commenced operations under Holcim on August 1, 2016. Development activities undertaken in 2017 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 2017 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 2017.

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

Table 7: Total Product Distributed (Dunloe Sand Quarry)

Material	Approval Limit (Tonnes)	2016 Reporting Period (Tonnes)	2017 Reporting Period (Tonnes)
Product Distributed- Total	300,000	65,730.30	150,339

4.5 Next Reporting Period

Development activities proposed at the Dunloe Sand Quarry in 2018, 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.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

Actions required by the 2016 Annual Review are listed in **Table 8**. These items have been closed out in accordance with the conditions of the Project Approval. Ongoing actions and their current compliance status are provided in **Table 9**.

Table 8: Actions Required from Annual Review – DPE

Aspect	Requirement	Compliance Status
Outstanding actions from previous AEMR Review	The Department letter of 19 October 2016 requested a number of changes be incorporated into future AEMRs. The following changes have not been incorporated into the 2016 AEMR as requested: i) The name/number of all relevant approvals held, including but not limited to: EPL, water licences and groundwater bore licences. The Department Review of the 2016 AEMR notes that changes occurred during the reporting period should also be identified (e.g. the EPL Licence was transferred on 12 September 2016). ii) Reporting and discussion of all relevant monitoring results (Schedule 5, Condition 5 f) and a comparison against monitoring results from previous years (the minimum, maximum, historical average, trends). iii) Figures showing the approved site boundary (plus a legend denoting as such) and its location with regional context, and a figure of the site on a current aerial photograph showing the approved site boundary, approved extraction areas and the current rehabilitation areas as defined in Schedule 3, Condition 26a (plus a legend denoting as such). iv) A table that outlines actions required for last year's AEMR and details the status of the actions and a reference as to where each action has been addressed within the AEMR. v) Tabulated noise monitoring data for the full reporting period with the raw data appended to the report. A report on the performance of the rehabilitation vegetation. Include a comparison of monitoring results to previous year's results and against the rehabilitation and revegetation objectives. Also, please list the identified improvements that were noted in the revised AEMR. The Department's review of the 2016 AEMR notes that the AEMR includes a number of the routine quarterly rehabilitation monitoring sheets in an Appendix. These sheets are not dated and poorly identify the monitoring locations. The AEMR and sheets refer to photographs yet none are provided. As such the information provide has not addressed the Department's request.	i– Section 3 ii – Section 6. Appendix 2. iii - Figure 1-3 iv –Table 4 and 7 v – Section 6 and Appendix 1

Aspect	Requirement	Compliance Status
Rehabilitation Bond	In accordance with Schedule 3, Condition 30, the Department requests that the rehabilitation bond calculation be reviewed and submitted to the Director General for their satisfaction.	Previously updated.
Annual production data	Annual production data has not been provided in the specific format required under Schedule 3, Condition 45. This non-compliance was also identified in the Independent Environmental Audit.	Section 4.4
Annual Reporting	In accordance with Schedule 5, Condition 5, AEMR's are to be submitted annually which comprises and analyse the monitoring results for the project for the past year. The AEMR reissued in 2016 reported on monitoring data from December 2014 till June 2015. This current report covers the period from the 1 January 2016 to 31 December 2016. The Department requests the monitoring results for the period 1 July 2015 to 31 December 2016 be included as part of this report.	This Annual Review covers the 2017 Calendar Year.
Annual Reporting	In accordance with Schedule 5, Condition 5(h), the non-compliance with the analysis of samples for DLP locations, as notified in Sasha Peterson's email dated 1 August 2016, has not been included in the AEMR as advised by the Department under email of 17 August 2016.	Included in revised version of the 2016 AEMR.
Annual Reporting	In accordance with Schedule 5, Condition 5(f), the Department notes the following anomalies, and seeks further clarification: i) Appendix 2 only includes blue green algae monitoring results only for the first two quarters of 2016. Please advise the status of the 2016 third and fourth quarter monitoring data. It is also noted that monitoring is not being undertaken in accordance with the frequency specified in the approved management (i.e. fortnightly). ii) Holcim Fines Managements Action Plan (20/10/2016) identifies that site staff will undertake monthly pond depth surveys to ensure all fines are interned below a depth of approximately 8 metres (+/-1 metres) on the bed of the pond. This was to commence in October 2016. The Department requests a summary of monitoring be included in the AEMR for the reporting period. iii) pH levels recorded in the extraction pond ranged between 3.5 and 4.9 which is below interim target criteria (5.0 to 8.5). Please provide further advice as to how this issue is being addressed.	i – Appendix 2 ii - Section 6.8 iii – Section 7.3
Annual Reporting	Revision of environmental management and monitoring strategies/plan/programs in accordance with Schedule 5, Condition 8, please advise that status of the review of environmental management and monitoring strategies/plans/programs in Schedules 3 and 5 as a result of the Independent Environmental Audit.	Covered in previous AEMR submission

Aspect	Requirement	Compliance Status
Presentation of monitoring data	The Department suggests: ii) The units of measurement and performance criteria and EA predictions be noted in tables. iii) Monitoring data which is not within target criteria are highlighted. Graphs of monitoring data also include performance criteria and EA predictions, as applicable.	Covered in previous report and this report.
Administrative matters	Section 8 of the AEMR 2016 states that a copy of the external stakeholder reporting database register is attached. The database has not been attached as indicated.	Attached to the revised 2016 AEMR
Access to Information	The Department notes that the company's website contains various environmental and community documents. The Department requests that the website be updated to include the management plans for the site.	Holcim website has been updated.

Table 9: Actions required from Annual Review – Holcim Proposed Actions

Commitment	Compliance Status
Independent Environmental Audit - Staff will close out all actions associated with the 2016 IEA.	Actions closed out
Progressive Rehabilitation - The site will continue to progressively rehabilitate available areas on the northern and eastern boundary lines.	Progressive rehabilitation is completed by the lease owner – Ramtech.
Development Application (Truck Movements Modification) - Application to modify the current Project Approval condition limiting truck movement to 4 (in and out) per hour.	Section 6.4
EMP Review - Development of a new Environmental Management Plan with alignment to Holcim Australia's Environmental Management System.	Still being developed

6 ENVIRONMENTAL PERFORMANCE

6.1 Meteorological Monitoring

Monthly rainfall data for 2017 has been provided in **Table 10.**

Table 10: Monthly Rainfall at the Dunloe Sand Quarry for 2017

Monthly Rainfall (mm)												Total 2017
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0	98	280	49	76	102	22	0	0	191	167	34	**1,019**

No meteorological trends are currently available.

6.2 Noise

6.2.1 EIS Predictions

The EIS (2007) stated that modelling of noise levels likely to originate from the proposal indicate that 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 11.**

Table 11: 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.

Receiver Location	*Day $L_{Aeq\ (15\ min)}$ dB(A)*
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 2017;
- 20 June 2017;
- 3 September 2017; and
- 15 December 2017.

The compliance assessments for each residential receiver (R1, R2, R3 and R4) are presented in **Table 12**.

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.

Longterm Trends:

Noise monitoring completed over a number of years for this project has generally been inaudible and within criteria. This continued for noise monitoring in 2017.

Comparison to EIS Predictions:

As noise levels were within criteria in 2017, 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:

- Restrict hours of operation of the 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 12: Noise Monitoring Assessment for the Dunloe Sand Quarry (MAC, 2017)

Assessment Period	Receiver No.	Quarrying Noise Criteria $LAeq_{(15min)}$	Q1		Q2		Q3		Q4	
			Quarry Noise Contribution $LAeq_{(15min)}$	Compliant	Quarry Noise Contribution $LAeq_{(15min)}$	Compliant	Quarry Noise Contribution $LAeq_{(15min)}$	Compliant	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 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

The site is required to monitor dust deposition in accordance with the criteria listed in **Table 13, Table 14** and **Table 15.**

Table 13: 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 14: Short Term Impact Assessment Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion
Particulate Matter 10 µm (PM_{10})	24 Hour	50 $\mu g/m^3$

Table 15: Long Term Impact Assessment Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion
Total suspended particulate (TSP) matter	Annual	90 $\mu g/m^3$
Particulate Matter 10 µm (PM_{10})	Annual	30 $\mu g/m^3$

6.3.3 Key Environmental Performance

6.3.3.1 Depositional Dust

Dust deposition monitoring was undertaken at 4 locations across the 2017 reporting period (see **Table 16**). All four monitoring points were found to be well below the annual average ($4g/m^2$) and in compliance with the Project Approval. However it should be noted, there was an error with sampling depositional dust, with thirteen monitoring events occurring instead of twelve.

Table 16: 2017 Dust Monitoring (Depositional Dust)

Start Date	End Date	DDG1	DDG2	DDG3	DDG4
		(g/m^2/month)			
01-Jan-17	30-Jan-17	0.3	0.2	0.5	0.3
30-Jan-17	27-Feb-17	0.3	0.2	0.2	0.3
27-Feb-17	22-Mar-17	0.2	0.1	2.4	0.3
22-Mar-17	19-Apr-17	0.2	0.9	1	0.3
19-Apr-17	17-May-17	0.8	0.8	1.4	0.7
17-May-17	14-Jun-17	0.2	0.2	0.2	0.2
14-Jun-17	12-Jul-17	0.3	<0.1	0.2	0.3
12-Jul-17	09-Aug-17	0.1	<0.1	0.2	0.5
09-Aug-17	06-Sep-17	0.5	0.2	0.5	0.5
06-Sep-17	04-Oct-17	0.7	0.6	2.4	0.9
04-Oct-17	01-Nov-17	0.5	0.3	0.8	0.5
01-Nov-17	29-Nov-17	0.1	0.2	0.3	<0.1
29-Nov-17	28-Dec-17	0.4	0.3	0.2	0.2
Minimum Insoluble Solids		**0.1**	**<0.1**	**0.2**	**<0.1**
Maximum Insoluble Solids		**0.8**	**0.9**	**2.4**	**0.9**
Annual Average ($4g/m^2$/year)		**0.35**	**0.32**	**0.79**	**0.39**
Result		**Within Criteria**	**Within Criteria**	**Within Criteria**	**Within Criteria**

A comparison of results from 2016 and 2017 has been undertaken in **Table 17**. The monthly average at all gauges remained below the allowable maximum increase of 2 g/m^2/month.

Table 17: Depositional Dust Monitoring Summary (2016-2017)

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

Longterm Trends:

The annual average depositional dust levels recorded in the 2017 reporting period at all monitoring locations are generally consistent with those recorded in 2016. The maximum increase in annual average deposited dust levels remained within 0.31 g/m^2/month at all monitoring locations, well below the 2 g/m^2/month criteria.

Comparison to EIS Predictions:

The results for depositional dust were within the predicted limits of the EIS predictions.

6.3.3.2 PM_{10} Monitoring

PM_{10} monitoring is required to be undertaken in accordance with the criteria provided in **Table 14** and **Table 15.**

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 PM_{10} 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 PM_{10} 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 PM_{10} monitor arriving on site.

Holcim provided DPE a letter on 22 September 2017 detailing the reasons behind the site's failure to monitor PM_{10}. Holcim were issued with an Official Caution from DPE on 4 October 2017.

Results of PM_{10} monitoring undertaken since November 2017 have been provided in **Table 18**.

Table 18: Particulate Matter (PM_{10}) 2017 Dust Monitoring at Dunloe Sand Quarry

Date Sampled	Sampling Period (hours)	PM_{10} (µg/m^3)	Compliance with Criteria (50 µg/m^3 in 24hr)
02-Nov-17	24	32	Within criteria
08-Nov-17	24	12	Within criteria
14-Nov-17	24	18	Within criteria
20-Nov-17 and 26-Nov-17	48	18	Result inadmissible. Filter was not changed and ran twice
02-Dec-17	24	12	Within criteria
08-Dec-17	24	15	Within criteria
14-Dec-17	24	13	Within criteria
20-Dec-17 and 26-Dec-17	48	15	Result inadmissible. Filter was not changed due to holiday period
Annual Average (30µg/m^3/year)		**Not yet reportable**	

The Long Term Impact Assessment Criteria (annual average) is not yet reportable due to results only being collected for two months of the 2017 reporting period.

During the 2017 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. No issues associated with dust from operations were identified in 2017.

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. To ensure the effectiveness of the shaker screen, the product removed from vehicles is to be removed from under the screen at least twice per week;
- 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;
- It is expected that dust generation would be limited to freshly disturbed areas. To facilitate dampening, a portable hose or water spray/sprinkler system is 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 Development Consent requirements.

6.4 Traffic Management

6.4.1 EIS Predictions

Operating times and the volume of material within the resource will see the requirement for 18 full time employees plus additional contract maintenance personnel as may be required. Operations will be conducted Monday to Saturday. No operations are to be undertaken on Sunday or public holidays.

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

Operations will be conducted Monday to Saturday. No operations are to be undertaken on Sunday or public holidays as per the Development Consent (Schedule 3 Condition 3).

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 (ie - 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 (ie - 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 are illustrated within **Appendix 4**.

Traffic travelling to and from the site continued to make use of the Pacific Highway, via the Cudgera Creek interchange during the 2017 reporting period.

In summary:

- There was a total of 4382 trucks recorded leaving site during 2017; and
- Haulage occurred at an average of 17.5 trucks during haulage days during 2017.

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*. These include:

- 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 8 trips 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.

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.

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. During the 2017 reporting period, vegetation clearance was limited to exotic pasture grassland within the approved extraction boundary. There was no removal of trees due to a lack thereof and hence a pre-clearance survey and fauna spotter-catcher was not required.

There was some minor weed spraying at the site in 2017.

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
- Ecological monitoring.

6.5.5 Proposed Improvements

Continuation of weed management during 2018.

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), with no areas of concern identified.

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. There is a potential heritage item at site which has been cordoned off (prior to 2017) following consultation with an Aboriginal heritage specialist.

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 Conditions 10 and 11, Schedule 3 of 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 EMP, for an area of extraction required for the following 2-3 years. The drilling program was been 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 m^2 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 m^2 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 Environmental Management Plan. A summary report of the 2016 acid sulphate soils monitoring results is included as **Appendix 5**.

6.7.2 Extraction

Excavation of loam, dredging and washing activities 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-interned below the 3 meter water mark at a depth of 8 metres in the returns pond; and

4. Cardno test production sand stockpiles on a testing regime 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 2017 are detailed in **Table 21.**

Table 21: Environmental Performance at the Dunloe Sand Quarry in 2017

Aspect	Approval Criteria / EIS Prediction	Performance during 2017 reporting period	Trend / key management implications	Implemented / proposed management actions
Noise	EIS predictions are all below development consent criteria.	Quarterly monitoring has met the Development Consent Criteria.	Consistently meets criteria.	None Required.
Air Quality	EIS predictions are all below development consent criteria.	Dust deposition results are within criteria of EPL, EIS and Development Consent. PM_{10} monitoring only recently commenced	Dust deposition has been consistent with EIS and previous Annual Review reporting.	Complete monitoring as per the EMP and Development Consent requirements.
Traffic Management	EIS predictions are all below development consent 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 development consent criteria.	Criteria meets EIS, EPL and Development Consent criteria.	Groundwater consistent with trend data.	Ensure water quality monitoring is completed in accordance with the EMP.
Biodiversity	No impacts to threatened species. No criteria.	No impacts	Consistently no impacts.	None required.
Heritage	No impacts to Aboriginal Heritage. No criteria.	No impacts	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 undertaken monthly extraction pond water monitoring in accordance with the criteria listed in **Table 22.**

Table 22: Monthly Surface Water Quality Criteria – Extraction Pond

Monthly Monitoring

Parameter	Interim Target Criteria	Baseline monitoring 9/06-8/07
pH	5.0 – 8.5	3.55-8.44 (6.49)
Electrical Conductivity (EC)	<5.50 mS/cm	0.286 - 45mS/cm (11.930mS/cm)
Dissolved Oxygen (DO)	>4.00 mg/L	0.81-7.49 (4.34)mg/L
Turbidity	<20 (NTU)	3-67 (14.4) NTU
Oil and Grease	10 mg/L	

The site has undertaken quarterly extraction pond water monitoring within the surrounding environment in accordance with the criteria listed in **Table 23.**

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 undertaken 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 undertaken 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 undertaken 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 undertaken 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

A summary of results obtained from monthly sampling in the extraction pond is provided in **Table 28**.

Table 28: Monthly Extraction Pond Water Quality Monitoring 2017 Results

Parameter	Unit	Interim Target Criteria	Baseline (2006/07)	Min	Max	Average
pH	-	5.0-8.5	3.55-8.44	3.4	6.5	4.55
EC	uS/cm	<2000	286-450	84	979	349.5
DO	Mg/L	>4.00	0.81-7.49	6.6	9.9	8.28
Turbidity	NTU	<20	3-67	1	400	68.5
Oil and Grease	Mg/L	10	-	<5.0	<5.0	<5.0

Results for pH have varied between 3.4 and 6.5 during the 2017 reporting period. pH results were below the lower limit of the interim target criteria on the majority of monitoring occasions throughout 2017, bringing the annual average below the interim target criteria. Other results were highly variable for EC and turbidity.

EC, dissolved oxygen and oil and grease remained within the interim target criteria for all monitoring occasions.

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

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.

Table 29: Quarterly Extraction Pond Chemical Analysis Monitoring 2017 Results

Parameter (mg/L)	Interim Target Criteria	Baseline (2006/07)	Min	Max	Average
Calcium	55	0.7-114	-	-	-
Manganese	0.15	0.01-0.56	0.12	0.57	0.275
Magnesium	40	0.8-173.0	2	10	4.43
Sodium	280	7-1,770	7	46	18
Potassium	17.5	0-71	2	7	3.5
Bicarbonate	400	-	-	-	-
Chloride	285	15-3,500	8	67	25.5
Alkalinity	185	0-534	<5	<5	<5
Sulphate	175	9-753	25	260	104
Aluminium	0.75	<0.01-4.96	0.17	5.6	1.68
Arsenic	0.005	<0.005-0.027	Not detected	Not detected	Not detected
Iron (Dissolved)	705	0.03-43	0.04	1.7	0.48

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 2017 reporting period are displayed within **Table 30.**

Table 30: Surface Water Quality Monitoring 2017 Results – Blue Green Algae

Date	Cyanophyta (cells/ml)	Chlorophyta (cells/ml)
	Criteria: <50,000	
30-Jan-17	ND	1,780
27-Feb-17	ND	640
22-Mar-17	<1	175
19-Apr-17	<5	600
17-May-17	<5	2,820
14-Jun-17	<5	1,830
12-Jul-17	<5	5,260
09-Aug-17	<5	41,500
06-Sep-17	<5	99,800
04-Oct-17	<5	128,000
01-Nov-17	<5	38,600
19-Nov-17	<5	8,150
28-Dec-17	<5	1,890

The cyanophyta results remain below the detection limit throughout the 2017 reporting period.

The Chlorophyta results gathered at site across several years have illustrated some variability. It is noted that variations in Chlorophyta 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 cyanophyta readings. Advice previously received the Blue Green Algae expert nominated in the EMP (Paul Wright from the Tweed Laboratory) is that it is quite normal for Chlorophyta results to vary markedly and that high readings are not dangerous or indicative of any other potential cause for concern.

No visible algal blooms were noted by site staff during the 2017 reporting period.

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:

- Generally acidic pH readings,
- High variability of turbidity,
- Low levels of oil and grease;
- 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

Groundwater monitoring was undertaken at DLP 1, DLP 3, DLP 5, DLP 6 and DLP 7 during the 2017 reporting period. Results obtained at each bore in 2017 have been consistent at each location with no trends identified in the data showing any substantial changes in results since the 2015 and 2016 reporting periods.

DLP3 and DLP 7 present conductivity levels above the maximum interim target of 2000uS/cm^2 stated within the EMP, with this also being the case in 2016. These sites have also expressed similar levels of 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 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 2017 Results

Location	Parameter	Interim Target Criteria	Minimum	Maximum	Average
DLP1	pH	4.2-7.0	4	4.6	4.3
	EC (uS/cm)	<2.0	103	197	133.8
DLP3	pH	4.2-7.0	5.9	6.2	6
	EC (uS/cm)	<2.0	7013	7970	7463.5
DLP5	pH	4.2-7.0	4.5	5.5	5.1
	EC (uS/cm)	<2.0	179	2200	405.5
DLP6	pH	4.2-7.0	3.6	3.9	3.8
	EC (uS/cm)	<2.0	822	1745	1269.7
DLP7	pH	4.2-7.0	6.8	7.1	6.95
	EC (uS/cm)	<2.0	344	3480	3125.4

Quarterly Groundwater monitoring was undertaken at DLP 1, DLP 3, DLP 5, DLP 6 and DLP 7 during the 2017 reporting period. A summary of results is provided in **Table 32**. Results at DLP 1 and DLP 5 are within the expected interim target criteria for these locations.

‘

Table 32: Quarterly Groundwater Quality Monitoring 2017 Results

Location	Parameter	Interim Target Criteria	Q1	Q2	Q3	Q4	Average
DLP1	Manganese (mg/L)	0.15	0.018	0.039	0.017	0.02	**0.024**
	Magnesium (mg/L)	40	<0.5*	1	<0.5*	0.6	**0.65**
DLP3	Manganese (mg/L)	0.15	0.67	-	0.6	0.62	**0.63**
	Magnesium (mg/L)	40	130	-	120	130	**126.7**
DLP5	Manganese (mg/L)	0.15	0.009	-	<0.005*	0.11	**0.060**
	Magnesium (mg/L)	40	2	-	<0.5*	41	**14.5**
DLP6	Manganese (mg/L)	0.15	1.9	1.4	0.93	0.67	**1.12**
	Magnesium (mg/L)	40	12	17	11	8.8	**14.45**
DLP7	Manganese (mg/L)	0.15	0.076	-	0.065	0.063	**0.068**
	Magnesium (mg/L)	40	36	-	38	38	**37.3**

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

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 Flood Storage Capacity

In accordance with the recommendation detailed in the IEA the site is required to undertake the following condition to confirm flood storage:

Schedule 3, Condition 17

The Proponent shall ensure that the flood storage capacity of the site is no less than the pre-existing flood storage capacity at all stages of the project. Details of the available flood storage capacity shall be reported in the AEMR.

The site has been constructed in accordance with the extraction plans approved by the DPE. The entire northern extraction area has been bunded to a height of approximately 1 metre along the perimeter of disturbance.

No significant changes to the layout or the landform (with exception to the creation of the extraction ponds) has been created by the site since operations commenced with the flood storage capacity maintained in accordance with the original storage levels at the commencement of the project.

7.7 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 2017

Guideline Requirement	Site Comment
Extent of the operations and rehabilitation at completion of the reporting period	Rehabilitation completed by the lease holder Ramtech. Throughout 2017 the three rehabilitation zones were managed and worked on in accordance with the approved EMP including invasive species removal and monitoring.
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 *Rehabilitation and Revegetation Management Plan*.
Renovation or removal of buildings	None during reporting period
Any other Rehabilitation taken including: ● Exploration activities; ● Infrastructure; ● Dams; and ● The installation or maintenance of fences, bunds and any other works.	No rehabilitation of these features was completed. Following the significant damage caused by the flooding associated with the Ex. tropical cyclone Debbie in 2017, boundary fence maintenance was undertaken in the form of removal of debris from fencing strands.
Any rehabilitation areas which have received formal sign off from DRG	None.
Variations to activities undertaken to those proposed (including why there were variations and whether DRG was notified)	No variations to the *Rehabilitation and Revegetation Management Plan*.
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

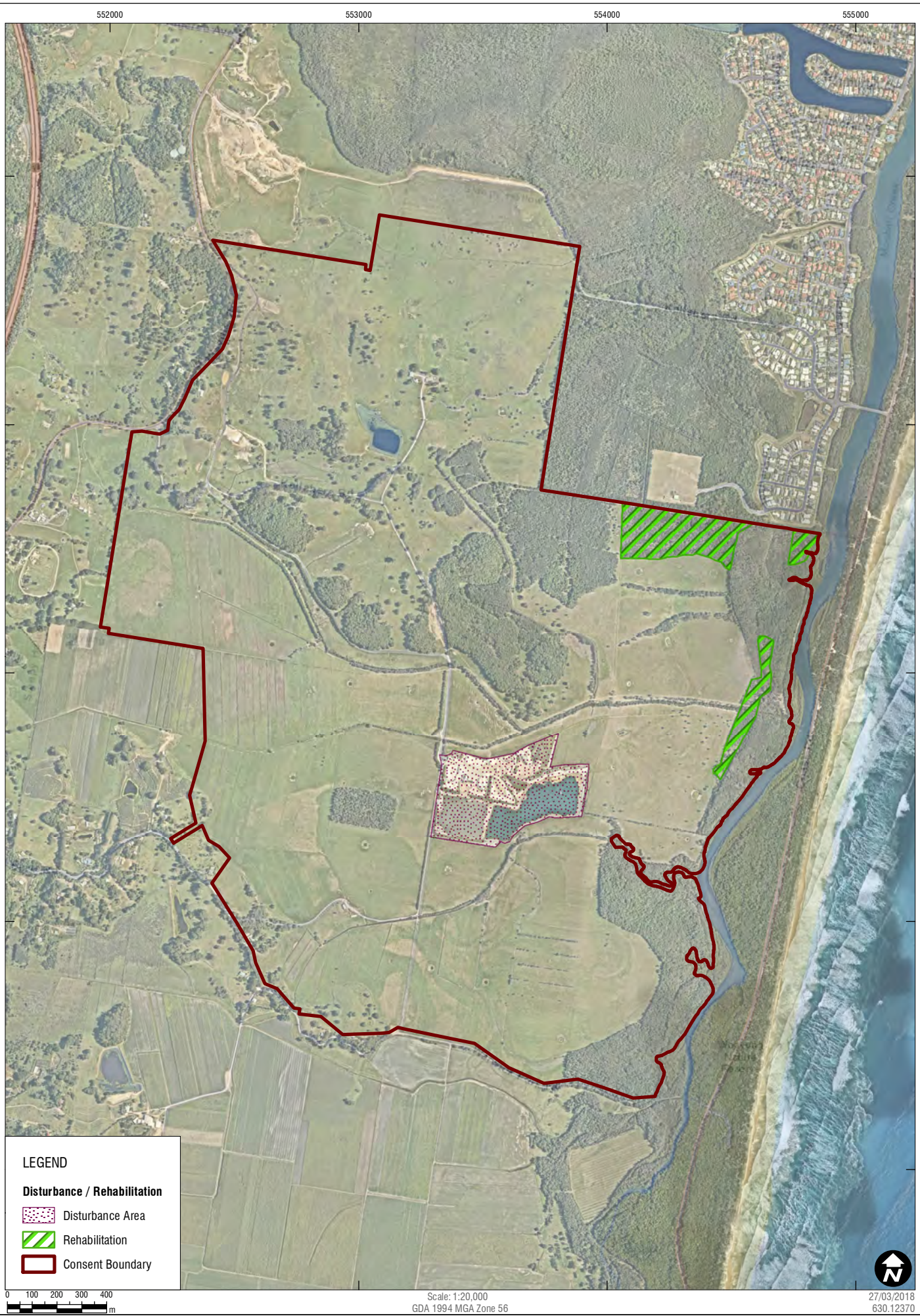
Quarry Area Type	This Reporting Period (Actual)	Next Reporting Period (Forecast)
	Current AEMR Period (ha)	Next AEMR Period (ha)
A. Total Quarry Footprint	32.2	32.2
B. Total Active Disturbance	18.8	18.8
C. Land Being Prepared for Rehabilitation	0	0
D. Land Under Active Rehabilitation	13.4	13.4
E. Completed Rehabilitation	0	0

At the end of 2017 there was approximately 18.8 Ha of active disturbance and 13.4 Ha of active rehabilitation. There is no rehabilitation proposed in 2018.

Rehabilitation monitoring of established rehabilitation has shown:

- Dominant species are melaleuca, banksia and casuarina;
- Evidence of grass and leaf litter; and
- Some tree species greater than 8 metres high, shrub species greater than 3 m high and groundcover to 1 m.

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



Sheet Size : A4

SLR

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Dunloe Sand Quarry
Disturbance and Rehabilitation

FIGURE 4

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

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	Rehabilitation to continue in 2018.
Outline proposed rehabilitation trials, research projects and other initiatives to be undertaken during next reporting period	Rehabilitation inspections/monitoring to continue.
Summary of rehabilitation activities proposed for next report period	No specific rehabilitation proposed for 2017.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

A Community Consultative Committee (CCC) meeting undertaken on 24 February 2017. The site implemented a CCC when under the operation of Ramtech as part of the conditions of consent. All minutes from each of the meetings undertaken in 2017, 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 Development Consent 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 and the local horse association.

9.3 Complaints

Two community complaints were received in 2017:

1. 24/2/17 – Stop sign faded at entry/exit to the Haul Road – Holcim installed a new sign and remarked the solid stop line at the site entry; and

2. 20/5/17 – Noise complaint regarding truck noise from resident located opposite entrance – Holcim engaged with the resident to confirm the nature of their concern and ensure open communication channels should further concerns arise; no further noise issues have been raised by this or other residents.

10 INDEPENDENT AUDIT

The site undertook an IEA in 2016 in accordance with the timeframes of the Development Consent. 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.

11 INCIDENTS AND NON-COMPLIANCE

Table 36 summarises the incidents and non - compliances at the Dunloe Sand Quarry in 2017.

Table 36: Summary of Incidents and Non - Compliances

<table>
<tr><th>Date</th><th>Incident</th><th>Action</th></tr>
<tr>
<td>Throughout the Annual Review period</td>
<td>
Schedule 3 Condition 6
The Proponent shall ensure that dust generated by the project does not cause additional exceedances of the criteria listed in Tables 3 to 5 at any privately owned land.
<table>
<tr><th>Pollutant</th><th>Averaging period</th><th>Criterion</th></tr>
<tr><td>Particulate matter < 10 µm (PM_{10})</td><td>24 hour</td><td>50 µg/m^3</td></tr>
</table>
Table 3: Short Term Impact Assessment Criteria for Particulate Matter
<table>
<tr><th>Pollutant</th><th>Averaging period</th><th>Criterion</th></tr>
<tr><td>Total suspended particulate (TSP) matter</td><td>Annual</td><td>90 µg/m^3</td></tr>
<tr><td>Particulate matter < 10 µm (PM_{10})</td><td>Annual</td><td>β0 µg/m^3</td></tr>
</table>
Table 4: Long Term Impact Assessment Criteria for Particulate Matter
<table>
<tr><th>Pollutant</th><th>Averaging period</th><th>Maximum increase in deposited dust level</th><th>Maximum total deposited dust level</th></tr>
<tr><td>Deposited dust</td><td>Annual</td><td>2 g/m^2/month</td><td>4 g/m^2/month</td></tr>
</table>
Table 5: Long Term Impact Assessment Criteria for Deposited Dust
Note: Deposited dust is assessed as insoluble solids as defined by Standards Australia, 1991, AS/NZS 3580.10.1-2003: Methods for Sampling and Analysis of Ambient Air - Determination of Particulates - Deposited Matter - Gravimetric Method.

Non - compliances related to:

Not monitoring for PM10 during the entire Annual Review period;
Completion of thirteen monitoring events, instead of 12 monitoring events for depositional dust.

</td>
<td>Complete monitoring as per the EMP and Development Consent requirements.</td>
</tr>
</table>

Date	Incident	Action
Throughout the Annual Review period	**Schedule 3 Condition 7** The Proponent shall prepare and implement a Dust Monitoring Program for the project to the satisfaction of the Director-General. Non-compliances related to not fully implementing the Dust Monitoring Program: • Not monitoring for PM10 during the entire Annual Review period; • Completion of thirteen monitoring events, instead of 12 monitoring events for depositional dust.	Complete monitoring as per the EMP and Development Consent requirements.

12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Holcim staff will undertake the following works and improvement measures and projects in 2018 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
Progressive Rehabilitation	The site will continue to progressively rehabilitate available areas on the northern and eastern boundary lines.
Development Application (Truck Movements Modification)	Application to modify the current Project Approval condition limiting truck movement to 4 (in and out) per hour.
EMP Review	Development of a new *Environmental Management Plan* with alignment to Holcim Australia's Environmental Management System.
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.

13 REFERENCES

Craven Elliston Hayes (2017) Monitoring of Heritage Infrastructure Report;

DPI Water (2017) Water Access Licence Usage;

EPA (Ongoing) Environment Protection Licence) – 13077;

Holcim (2017) Quarterly Environmental Monitoring Report;

Holcim (2017) CCC Minutes;

Pitt and Sherry (2018) Independent Environmental Audit – Cooma Road Quarry;

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 2017

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW, March 2017.

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

April 2017

MAC
Muller Acoustic Consulting

Document Information

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

March 2017

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

Prepared by: Muller Acoustic Consulting Pty Ltd
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Document ID	Status	Date	Written By	Signed
MAC170440RP1	Final	24 April 2017	Oliver Muller	

CONTENTS

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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.

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

- NSW Environment Protection Authority (EPA), Industrial Noise Policy (INP), 2000;
- Dunloe Noise Management Plan (NMP); 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**.

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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 7am – 5pm Monday to Friday and 7am – 12am Saturday.

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

Table 1 Noise Criteria

Location	Day $LA_{eq(15min)}$ Criteria[2]
All privately-owned receivers[1]	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: 7am – 5pm Monday to Friday and 7am – 12am Saturday.

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3 Methodology

3.1 Locality

The quarry is located in Pottsville, NSW. Receivers in the locality surrounding the quarry are primarily rural/residential. The surroundings of the quarry include bushland and elevated areas, with the ocean located 2km to the east. 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 :

- L1 is located to the north-west of the quarry art the Dunloe Quarry entrance on Pottsville Road;
- L2 is located west of the quarry on the boundary of 574 Pottsville Road;
- L3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- L4 is located at 200 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 29 March 2017. 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 ±0.5dBA.

Day assessment period measurements were conducted at each of the monitoring locations. 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.

In the event of quarry attributed noise being above the applicable statutory noise criteria, prevailing meteorological conditions for the monitoring period will be sourced from the quarries on-site meteorological station and analysed in accordance with Appendix E4 of the INP to determine the stability category present at the time of each measured sample.

FIGURE 1

LOCALITY PLAN

REF: MAC170440

0 500m

KEY	
L1	MONITORING LOCATION
	SITE LOCATION

MAC
Muller Acoustic Consulting

*Imagery Source : nearmaps

4 Results

4.1 Assessment Results - Location L1

The monitored noise level contributions and observed meteorological conditions for each day survey period at L1 for Wednesday 29 March 2017 are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location L1

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		LAmax	L_{Aeq}	L_{A90}		
29/03/2017	13:36	89	64	45	Dir: North East Wind Speed: 3.5 m/s Rain: Nil	Birds 40 - 50 Traffic 50 - 65 Wind 40 - 48 Road Trains 60
Dunloe Quarry $L_{Aeq(15min)}$ Contribution						Quarry Inaudible

4.2 Assessment Results - Location L2

The monitored noise level contributions and observed meteorological conditions for each day survey period at L2 for Wednesday 29 March 2017 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location L2

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		LAmax	L_{Aeq}	L_{A90}		
29/03/2017	13:58	91	64	45	Dir: North Wind Speed: 3 m/s Rain: Nil	Traffic 75 Birds 36 - 46 Wind 36 - 44 Insects
Dunloe Quarry $L_{Aeq(15min)}$ Contribution						Quarry Inaudible

4.3 Assessment Results - Location L3

The monitored noise level contributions and observed meteorological conditions for each day survey period at L3 for Wednesday 29 March 2017 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location L3

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		LAmax	L_{Aeq}	L_{A90}		
29/03/2017	14:18	74	49	42	Dir: North Wind Speed: 4 m/s Rain: Nil	Birds 36 – 46 – 53 Highway traffic 40 – 42 - 70 Insects 36 Wind 34 - 46
Dunloe Quarry $L_{Aeq(15min)}$ Contribution						Quarry Inaudible

4.4 Assessment Results - Location L4

The monitored noise level contributions and observed meteorological conditions for each day survey period at L4 for Wednesday 29 March 2017 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location L4

Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		LAmax	L_{Aeq}	L_{A90}		
29/03/2017	14:37	65	47	44	Dir: North Wind Speed: 3.5 m/s Rain: Nil	Wind <40 Traffic Birds 40 - 50 Livestock Aircraft 43 - 60
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 $L_{Aeq(15min)}$	Quarrying Noise Criteria $L_{Aeq(15min)}$	Complies
R1	Nil	48	✓
R2	Nil	48	✓
R3	Nil	48	✓
R4	Nil	48	✓

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6 Conclusion

MAC has completed a noise monitoring assessment 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.

Attended noise monitoring was undertaken on 29 March 2017 at representative monitoring locations, quarry noise contributions were 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.

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Appendix A - Glossary of Terms

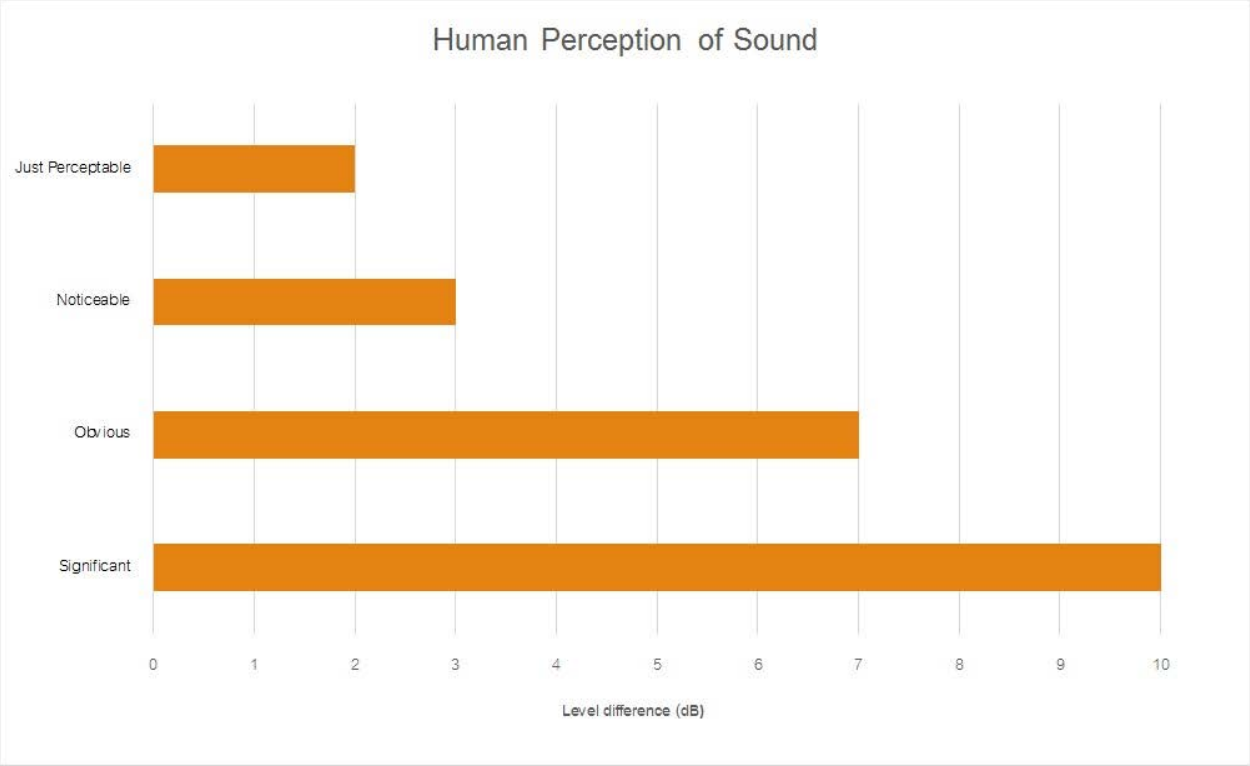
Table A1 provides a number of technical terms have been used in this report.

Table 1A 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 INP 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.
LAmax	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.log10 (W/Wo) Where : W is the sound power in watts and Wo 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



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Quarterly Noise Monitoring Assessment

Dunloe Quarry, June 2017

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

July 2017

MAC
Muller Acoustic Consulting

Document Information

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

June 2017

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

Prepared by: Muller Acoustic Consulting Pty Ltd
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Document ID	Status	Date	Written By	Signed
MAC170440RP2	Final	6 July 2017	Oliver Muller	

CONTENTS

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1 Introduction

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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 of 2017.

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

- NSW Environment Protection Authority (EPA), Industrial Noise Policy (INP), 2000;
- 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**.

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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 7am – 5pm Monday to Friday and 7am – 12pm Saturday.

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

Table 1 Noise Criteria

Location	Day $LA_{eq(15min)}$ Criteria[2]
All privately-owned receivers[1]	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: 7am – 5pm Monday to Friday and 7am – 12pm Saturday.

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3 Methodology

3.1 Locality

The quarry is located in Pottsville, NSW. Receivers in the locality surrounding the quarry are primarily rural/residential. The surroundings of the quarry include bushland and elevated areas, with the ocean located 2km to the east. 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 Tuesday 20 June 2017. 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 ±0.5dBA.

Day assessment period measurements were conducted at each of the monitoring locations. 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 LAeq (15min) quarry noise contribution for comparison against the applicable noise criteria.

In the event of quarry attributed noise being above the applicable statutory noise criteria, prevailing meteorological conditions for the monitoring period will be sourced from the quarry's on-site meteorological station and analysed in accordance with Appendix E4 of the INP to determine the stability category present at the time of each measured sample.

FIGURE 1

LOCALITY PLAN

REF: MAC170440

0 500m

KEY	
R1	RECEIVER LOCATION
	SITE LOCATION

MAC
Muller Acoustic Consulting

*Imagery Source : nearmaps

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 Tuesday 20 June 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/06/17	10:37	72	55	49	Dir: SW Wind Speed: 4 m/s Rain: Nil	Insects <30 Birds 46-58 Wind in trees 38-43 Distant traffic <35 Livestock <35
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 Tuesday 20 June 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/06/17	11:05	83	62	51	Dir: S Wind Speed: 1.5 m/s Rain: Nil	Highway traffic 43-54 Local traffic 46-81 Birds 55-70 Wind in trees 36-43 Local residential noise 54-79
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 Tuesday 20 June 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/06/17	11:26	74	50	45	Dir: SW Wind Speed: 3 m/s Rain: Nil	Wind in trees 38-42 Birds 41-56 Distant traffic <35 Local traffic 51-73
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 Tuesday 20 June 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/06/17	11:50	67	48	41	Dir: SW Wind Speed: 3 m/s Rain: Nil	Birds 38-56 Wind in trees 48-53
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 $L_{Aeq(15min)}$	Quarry Noise Criteria $L_{Aeq(15min)}$	Compliant
R1	Nil	48	✓
R2	Nil	48	✓
R3	Nil	48	✓
R4	Nil	48	✓

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6 Discussion

6.1 Discussion of Results - Location R1

Dunloe Quarry remained inaudible at location R1 during the June 2017 monitoring assessment. Quarry contributions therefore satisfy the relevant LAeq criteria of 48dBA. Extraneous sources audible included insects, birds, wind in trees, distant traffic and livestock. All extraneous noises remained generally constant during the 15-minute measurements at R1.

6.2 Discussion of Results - Location R2

Dunloe Quarry remained inaudible at location R2 during the June 2017 monitoring assessment. Quarry contributions therefore satisfied the relevant LAeq criteria of 48dBA. Highway traffic dominated the June measurements at R2. Other extraneous sources include birds, wind in trees, local traffic and local residential noise. All extraneous noises remained generally constant during the 15-minute measurement at R2.

6.3 Discussion of Results - Location R3

Quarry noise was inaudible during the June 2017 survey period at R3, satisfying the daytime criteria of 48dBA. Non-mining noise sources included birds, wind in trees, distant and local traffic. All extraneous noises remained mostly constant during the 15-minute measurement at R3.

6.4 Discussion of Results - Location R4

Holcim Quarry hum was inaudible throughout the June 2017 monitoring quarter at R4. Therefore, quarry emissions satisfied the relevant daytime noise limit of 48dBA. Extraneous non-quarrying sources include wind in trees and birds.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment 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 2, June 2017 assessment.

Attended noise monitoring was undertaken on 20 June 2017 at representative monitoring locations, quarry noise contributions were 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.

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Appendix A - Glossary of Terms

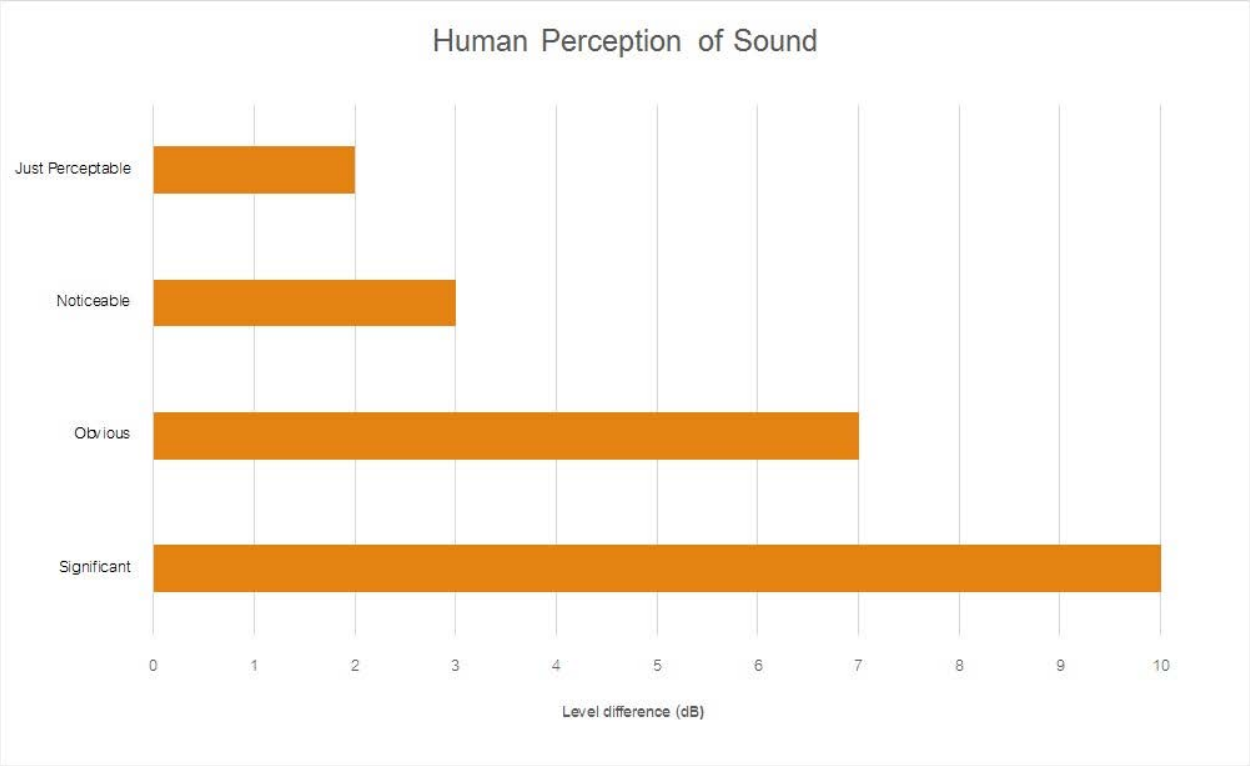
Table A1 provides a number of technical terms have been used in this report.

Table 1A 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 INP 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.
LAmax	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.log10 (W/Wo) Where : W is the sound power in watts and Wo 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



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Quarterly Noise Monitoring Assessment

Dunloe Quarry, September 2017

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

October 2017

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Muller Acoustic Consulting

Document Information

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

September 2017

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

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MAC170440RP3	Final	16 October 2017	Oliver Muller	

CONTENTS

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1 Introduction

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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 of 2017.

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

- NSW Environment Protection Authority (EPA), Industrial Noise Policy (INP), 2000;
- 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**.

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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 7am – 5pm Monday to Friday and 7am – 12pm Saturday.

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

Table 1 Noise Criteria

Location	Day $LA_{eq(15min)}$ Criteria[2]
All privately-owned receivers[1]	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: 7am – 5pm Monday to Friday and 7am – 12pm Saturday.

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3 Methodology

3.1 Locality

The quarry is located in Pottsville, NSW. 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 20 September 2017. 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 ±0.5dBA.

Day assessment period measurements were conducted at each of the monitoring locations. 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 LAeq (15min) quarry noise contribution for comparison against the applicable noise criteria.

FIGURE 1

LOCALITY PLAN

REF: MAC170440

0 500m

KEY	
R1	RECEIVER LOCATION
	SITE LOCATION

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*Imagery Source : nearmaps

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 20 September 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/09/17	13:32	66	44	36	Dir: SE Wind Speed: 2.5 m/s Rain: Nil	Wind in trees 38-56 Livestock <56 Birds <42
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 20 September 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/09/17	13:58	85	63	45	Dir: SE Wind Speed: 2 m/s Rain: Nil	Birds <49 Local residential noise 47-64 Local traffic 48-84 Wind in trees <39 Distant traffic 38-46
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 20 September 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/09/17	14:20	65	44	37	Dir: S Wind Speed: 1.5 m/s Rain: Nil	Birds <38 Wind in trees 36-46
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 20 September 2017 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
		LAmax	L_{Aeq}	L_{A90}		
20/09/17	14:39	65	45	38	Dir: S Wind Speed: 1.8 m/s Rain: Nil	Win in trees 36-44 Birds <36 Aircraft 44-56
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 $L_{Aeq(15min)}$	Quarry Noise Criteria $L_{Aeq(15min)}$	Compliant
R1	Nil	48	✓
R2	Nil	48	✓
R3	Nil	48	✓
R4	Nil	48	✓

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6 Discussion

6.1 Discussion of Results - Location R1

Dunloe Quarry remained inaudible at location R1 during the September 2017 monitoring assessment. Quarry contributions therefore satisfy the relevant LAeq criteria of 48dBA. Extraneous sources audible included birds, wind in trees and livestock. All extraneous noises remained generally constant during the 15-minute measurements at R1.

6.2 Discussion of Results - Location R2

Dunloe Quarry remained inaudible at location R2 during the September 2017 monitoring assessment. Quarry contributions therefore satisfied the relevant LAeq criteria of 48dBA. Highway traffic dominated the September measurements at R2. Other extraneous sources include birds, wind in trees, local traffic, distant traffic and local residential noise. All extraneous noises remained generally constant during the 15-minute measurement at R2.

6.3 Discussion of Results - Location R3

Quarry noise was inaudible during the September 2017 survey period at R3, satisfying the daytime criteria of 48dBA. Non-quarrying noise sources included birds and wind in trees. All extraneous noises remained mostly constant during the 15-minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry emissions were inaudible throughout the September 2017 monitoring quarter at R4. Therefore, quarry emissions satisfied the relevant daytime noise limit of 48dBA. Extraneous non-quarrying sources include wind in trees, aircraft and birds.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment 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 3, September 2017 assessment.

Attended noise monitoring was undertaken on 20 September 2017 at representative monitoring locations, quarry noise contributions were 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.

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Appendix A - Glossary of Terms

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

Table 1A 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 INP 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.
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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.
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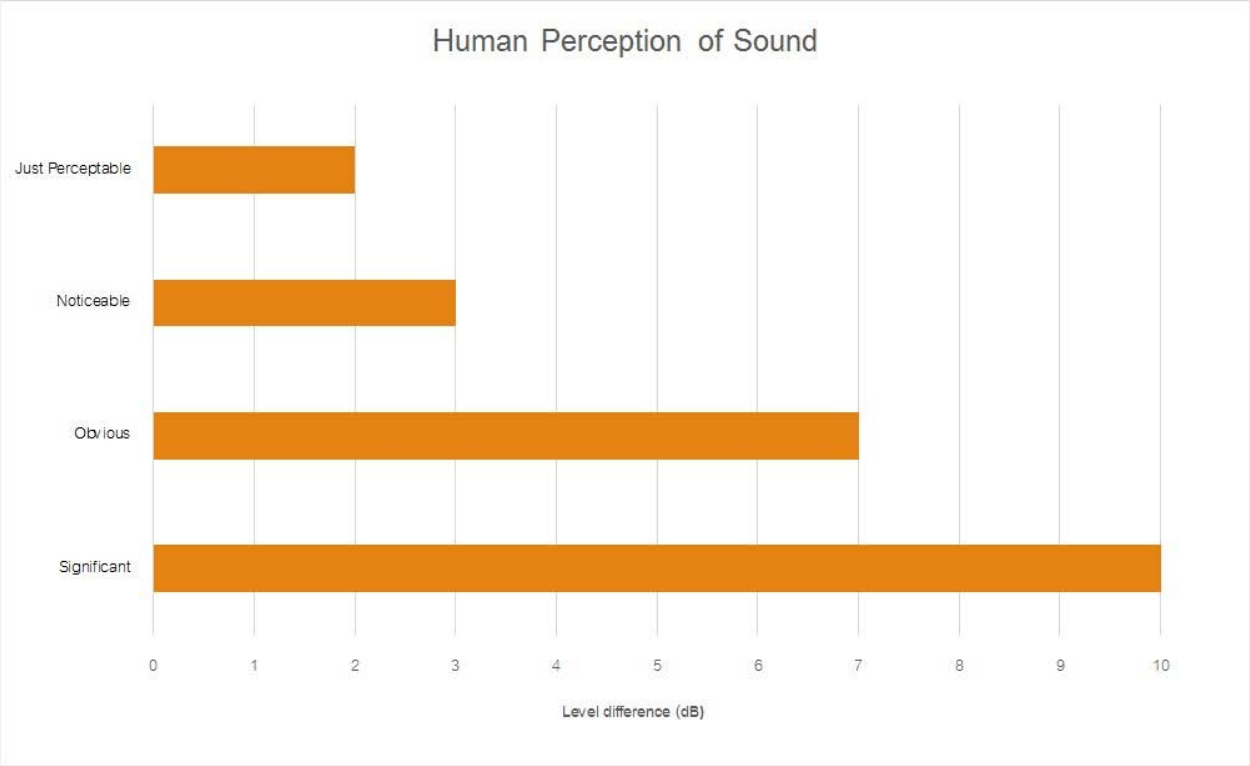
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is 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.log10 (W/Wo) Where : W is the sound power in watts and Wo 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



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Quarterly Noise Monitoring Assessment

Dunloe Quarry, December 2017

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

December 2017

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Muller Acoustic Consulting

Document Information

Quarterly Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

December 2017

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

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Document ID	Status	Date	Written By	Signed
MAC170440RP4	Final	22 December 2017	Oliver Muller	

CONTENTS

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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 of 2017.

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

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- Dunloe Noise Management Plan (NMP), 2016; and
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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 7am – 5pm Monday to Friday and 7am – 12pm Saturday.

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

Table 1 Noise Criteria

Location	Day dBA, $LA_{eq(15min)}$ Criteria[2]
All privately-owned receivers[1]	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: 7am – 5pm Monday to Friday and 7am – 12pm Saturday.

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3 Methodology

3.1 Locality

The quarry is located in Pottsville, NSW. 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;
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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 Friday 15 December 2017. 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 ±0.5dBA.

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 $LA_{eq(15min)}$ quarry noise contribution for comparison against the applicable noise criteria.

FIGURE 1

LOCALITY PLAN

REF: MAC170440

0 500m

KEY	
R1	RECEIVER LOCATION
	SITE LOCATION

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Muller Acoustic Consulting

*Imagery Source : nearmaps

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 Friday 15 December 2017 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
		LAmax	L_{Aeq}	L_{A90}		
15/12/17	09:51	61	43	36	Dir: NW Wind Speed: 1m/s Rain: Nil	Birds 39-45 Distant traffic 36-40 Wind in trees 40-56 Insects <36
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 Friday 15 December 2017 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
		LAmax	L_{Aeq}	L_{A90}		
15/12/17	10:12	88	66	51	Dir: N Wind Speed: 0.5m/s Rain: Nil	Highway traffic 54-60 Local traffic 58-87 Birds <50
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 Friday 15 December 2017 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
		LAmax	L_{Aeq}	L_{A90}		
15/12/17	10:31	68	53	45	Dir: NE Wind Speed: 1m/s Rain: Nil	Distant traffic 41-54 Local traffic 49-56 Birds 43-61 Wind in trees 45-47 Aircraft 48-55
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 Friday 15 December 2017 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
		LAmax	L_{Aeq}	L_{A90}		
15/12/17	10:51	65	55	50	Dir: NE Wind Speed: 1.5m/s Rain: Nil	Wind in trees 49-60 Aircraft 49-61
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, $L_{Aeq(15min)}$	dBA, $L_{Aeq(15min)}$	
R1	Nil	48	✓
R2	Nil	48	✓
R3	Nil	48	✓
R4	Nil	48	✓

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6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise was inaudible at location R1 during the December 2017 monitoring assessment, and therefore satisfies the relevant criteria of 48dBA $L_{Aeq15\text{-}min}$. Extraneous noise sources included birds, wind in trees, distant traffic and insects. All extraneous noises remained generally constant during the 15-minute measurements at R1.

6.2 Discussion of Results - Location R2

Quarry noise remained inaudible at location R2 during the December 2017 monitoring assessment. Quarry contributions therefore satisfied the relevant criteria of 48dBA $L_{Aeq15\text{-}min}$. Highway and local traffic dominated the December 2017 measurements at R2 and extraneous sources including birds and insects which were barely audible although remained generally constant during the 15-minute measurement at R2.

6.3 Discussion of Results - Location R3

Quarry noise was inaudible during the December 2017 survey period at R3, satisfying the daytime criteria of 48dBA $L_{Aeq15\text{-}min}$. Non-quarrying noise sources included birds, wind in trees, aircraft, distant and local traffic. Extraneous noises remained constant during the 15-minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry emissions were inaudible throughout the December 2017 monitoring quarter at R4. Therefore, quarry emissions satisfied the relevant daytime noise limit of 48dBA $L_{Aeq15\text{-}min}$. Extraneous non-quarrying sources include wind in trees and aircraft.

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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 4, December 2017 assessment.

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Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
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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.
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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.
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Bedroom (night with windows closed)	20
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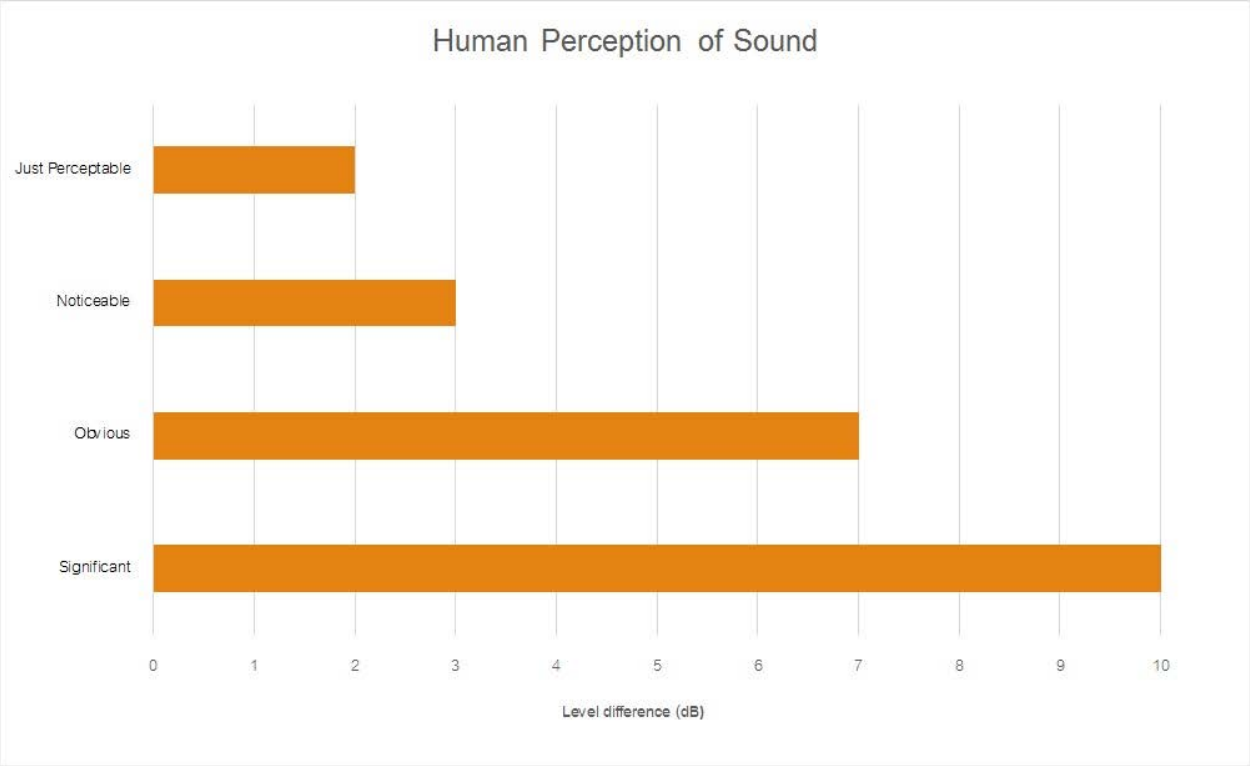
Figure A1 – Human Perception of Sound



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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
		Minimum	**0.1**	**0.1**	**0.2**	**0.1**
		Maximum	**0.8**	**4.7**	**2.4**	**1.6**
		Average	**0.38**	**0.79**	**0.60**	**0.46**

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	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	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												
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		<5		16	1			<5.0	<0.05	<0.1	<0.005		3.7	11	3	84	0.6	<0.001	0.12	0.23
		Minimum	**3.4**	**84**	**6.6**	**160**			**8**	**1**	**4**	**2**					**13**	**1.5**	**6.3**		**25**	**0.17**		**0.04**	**0.03**
		Maximum	**7**	**1060**	**9.9**	**204**			**67**	**400**	**187**	**16**					**159**	**18**	**46**		**429**	**33**		**12**	**1.23**
		Average	**4.45**	**653.48**	**8.22**	**177.33**			**27.92**	**46.54**	**61.79**	**8.50**					**86.82**	**8.77**	**22.12**		**235.66**	**9.78**		**2.97**	**0.58**

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	Chlorophyta	Diatoms (Bacillariophyta)	Dinophyta (Dinoflagellates)	Euglenophyta (Euglenoids)
			cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
2011/2012 AEMR	30-11-2011	Lake	240				
2011/2012 AEMR	22-12-2012	Lake	800				
2011/2012 AEMR	02-02-2012	Lake	<100				
2011/2012 AEMR	20-02-2012	Lake	700				
2011/2012 AEMR	28-02-2012	Lake	14375				
2011/2012 AEMR	27-03-2012	Lake	1200				
2011/2012 AEMR	30-05-2012	Lake	<100				
2011/2012 AEMR	27-06-2012	Lake	130	0.01			
2011/2012 AEMR	26-07-2012	Lake	16360	2520			
2011/2012 AEMR	27-08-2012	Lake	24640	3720			
2011/2012 AEMR	27-09-2012	Lake	68000	35000			
2011/2012 AEMR	29-10-2012	Lake	<100	7900			
2012/2013 AEMR	28-11-2012	Lake	<100	80670			
2012/2013 AEMR	24-12-2012	Lake	<100				
2012/2013 AEMR	17-01-2013	Lake	<100				
2012/2013 AEMR	01-02-2013	Lake	<100				
2012/2013 AEMR	15-02-2013	Lake	<100				
2012/2013 AEMR	08-03-2013	Lake	<100	215			
2012/2013 AEMR	30-05-2013	Lake	<100	880			
2012/2013 AEMR	30-06-2013	Lake	<100				
2012/2013 AEMR	30-07-2013	Lake	<100	34000			
2012/2013 AEMR	28-08-2013	Lake	<100	205			
2012/2013 AEMR	30-09-2013	Lake	<100				
2012/2013 AEMR	25-10-2013	Lake	<100	17430			
2013/2014 AEMR	25-11-2013	Lake				480	
2013/2014 AEMR	12-12-2013	Lake	1150	39500			
2013/2014 AEMR	19-12-2013	Lake		22000			
2013/2014 AEMR	09-01-2014	Lake		123000			
2013/2014 AEMR	29-01-2014	Lake		34000			
2013/2014 AEMR	31-03-2014	Lake			295		
2013/2014 AEMR	28-04-2014	Lake		7700	45		
2013/2014 AEMR	29-05-2014	Lake	ND	7600			
2013/2014 AEMR	26-06-2014	Lake	ND	52000			
2013/2014 AEMR	31-07-2014	Lake	ND	28000			
2013/2014 AEMR	28-10-2014	Lake	ND	168000			
Appendix of 2015 AEMR	28-11-2014	Lake	ND	123000	260	60	
Appendix of 2015 AEMR	16-12-2014	Lake	ND	106500	220	35	
Appendix of 2015 AEMR	22-01-2015	Lake	ND	37000			
Appendix of 2015 AEMR	26-02-2015	Lake	ND				
Appendix of 2015 AEMR	26-03-2015	Lake	ND	8750			
Appendix of 2015 AEMR	24-04-2015	Lake	ND	8000			
Appendix of 2015 AEMR	29-05-2015	Lake	ND	76000	4200		
Appendix of 2015 AEMR	29-06-2015	Lake	ND	211000	6300		
Appendix of 2015 AEMR	21-10-2015	Lake	ND	18330	65	35	155
Appendix of 2015 AEMR	26-11-2015	Lake	ND	4850		5	
Appendix of 2015 AEMR	11-12-2015	Lake	ND	11900	30	10	
2016 AEMR	25-01-2016	Lake	ND	34000			
2016 AEMR	08-02-2016	Lake	ND	0			
2016 AEMR	24-02-2016	Lake	ND	3700			
2016 AEMR	10-03-2016	Lake	ND	1575			
2016 AEMR	24-03-2016	Lake	ND	7600			
2016 AEMR	07-04-2016	Lake	ND	9700			
2016 AEMR	29-04-2016	Lake	ND	11800			
2016 AEMR	24-05-2016	Lake	ND	5700			
2016 AEMR	30-06-2016	Lake	ND	28930			
2016 AEMR	31-08-2016	Lake	840	61500			
2016 AEMR	30-09-2016	Lake	ND	920			
2016 AEMR	04-10-2016	Lake	ND	920			
2016 AEMR	28-10-2016	Lake	ND	29000			
2016 AEMR	21-12-2016	Lake	ND	10830			
2017 Q1 Env Mon report	30-01-2017	Lake	ND	1480			
2017 Q1 Env Mon report	27-02-2017	Lake	ND	640			
2017 Env Monitoring	22-03-2017	Lake	ND	175			
2017 Env Monitoring	19-04-2017	Lake	ND	600			
2017 Env Monitoring	17-05-2017	Lake	ND	2820			
2017 Env Monitoring	14-06-2017	Lake	ND	1830			
2017 Env Monitoring	12-07-2017	Lake	ND	5260			
2017 Env Monitoring	09-08-2017	Lake	ND	41500			
2017 Env Monitoring	06-09-2017	Lake	ND	99800			
2017 Env Monitoring	04-10-2017	Lake	ND	128000			
2017 Env Monitoring	01-11-2017	Lake	ND	38600			
2017 Env Monitoring	29-11-2017	Lake	ND	8150			
2017 Env Monitoring	28-12-2017	Lake	ND	1890			
Number of Samples			**11**	**57**	**8**	**6**	**1**
Minimum				**0**	**30**	**5**	**155**
Maximum				**211000**	**6300**	**480**	**155**
Average				**31694.6**	**1426.9**	**104.2**	**155.0**

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Alkalinity as CaCO3	Bicarbonate as CaCO3	Chloride	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	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	Dec-11	DPL1							13				0.2	0.4	4	<5	3.5		<0.005	1.34	<0.01
2011/2012 AEMR	Mar-12	DPL1							17				0.2	0.4	5.4	<5	4.8		<0.005	1.32	<0.01
2011/2012 AEMR	30-05-2012	DPL1	4.2	98	3.3	435															
2011/2012 AEMR	Jun-12	DPL1	4.2	105	3.8	405	<1	<1	20				0.6	0.6	11	<5	5.3		<0.005	2.49	<0.01
2011/2012 AEMR	26-07-2012	DPL1	4.3	87	5.1	374															
2011/2012 AEMR	27-08-2012	DPL1	4.2	98	2.1	365															
2011/2012 AEMR	27-09-2012	DPL1	4.2	94	2.6	305	<1	<1	15				0.5	0.3	8.4	<5	6.7		<0.005	3.25	<0.01
2011/2012 AEMR	29-10-2012	DPL1	4.6	96	5.8	208															
2012/2013 AEMR	Dec-12	DPL1							36				1	0.7	6.3	<5	4.9		<0.005	4.32	<0.01
2012/2013 AEMR	Mar-13	DPL1							12				0.2	0.1	9.2	<5	7.3		<0.005	1.68	<0.01
2012/2013 AEMR	Jun-13	DPL1							19				0.1	<0.1	0.1	<5	5.9		<0.005	1.5	<0.01
2012/2013 AEMR	Sep-13	DPL1							16				0.4	0.2	7.5	<5			<0.005	5.82	<0.01
2013/2014 AEMR	12-12-2013	DPL1	4.8	86	3.5	91	3	2	20				0.4	0.2	0.2	<5	6.2		<0.005	3.83	0.02
2013/2014 AEMR	29-01-2014	DPL1	4	279	5.7	264															
2013/2014 AEMR	24-02-2014	DPL1	4.6	76	3.8	242															
2013/2014 AEMR	31-03-2014	DPL1	4.9	72	6.3	136	3	2	15				0.6	0.1	0.1	<5	3.5		<0.005	2.44	<0.01
2013/2014 AEMR	24-04-2014	DPL1	4	75		204															
2013/2014 AEMR	28-05-2014	DPL1	4.2	95		307															
2013/2014 AEMR	25-06-2014	DPL1	4.1	98	2	350	<1	<1	16				0.5	0.3	9.7	<5	6.4		<0.005	0.76	<0.01
2013/2014 AEMR	30-07-2014	DPL1	4.1	112	3.9	174	<1	<1	19				0.4	0.2	11	<5	7.7	0.77	<0.005	0.62	<0.01
2013/2014 AEMR	29-08-2014	DPL1	4.4	97	4.3	185	NP	NP	20				0.2	<0.1	9.6	<5	4.3		<0.005	3.93	<0.01
2013/2014 AEMR	29-09-2014	DPL1	4	108	3.5	177															
Appendix of 2015 AEMR	28-11-2014	DPL1	4.7	81	3.3	110															
Appendix of 2015 AEMR	15-12-2014	DPL1	4.6	94	1.5	160	NP	<1	15				1.6	0.4	10	<5	6.1	0.32	<0.005	2.55	0.02
Appendix of 2015 AEMR	22-01-2015	DPL1	4.8	80	3.8	110															
Appendix of 2015 AEMR	25-02-2015	DPL1	4.2	110	1.1	160															
Appendix of 2015 AEMR	26-03-2015	DPL1	4	109	4	245	NP	NP													
Appendix of 2015 AEMR	24-04-2015	DPL1	4.1	131	2.7	253															
Appendix of 2015 AEMR	28-05-2015	DPL1	3.8	164	2	256															
Appendix of 2015 AEMR	17-09-2015	DPL1	4.1	135	3.9	195	NP		18			<0.02	0.7	0.8	12	<5	10	0.64	<0.001	0.95	0.017
Appendix of 2015 AEMR	21-10-2015	DPL1	4.3	116	2.9	217															
Appendix of 2015 AEMR	25-11-2015	DPL1	4.2	102	6.1	170															
Appendix of 2015 AEMR	11-12-2015	DPL1	4.6	86	2.4	232	1	1	14				0.3	0.2	11	<5	10	0.32	<0.001	3.21	0.009
Appendix of 2016 AEMR	25-01-2016	DPL1	4.7	95	1.6	165															
Appendix of 2016 AEMR	24-02-2016	DPL1	4.8	98	5.7	138															
Appendix of 2016 AEMR	24-03-2016	DPL1	4.6	104	3.8	268	2	2	17				0.37	0.23	10.21	<5	9.403	0.727	0.001	4.224	0.007
Appendix of 2016 AEMR	29-04-2016	DPL1	4.3	96	6.4	388															
Appendix of 2016 AEMR	24-05-2016	DPL1	4.2	106	2.7	255															
Appendix of 2016 AEMR	30-06-2016	DPL1	4.9	101.1	3.6	283							3.503	0.353	10.561	<5	9.636	0.471	0.001	2.508	0.14
Appendix of 2016 AEMR	21-07-2016	DPL1	3.9	142.2	6.8	384															
Appendix of 2016 AEMR	31-08-2016	DPL1	4	140	6.5	321															
Appendix of 2016 AEMR	29-09-2016	DPL1	3.9	151	2.5	366															
Appendix of 2016 AEMR	27-10-2016	DPL1	4	151	2.5	366															
Appendix of 2016 AEMR	29-11-2016	DPL1	4.7	116	1.9	108															
Appendix of 2016 AEMR	20-12-2016	DPL1	4.7	131	5.2	307.1															
Q1 2017 Env mon report	30-01-2017	DPL1	4.2	121																	
Q1 2017 Env mon report	27-02-2017	DPL1	4.6	103																	
2017 Env Monitoring	22-03-2017	DPL1	4.4	116			<5		18	0.09	1.1	0.056		<0.5	12	1	12	0.48	<0.001	4.8	0.018
2017 Env Monitoring	19-04-2017	DPL1	4.2	180																	
2017 Env Monitoring	17-05-2017	DPL1	4.4	135																	
2017 Env Monitoring	14-06-2017	DPL1	4.3	197			<5		22	<0.05	0.5	0.039		1	14	1	39	1.6	<0.001	13	0.039
2017 Env Monitoring	12-07-2017	DPL1	4.1	137																	
2017 Env Monitoring	09-08-2017	DPL1	4.3	123																	
2017 Env Monitoring	06-09-2017	DPL1	4	124			<5		18	<0.05	1.2	0.031		<0.5	11	1	10	0.73	<0.001	3.4	0.017
2017 Env Monitoring	04-10-2017	DPL1	4.3	123																	
2017 Env Monitoring	01-11-2017	DPL1	4.4	121																	
2017 Env Monitoring	29-11-2017	DPL1	4.5	129																	
2017 Env Monitoring	28-12-2017	DPL1	4.5	130			<5		21	<0.05	0.4	0.071		0.6	12	2.1	44	0.53	<0.001	5	0.02
No of Samples			**52**	**52**	**37**	**39**			**21**		**4**		**18**		**22**	**4**	**21**	**10**		**22**	**10**
Minimum			**3.8**	**72**	**1.1**	**91**			**12**		**0.4**		**0.1**		**0.1**	**1**	**3.5**	**0.32**		**0.62**	**0.007**
Maximum			**4.9**	**279**	**6.8**	**435**			**36**		**1.2**		**3.503**		**14**	**2.1**	**44**	**1.6**		**13**	**0.14**
Average			**4.33**	**116.43**	**3.75**	**248.18**			**18.14**		**0.80**		**0.65**		**8.42**	**1.28**	**10.32**	**0.66**		**3.32**	**0.03**

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	399	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
No of Samples			**51**	**51**	**37**	**39**	**17**	**11**	**22**		**3**	**4**	**19**	**22**	**22**		**21**	**8**		**22**	**22**
Minimum			**5.9**	**6677**	**1.8**	**58**	**110**	**66**	**120**		**3**	**0.04**	**60**	**93**	**1.28**		**126**	**0.03**		**0.74**	**0.51**
Maximum			**6.7**	**7970**	**399**	**1738**	**150**	**128**	**2700**		**4.1**	**2.9**	**82**	**130**	**1700**		**230**	**0.22**		**15**	**6.23**
Average			**6.28**	**7359.71**	**14.71**	**228.59**	**123.82**	**88.00**	**2259.09**		**3.63**	**1.94**	**70.74**	**112.64**	**1018.28**		**163.67**	**0.08**		**3.82**	**0.84**

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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
No of Samples			**51**	**51**	**37**	**39**			**21**		**3**	**4**	**18**		**21**		**20**	**8**		**21**	
Minimum			**3.6**	**5.4**	**1.6**	**74**			**12**		**0.6**	**0.055**	**0.5**		**0.7**		**3.5**	**0.13**		**0.09**	
Maximum			**5.6**	**2200**	**6.6**	**386**			**640**		**1.3**	**0.24**	**13**		**450**		**79**	**3.96**		**15**	
Average			**4.71**	**420.35**	**3.56**	**217.24**			**138.05**		**0.97**	**0.14**	**3.60**		**69.41**		**18.08**	**1.04**		**4.62**	

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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
No of Samples			**51**	**51**	**34**	**38**					**4**	**5**	**18**	**22**	**22**		**21**	**8**		**22**	**22**
Minimum			**3.2**	**3.8**	**0.9**	**14**					**1.6**	**0.41**	**2.4**	**1.5**	**1.5**		**30**	**10**		**9.48**	**0.02**
Maximum			**5.2**	**2264**	**6.1**	**464**					**2.5**	**1.13**	**134**	**33**	**24**		**1520**	**147**		**580**	**3.75**
Average			**3.97**	**1256.00**	**2.86**	**222.15**					**1.83**	**0.64**	**22.59**	**12.98**	**12.07**		**572.91**	**60.77**		**166.82**	**1.09**

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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
No of Samples			**50**	**50**	**37**	**39**	**17**		**23**	**3**	**3**	**4**	**20**	**23**	**23**		**22**	**9**		**23**	
Minimum			**4.6**	**7.1**	**1.7**	**-60**	**1**		**15**	**0.1**	**2.1**	**0.06**	**0.3**	**0.2**	**9.9**		**4.2**	**0.04**		**0.28**	
Maximum			**7.6**	**3558**	**6.5**	**320**	**550**		**780**	**0.1**	**3.6**	**2.4**	**24**	**43**	**940**		**710**	**0.62**		**2.62**	
Average			**7.16**	**3206.28**	**3.77**	**94.57**	**375.00**		**671.96**	**0.10**	**2.87**	**0.83**	**16.98**	**35.70**	**547.84**		**254.25**	**0.36**		**1.41**	

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
Minimum	**0.3**	**0.57**	**0.2**	**0.59**	**0.61**
Maximum	**1.94**	**1.9**	**1.74**	**1.97**	**1.9**
Average	**1.31**	**1.42**	**1.17**	**1.34**	**1.48**

APPENDIX 3

DUNLOE SAND QUARRY REHABILITATION AND ECOLOGICAL MONITORING 2017

ZONE 1
DEC '17
(1A+B)

FORM A: ROUTINE QUARTERLY REHABILITATION MONITORING SHEET

General Management

Has there been a fire within the last quarter? NO.

Do the bushfire trails or adjacent pasture areas require slashing or maintenance to reduce fire risk? YES.

Is there evidence of rubbish dumping within the rehabilitation zones? NO.

Is there evidence of plant theft within the rehabilitation zone? NO.

Does it appear that the rehabilitation zone has been utilized for stockpiling, vehicle parking, building waste dumping, cattle grazing or person traffic? NO.

If yes, acknowledge below what works were undertaken to rectify/restore and the date TRAILS TO BE SLASHED JAN 2018.

Weeds

Have any areas of weeds re-established within the rehabilitation zones during the last quarter? YES.

What species? 1 LANTANA BUSH + 2 CAMPHORS ON TRAIL EDGE.

What management was undertaken to eradicate these weeds? LANTANA + CAMPHORS TO BE POISONED IN 2018

If management was undertaken acknowledge that such was performed in accordance with the approved rehabilitation management plan. —

Vegetation regeneration

Natural regeneration is occurring in (record height range estimate):

- Tree species > 7m
- Shrub species > 2m
- ground covers < 1m

What are the dominant species within each layer?

- Tree MELALUCA + CASUARINA
- Shrub —
- ground covers GRASS + LEAF LITTER.

Have you noticed any new native plant species since the last monthly inspection? —

If yes name the species or take a photograph

Acknowledge that the required routine photographs have been taken within the rehabilitation zones YES.

Biodiversity

Have you spotted native fauna within the rehabilitation zone during inspection?

If yes, what types?

Koala —
Kangaroo/wallaby —
Possums/gliders —
Small mammal (i.e. bandicoot, echidna) —
Reptiles (i.e. snakes/lizards) TREE
Birds of prey —
Large nectar feeding birds (i.e. lorikeets, parrots, cockatoos) —
Small tree and ground birds (i.e. finches, fairy wrens, treecreepers) —
Glossy Black Cockatoos —
Other —

Modifications

Have there been any structural additions (eg. new tracks, buildings) to the rehabilitation zones since the last visit? NO.

What actions were undertaken to remove any illegal modifications?

Condition of fences

- Good
- Need minor repair
- Poor (need replacement)

Are any of the following performance criteria exceeded (refer Section 4.5 below)?

Declared Weeds? —
Extent of other Weeds? —
Survival Rate of Plants? —
Condition of Plants? —
Canopy Coverage? —
Tree, Small Tree & Shrub Diversity? —
Groundcover Coverage? —
General Coverage/Success? —

If yes, what corrective action was performed (i.e. plant showed drought stress and so watering was undertaken, plant was dead so a replacement plant was pocket planted, canopy plant coverage was not achieved so relevant pioneer plants were pocket planted).

ZONE 1
DEC '17
(C)

FORM A: ROUTINE QUARTERLY REHABILITATION MONITORING SHEET

General Management

Has there been a fire within the last quarter? NO.

Do the bushfire trails or adjacent pasture areas require slashing or maintenance to reduce fire risk? NO. TRAIL IS INUNDATED N. WATER DUE TO TIDES.

Is there evidence of rubbish dumping within the rehabilitation zones? NO.

Is there evidence of plant theft within the rehabilitation zone? NO.

Does it appear that the rehabilitation zone has been utilized for stockpiling, vehicle parking, building waste dumping, cattle grazing or person traffic? NO.

If yes, acknowledge below what works were undertaken to rectify/restore and the date —

Weeds

Have any areas of weeds re-established within the rehabilitation zones during the last quarter? NO.

What species? —

What management was undertaken to eradicate these weeds? —

If management was undertaken acknowledge that such was performed in accordance with the approved rehabilitation management plan. —

Vegetation regeneration

Natural regeneration is occurring in (record height range estimate):

- Tree species > 7m
- Shrub species > 2m
- ground covers < 1m

What are the dominant species within each layer?

- Tree CASUARINA
- Shrub MANGROVE
- ground covers

Have you noticed any new native plant species since the last monthly inspection? —

If yes name the species or take a photograph —

Acknowledge that the required routine photographs have been taken within the rehabilitation zones YES.

Biodiversity

Have you spotted native fauna within the rehabilitation zone during inspection?

If yes, what types?

Koala —
Kangaroo/wallaby —
Possums/gliders —
Small mammal (i.e. bandicoot, echidna) —
Reptiles (i.e.snakes/lizards) —
Birds of prey —
Large nectar feeding birds (i.e. lorikeets, parrots, cockatoos) —
Small tree and ground birds (i.e. finches, fairy wrens, treecreepers) —
Glossy Black Cockatoos —
Other

Modifications

Have there been any structural additions (eg. new tracks, buildings) to the rehabilitation zones since the last visit? NO.

What actions were undertaken to remove any illegal modifications? —

Condition of fences

- Good
- Need minor repair
- Poor (need replacement)

Are any of the following performance criteria exceeded (refer Section 4.5 below)?

Declared Weeds? —
Extent of other Weeds? —
Survival Rate of Plants? —
Condition of Plants? —
Canopy Coverage? —
Tree, Small Tree & Shrub Diversity? —
Groundcover Coverage? —
General Coverage/Success? —

If yes, what corrective action was performed (i.e. plant showed drought stress and so watering was undertaken, plant was dead so a replacement plant was pocket planted, canopy plant coverage was not achieved so relevant pioneer plants were pocket planted).

ZONE 2
DEC '17
(A + B)

FORM A: ROUTINE QUARTERLY REHABILITATION MONITORING SHEET

General Management

Has there been a fire within the last quarter? NO.

Do the bushfire trails or adjacent pasture areas require slashing or maintenance to reduce fire risk? ~~NO~~ YES. EASTERN TRAIL TO BE SLASHED.

Is there evidence of rubbish dumping within the rehabilitation zones? NO.

Is there evidence of plant theft within the rehabilitation zone? NO.

Does it appear that the rehabilitation zone has been utilized for stockpiling, vehicle parking, building waste dumping, cattle grazing or person traffic? NO.

If yes, acknowledge below what works were undertaken to rectify/restore and the date —

Weeds

Have any areas of weeds re-established within the rehabilitation zones during the last quarter? NO.

What species? —

What management was undertaken to eradicate these weeds? —

If management was undertaken acknowledge that such was performed in accordance with the approved rehabilitation management plan. —

Vegetation regeneration

Natural regeneration is occurring in (record height range estimate):

- Tree species > 8M
- Shrub species > 2M
- ground covers < 1M

What are the dominant species within each layer?

- Tree
- Shrub
- ground covers

Have you noticed any new native plant species since the last monthly inspection? —

If yes name the species or take a photograph —

Acknowledge that the required routine photographs have been taken within the rehabilitation zones YES.

Biodiversity

Have you spotted native fauna within the rehabilitation zone during inspection?

If yes, what types?

Koala —
Kangaroo/wallaby —
Possums/gliders —
Small mammal (i.e. bandicoot, echidna) —
Reptiles (i.e.snakes/lizards) —
Birds of prey —
Large nectar feeding birds (i.e. lorikeets, parrots, cockatoos) —
Small tree and ground birds (i.e. finches, fairy wrens, treecreepers) —
Glossy Black Cockatoos
Other

Modifications

Have there been any structural additions (eg. new tracks, buildings) to the rehabilitation zones since the last visit? NO.

What actions were undertaken to remove any illegal modifications? —

Condition of fences

- (Good)
- Need minor repair
- Poor (need replacement)

Are any of the following performance criteria exceeded (refer Section 4.5 below)?

Declared Weeds? —
Extent of other Weeds? —
Survival Rate of Plants? —
Condition of Plants? —
Canopy Coverage? —
Tree, Small Tree & Shrub Diversity? —
Groundcover Coverage? —
General Coverage/Success? —

If yes, what corrective action was performed (i.e. plant showed drought stress and so watering was undertaken, plant was dead so a replacement plant was pocket planted, canopy plant coverage was not achieved so relevant pioneer plants were pocket planted).

ZONE 2
DEC '17
(2C)

FORM A: ROUTINE QUARTERLY REHABILITATION MONITORING SHEET

General Management

Has there been a fire within the last quarter? NO.

Do the bushfire trails or adjacent pasture areas require slashing or maintenance to reduce fire risk? NO.

Is there evidence of rubbish dumping within the rehabilitation zones? NO.

Is there evidence of plant theft within the rehabilitation zone? NO.

Does it appear that the rehabilitation zone has been utilized for stockpiling, vehicle parking, building waste dumping, cattle grazing or person traffic? NO.

If yes, acknowledge below what works were undertaken to rectify/restore and the date —

Weeds

Have any areas of weeds re-established within the rehabilitation zones during the last quarter? NO.

What species? —

What management was undertaken to eradicate these weeds? —

If management was undertaken acknowledge that such was performed in accordance with the approved rehabilitation management plan. —

Vegetation regeneration

Natural regeneration is occurring in (record height range estimate):

- Tree species > 8m
- Shrub species > 3m
- ground covers < 1m

What are the dominant species within each layer?

- Tree MELALUCA QUINQUENERVIA.
- Shrub BANKSIA
- ground covers LEAF LITTER.

Have you noticed any new native plant species since the last monthly inspection? NO.

If yes name the species or take a photograph NO.

Acknowledge that the required routine photographs have been taken within the rehabilitation zones YES.

Biodiversity

Have you spotted native fauna within the rehabilitation zone during inspection?

If yes, what types?

Koala —
Kangaroo/wallaby —
Possums/gliders —
Small mammal (i.e. bandicoot, echidna) —
Reptiles (i.e.snakes/lizards) —
Birds of prey —
Large nectar feeding birds (i.e. lorikeets, parrots, cockatoos) YES.
Small tree and ground birds (i.e. finches, fairy wrens, treecreepers) YES.
Glossy Black Cockatoos —
Other NILLIE NAGTAIL. EASTERN ROSELLA.

Modifications

Have there been any structural additions (eg. new tracks, buildings) to the rehabilitation zones since the last visit? NO.

What actions were undertaken to remove any illegal modifications? —

Condition of fences

- (Good)
- Need minor repair
- Poor (need replacement)

Are any of the following performance criteria exceeded (refer Section 4.5 below)?

Declared Weeds? —
Extent of other Weeds? —
Survival Rate of Plants? —
Condition of Plants? —
Canopy Coverage? —
Tree, Small Tree & Shrub Diversity? —
Groundcover Coverage? —
General Coverage/Success? —

If yes, what corrective action was performed (i.e. plant showed drought stress and so watering was undertaken, plant was dead so a replacement plant was pocket planted, canopy plant coverage was not achieved so relevant pioneer plants were pocket planted).

ZONE 3
DEC '17

FORM A: ROUTINE QUARTERLY REHABILITATION MONITORING SHEET

General Management

Has there been a fire within the last quarter? NO.

Do the bushfire trails or adjacent pasture areas require slashing or maintenance to reduce fire risk? NO.

Is there evidence of rubbish dumping within the rehabilitation zones? NO.

Is there evidence of plant theft within the rehabilitation zone? NO.

Does it appear that the rehabilitation zone has been utilized for stockpiling, vehicle parking, building waste dumping, cattle grazing or person traffic? NO.

If yes, acknowledge below what works were undertaken to rectify/restore and the date —

Weeds

Have any areas of weeds re-established within the rehabilitation zones during the last quarter? NO.

What species? —

What management was undertaken to eradicate these weeds? —

If management was undertaken acknowledge that such was performed in accordance with the approved rehabilitation management plan. —

Vegetation regeneration

Natural regeneration is occurring in (record height range estimate):

- Tree species > 6M
- Shrub species > 2M
- ground covers < 1M

What are the dominant species within each layer?

- Tree BANKSIA
- Shrub GROUND FERN
- ground covers GRASS + LEAF LITTER

Have you noticed any new native plant species since the last monthly inspection? NO.

If yes name the species or take a photograph —

Acknowledge that the required routine photographs have been taken within the rehabilitation zones
YES.

Biodiversity

Have you spotted native fauna within the rehabilitation zone during inspection?

If yes, what types?

Koala —
Kangaroo/wallaby —
Possums/gliders —
Small mammal (i.e. bandicoot, echidna) —
Reptiles (i.e.snakes/lizards) —
Birds of prey —
Large nectar feeding birds (i.e. lorikeets, parrots, cockatoos) —
Small tree and ground birds (i.e. finches, fairy wrens, treecreepers) —
Glossy Black Cockatoos —
Other —

Modifications

Have there been any structural additions (eg. new tracks, buildings) to the rehabilitation zones since the last visit?
NO.

What actions were undertaken to remove any illegal modifications? —

Condition of fences

- Good
- Need minor repair
- Poor (need replacement)

Are any of the following performance criteria exceeded (refer Section 4.5 below)?

Declared Weeds? —
Extent of other Weeds? —
Survival Rate of Plants? —
Condition of Plants? —
Canopy Coverage? —
Tree, Small Tree & Shrub Diversity? —
Groundcover Coverage? —
General Coverage/Success? —

If yes, what corrective action was performed (i.e. plant showed drought stress and so watering was undertaken, plant was dead so a replacement plant was pocket planted, canopy plant coverage was not achieved so relevant pioneer plants were pocket planted).

PROFORMA FOR MONITORING FOREST STRUCTURE

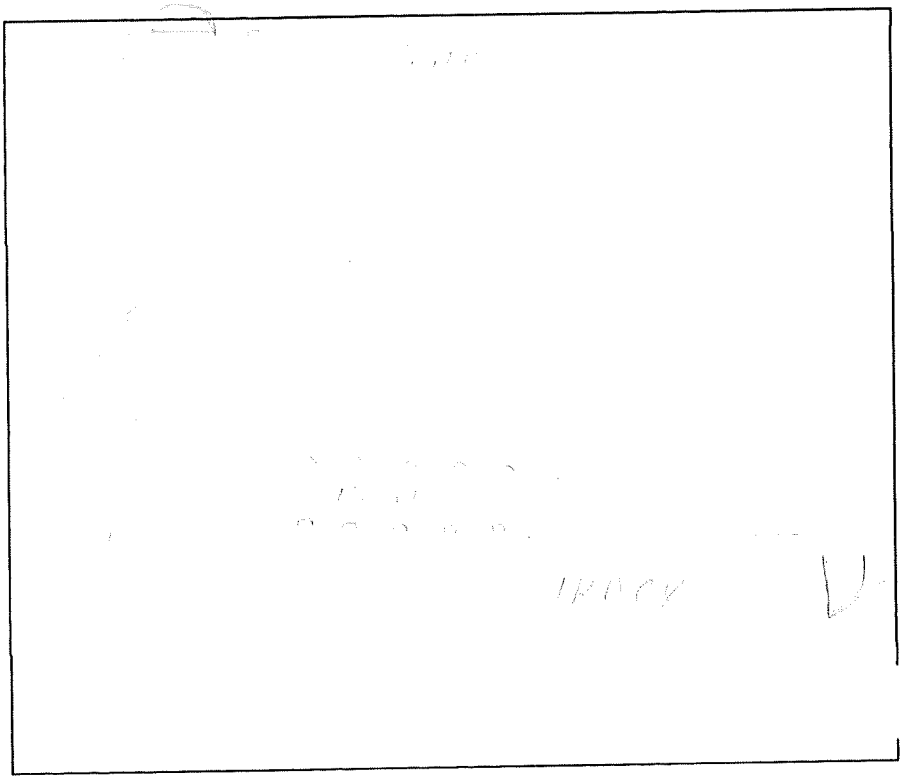
Project name: DUNLOE PARK SAND	**Project ID:** 06_0030
Site name: ZONE 1	**Site ID:**
Assessed by: S. PETERSON + K. KEARNEY	**Date:** 18/12/2017

LOCATION OF MONITORING PLOTS

Provide details and also mark on the map of the site	**Plot**
Location at 0 m point of plot (grid / GPS coordinates):	LAT: -28.415761
Datum:	LON: 153.555592
Compass bearing / direction of transect (from 0 m point)	
Landform (e.g. plateau, crest, upper slope, mid-slope, lower slope, stream bank, floodplain)	
Slope (: e.g. flat/steep)	
Aspect (compass bearing / direction of fall of slope)	

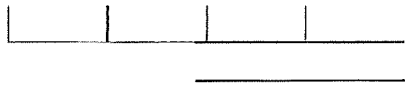
MAP OF MONITORING PLOTS

In the box, insert a map of the site showing the location of monitoring plots (mark 0 m point) in relation to notable features of the site (e.g. property boundaries, roads, waterways). Also show notable features of the monitoring plots (e.g. non-standard layout, presence of remnant trees) and location of any landscape photopoints. Include a scale bar (e.g. 0-100 m) and North arrow.



Site name:	Date:

GROUND COVER, CANOPY COVER and CANOPY HEIGHT
For each survey plot, lay out a 50 m transect. Then survey quadrats centred on the 5 m, 25 m and 45 m points



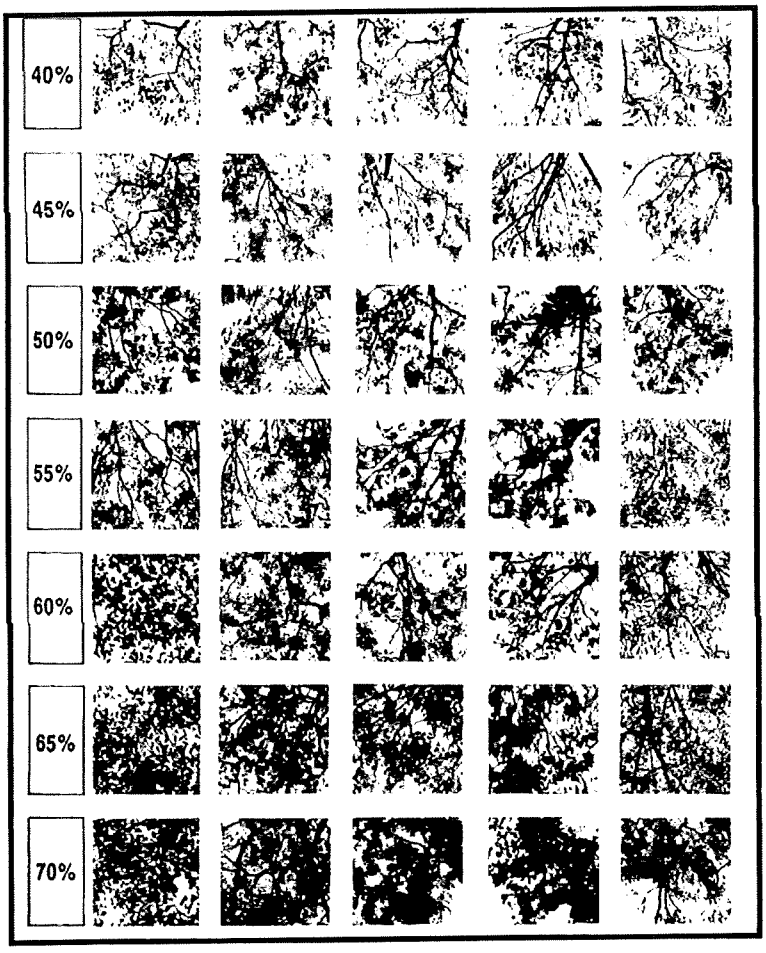
Ground cover = proportion of ground covered by (a) vegetation within 1 m of ground (categorised by life form), (b) leaf litter and fine woody debris, (c) coarse woody debris, d) rock, (e) soil, or (f) other. *At the 5 m, 25 m and 45 m points, define a 1 m x 1 m quadrat, using four 1 m sticks. Looking down at the quadrat from 1 m, estimate the % of ground covered by each type (as would be seen on a photo: total must add to 100%).*

Ground Cover			**Plot**
Location of quadrat:	**5 m**	**25 m**	**45 m**
a) **Vegetation within 1 m of the ground**			
Grass (and sedges)	10 %	5 %	20 %
Herbs (soft-stemmed plants)	0 %	0 %	0 %
Ferns	15 %	50 %	45 %
Vines and scramblers	10 %	3 %	0 %
Tree seedlings and shrubs	11 %	10 %	10 %
Moss (and liverworts and lichens)	2 %	3 %	3 %
b) **Leaf litter** and fine woody debris <10 cm diameter	30 %	20%	12 %
c) **Coarse woody debris** >10 cm diameter	15 %	0 %	8 %
d) **Bare rock**	0 %	0 %	0 %
e) **Bare soil**	5 %	0 %	1 %
f) **Other** (including tree trunks, roots, etc.)	2 %	9 %	1 %
TOTAL (must add up to 100%)	**100%**	**100%**	**100%**

Canopy (foliage) cover = projective cover of ecologically dominant layer above ground level (shade cast by foliage and stems, if the sun was overhead, assessed (approximately) above the entire 10 m x 10 m quadrat around each point. It can be estimated by eye (although this can be very subjective) or from a photo. *1. Estimate foliage cover visually, e.g. by comparison with reference photos. 2. Take a wide-angled digital photo looking up from the*

centre of each 10 x 10 m quadrat, and use to calculate foliage cover). Record the number of each photo for later reference.

Canopy (foliage) cover	**Plot**		
Location of quadrat:	**5 m**	**25 m**	**45 m**
Visual estimate of canopy (foliage) cover	60	50	40
Canopy (foliage) cover calculated from photo	65	55	50
Record number of canopy photo for reference	1	2	3



CANOPY COVER PHOTOGRAPHS PER WALKER AND HOPKINS (1990)

Canopy height The height of the tallest tree in the canopy of each 10 m x 10 m quadrat (the canopy is the layer of foliage forming the 'roof' of the forest: it may be broken by gaps or incomplete). In some sites, it may be necessary to distinguish canopy trees from emergents: i.e. trees projecting well above the canopy with crowns exposed on all sides *Note: Estimating height is difficult. Use a clinometer & tape measure, or range finder, or other measure. Alternatively, place a 2.5 m pole against a tree, & standing at a distance, estimate height in multiples of 2.5 m.*

Canopy height	Plot		
Location of quadrat:	5 m	25 m	45 m
Canopy height (tallest trees in canopy)	> 10m	8m	> 10m
Height of emergent trees (if present)	< 2m	<2m	<2m

Site name:	Date:

SPECIAL LIFE FORMS: *Record **presence** of life forms in each 10 m x 10 m quadrat centred on the 5 m, 25 m and 45 m points. If life forms are present on site, but not in quadrats, record in last column. Do not count no. of individuals.*

Special Life Forms		Plot			On site?
Location of quadrat:		5 m	25 m	45 m	
Strangler figs Figs with network of roots around stem of host tree, rooted in ground					
Hemi-epiphytes Climbing plants adhering to tree trunks, rooted in ground, e.g. *Pothos*, climbing pandanus					
Vines Climbing woody-stemmed plants dependent on trees for support, and rooted in the ground	Slender (stem <5 cm diam.)	✓	✓	✓	
	Robust (stem >5 cm diam.)				
Vine towers Dense columns of vines growing over and smothering tree crowns and stems					
Vine tangles Dense masses of interwoven vine stems in understorey or midstorey					
Thorny scramblers Thicket-forming vines or shrubs, often spiny, e.g. *Calamus*, lantana, cockspur, raspberry, other vines (e.g. *Eleagnus*, *Maesa*)	Individual plants present				
	Thickets present				
Palm trees Palms with stems >2 m high					
Understorey palms with stems <2 m high, e.g. walking stick palms (also includes juvenile palm trees)					
Tree ferns Ferns with stems usually >0.5 m high					
Ground ferns Ferns or fern-like plants without stems, growing on the ground		✓	✓	✓	
Clumping epiphytic ferns e.g. staghorns, basket ferns					
Other epiphytes Growing on trees, e.g. trailing ferns, orchids, not rooted on ground					
Cordylines 'Palm-lilies': shrubs to 5 m high, occasionally branched, with long leaves					
Herbs with long wide leaves e.g. gingers, cunjevoi, bananas					
Herbs with long strap-like leaves e.g. lilies, mat-rush					
Cycads Plants with leathery palm-like foliage borne on stout stems or growing on ground (subterranean stems)	Stout stems, e.g. *Lepidozamia*				
	Ground cycads, e.g. *Bowenia*				
Pandanus Shrub / small tree with serrated strap-like leaves					
Other life forms: describe...					

PROFORMA FOR MONITORING FOREST STRUCTURE

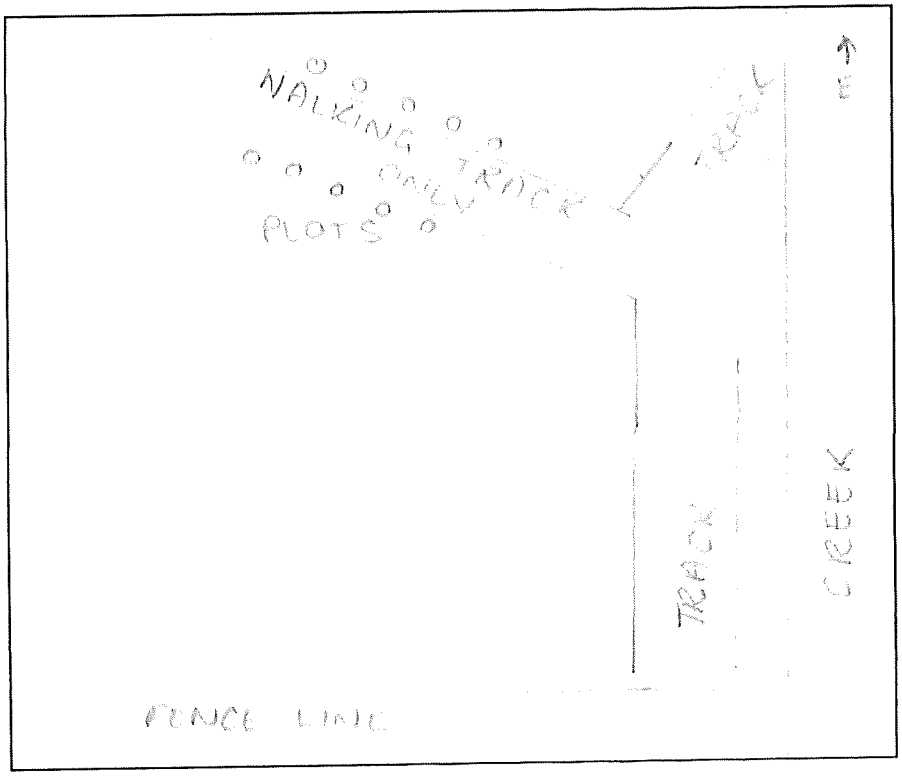
Project name: DUNLOE PARK SAND	**Project ID:** 06_0030
Site name: ZONE2	**Site ID:**
Assessed by:	**Date:** 18/12/2017

LOCATION OF MONITORING PLOTS

Provide details and also mark on the map of the site	**Plot**
Location at 0 m point of plot (grid / GPS coordinates):	LAT : -28·421486
Datum:	LON : 153·558109
Compass bearing / direction of transect (from 0 m point)	
Landform (e.g. plateau, crest, upper slope, mid-slope, lower slope, stream bank, floodplain)	
Slope (: e.g. flat/steep)	
Aspect (compass bearing / direction of fall of slope)	

MAP OF MONITORING PLOTS

In the box, insert a map of the site showing the location of monitoring plots (mark 0 m point) in relation to notable features of the site (e.g. property boundaries, roads, waterways). Also show notable features of the monitoring plots (e.g. non-standard layout, presence of remnant trees) and location of any landscape photopoints. Include a scale bar (e.g. 0-100 m) and North arrow.



Site name:	Date:

GROUND COVER, CANOPY COVER and CANOPY HEIGHT
For each survey plot, lay out a 50 m transect. Then survey quadrats centred on the 5 m, 25 m and 45 m points

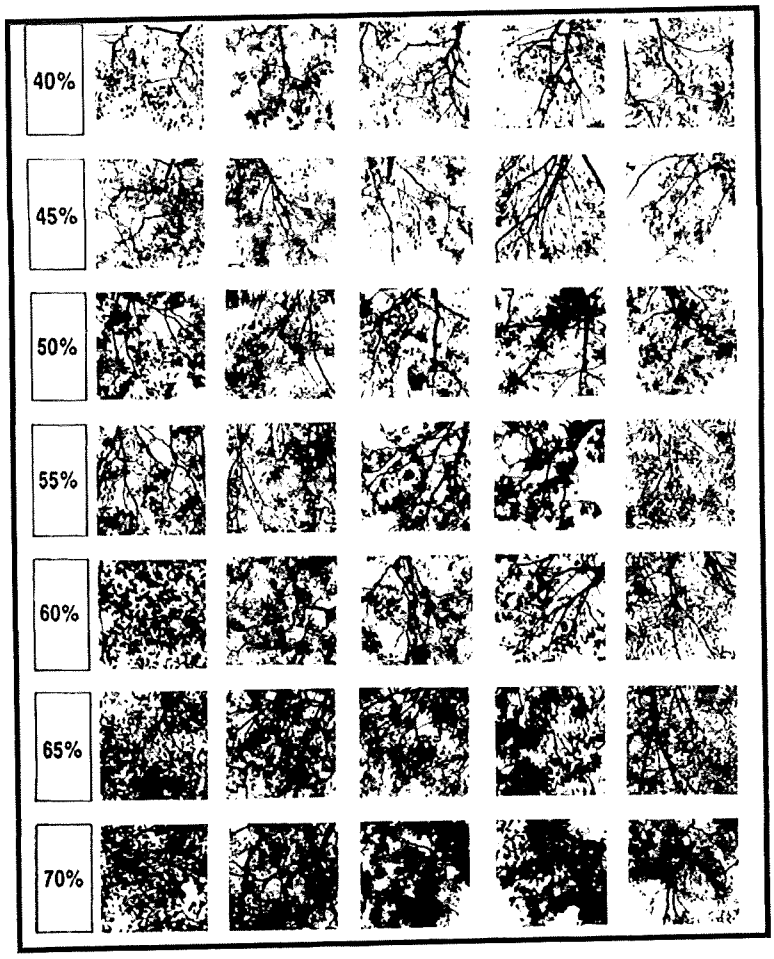
Ground cover = proportion of ground covered by (a) vegetation within 1 m of ground (categorised by life form), (b) leaf litter and fine woody debris, (c) coarse woody debris, d) rock, (e) soil, or (f) other. *At the 5 m, 25 m and 45 m points, define a 1 m x 1 m quadrat, using four 1 m sticks. Looking down at the quadrat from 1 m, estimate the % of ground covered by each type (as would be seen on a photo: total must add to 100%).*

Ground Cover	**Plot**		
Location of quadrat:	**5 m**	**25 m**	**45 m**
a) **Vegetation within 1 m of the ground**			
Grass (and sedges)	25 %	20 %	30 %
Herbs (soft-stemmed plants)	0 %	0 %	0 %
Ferns	1 %	20 %	20 %
Vines and scramblers	0 %	0 %	0 %
Tree seedlings and shrubs	20 %	10 %	25 %
Moss (and liverworts and lichens)	1 %	1 %	1 %
b) **Leaf litter** and fine woody debris <10 cm diameter	10 %	20 %	10 %
c) **Coarse woody debris** >10 cm diameter	0 %	0 %	0 %
d) **Bare rock**	0 %	0 %	0 %
e) **Bare soil**	0 %	0 %	0 %
f) **Other** (including tree trunks, roots, etc.)	0 %	0 %	0 %
TOTAL (must add up to 100%)	**100%**	**100%**	**100%**

Canopy (foliage) cover = projective cover of ecologically dominant layer above ground level (shade cast by foliage and stems, if the sun was overhead, assessed (approximately) above the entire 10 m x 10 m quadrat around each point. It can be estimated by eye (although this can be very subjective) or from a photo. *1. Estimate foliage cover visually, e.g. by comparison with reference photos. 2. Take a wide-angled digital photo looking up from the*

centre of each 10 x 10 m quadrat, and use to calculate foliage cover). Record the number of each photo for later reference.

Canopy (foliage) cover	**Plot**		
Location of quadrat:	**5 m**	**25 m**	**45 m**
Visual estimate of canopy (foliage) cover	40	50	40
Canopy (foliage) cover calculated from photo	45	45	50
Record number of canopy photo for reference	1	2	3



CANOPY COVER PHOTOGRAPHS PER WALKER AND HOPKINS (1990)

Canopy height The height of the tallest tree in the canopy of each 10 m x 10 m quadrat (the canopy is the layer of foliage forming the 'roof' of the forest: it may be broken by gaps or incomplete). In some sites, it may be necessary to distinguish canopy trees from emergents: i.e. trees projecting well above the canopy with crowns exposed on all sides *Note: Estimating height is difficult. Use a clinometer & tape measure, or range finder, or other measure. Alternatively, place a 2.5 m pole against a tree, & standing at a distance, estimate height in multiples of 2.5 m.*

Canopy height	Plot		
Location of quadrat:	5 m	25 m	45 m
Canopy height (tallest trees in canopy)	>10m	>10m	>10m
Height of emergent trees (if present)	>2m	>2m	>2m

Site name:	Date:

SPECIAL LIFE FORMS: *Record **presence** of life forms in each 10 m x 10 m quadrat centred on the 5 m, 25 m and 45 m points. If life forms are present on site, but not in quadrats, record in last column. Do not count no. of individuals.*

Special Life Forms		Plot			On site?
Location of quadrat:		5 m	25 m	45 m	
Strangler figs Figs with network of roots around stem of host tree, rooted in ground					
Hemi-epiphytes Climbing plants adhering to tree trunks, rooted in ground, e.g. *Pothos*, climbing pandanus					
Vines Climbing woody-stemmed plants dependent on trees for support, and rooted in the ground	Slender (stem <5 cm diam.)				
	Robust (stem >5 cm diam.)				
Vine towers Dense columns of vines growing over and smothering tree crowns and stems					
Vine tangles Dense masses of interwoven vine stems in understorey or midstorey					
Thorny scramblers Thicket-forming vines or shrubs, often spiny, e.g. *Calamus*, lantana, cockspur, raspberry, other vines (e.g. *Eleagnus*, *Maesa)*	Individual plants present				
	Thickets present				
Palm trees Palms with stems >2 m high					
Understorey palms with stems <2 m high, e.g. walking stick palms (also includes juvenile palm trees)					
Tree ferns Ferns with stems usually >0.5 m high					
Ground ferns Ferns or fern-like plants without stems, growing on the ground		✓	✓	✓	
Clumping epiphytic ferns e.g. staghorns, basket ferns					
Other epiphytes Growing on trees, e.g. trailing ferns, orchids, not rooted on ground					
Cordylines 'Palm-lilies': shrubs to 5 m high, occasionally branched, with long leaves					
Herbs with long wide leaves e.g. gingers, cunjevoi, bananas					
Herbs with long strap-like leaves e.g. lilies, mat-rush					
Cycads Plants with leathery palm-like foliage borne on stout stems or growing on ground (subterranean stems)	Stout stems, e.g. *Lepidozamia*				
	Ground cycads, e.g. *Bowenia*				
Pandanus Shrub / small tree with serrated strap-like leaves					
Other life forms: describe...					

Woody debris = fallen logs and branches lying on or within 1 m of the ground.									
Tally the number of times logs are intercepted by the 50 m transect, by diameter class at the point of intersection. If a log is intercepted by the transect more than once, it is tallied each time, by diameter at each of the points of intersection									
Tally intercepts with fallen logs by diameter class on each transect	**Fine woody debris <10 cm dia**		**Coarse woody debris (CWD) > 10 cm diameter**						
	2.5-5 cm	**5-10 cm**	**10-20**	**20-30**	**30-40**	**40-50**	**50-75**	**75-100**	**>100**
50 m transect									

FORM D: PROFORMA FOR MONITORING FLORISTIC COMPOSITION

Project name:	**Project ID:**
Site name:	**Site ID:**
Assessed by:	**Date:**

LOCATION OF MONITORING PLOTS

Provide details and also mark on the map of the site	**Plot**
Location at 0 m point of plot (grid / GPS coordinates):	
Datum:	
Compass bearing / direction of transect (from 0 m point)	
Landform (e.g. plateau, crest, upper slope, mid-slope, lower slope, stream bank, floodplain)	
Slope (: e.g. flat/steep)	
Aspect (compass bearing / direction of fall of slope)	

MAP OF MONITORING PLOTS

In the box, insert a map of the site showing the location of monitoring plots (mark 0 m point) in relation to notable features of the site (e.g. property boundaries, roads, waterways). Also show notable features of the monitoring plots (e.g. non-standard layout, presence of remnant trees) and location of any landscape photopoints. Include a scale bar (e.g. 0-100 m) and North arrow.

Site name:	Date:

GENERAL COMMENTS *on the composition of vegetation at the site (e.g. dominant or notable species, variation across the site): record by strata as follows:*

Canopy/ Ecologically Dominant Layer:

BANKSIA + CASUARINA DOMINANT

Midstorey:

Understorey/ Ground cover:

FERNS, GRASSES
LITTER INCREASING AS TREES
FURTHER ESTABLISH

RECRUITMENT: What species are common recruits to the site? Any other comments about recruitment?

Does this site have any WEED or MAINTENANCE ISSUES that need attention?

NIL

Any other comments on the site? Mark an 'X' here _____ and add extra page(s) as required


19/12/2017 Zone 3
1. Canopy Foliage


Zone 1A NW
19/12/2017

APPENDIX 4

DUNLOE SAND QUARRY TRUCK MOVEMENT SUMMARY 2017

Date	Truck Numbers
9-Jan-2017	18
10-Jan-2017	19
11-Jan-2017	17
12-Jan-2017	17
13-Jan-2017	34
14-Jan-2017	0
15-Jan-2017	0
16-Jan-2017	18
17-Jan-2017	15
18-Jan-2017	14
19-Jan-2017	22
20-Jan-2017	26
21-Jan-2017	0
22-Jan-2017	0
23-Jan-2017	11
24-Jan-2017	19
25-Jan-2017	17
26-Jan-2017	0
27-Jan-2017	12
28-Jan-2017	0
29-Jan-2017	0
30-Jan-2017	23
31-Jan-2017	12
MONTH TOTAL	**294**
1-Feb-2017	24
2-Feb-2017	19
3-Feb-2017	20
4-Feb-2017	0
5-Feb-2017	0
6-Feb-2017	0
7-Feb-2017	17
8-Feb-2017	17
9-Feb-2017	0
10-Feb-2017	15
11-Feb-2017	0
12-Feb-2017	0
13-Feb-2017	26
14-Feb-2017	25
15-Feb-2017	0
16-Feb-2017	21
17-Feb-2017	19
18-Feb-2017	0
19-Feb-2017	0
20-Feb-2017	21
21-Feb-2017	18
22-Feb-2017	18
23-Feb-2017	23
24-Feb-2017	16
25-Feb-2017	0
26-Feb-2017	0

27-Feb-2017	17
28-Feb-2017	14
MONTH TOTAL	**330**
1-Mar-2017	21
2-Mar-2017	19
3-Mar-2017	29
4-Mar-2017	5
5-Mar-2017	0
6-Mar-2017	19
7-Mar-2017	19
8-Mar-2017	20
9-Mar-2017	17
10-Mar-2017	16
11-Mar-2017	2
12-Mar-2017	0
13-Mar-2017	21
14-Mar-2017	7
15-Mar-2017	2
16-Mar-2017	17
17-Mar-2017	18
18-Mar-2017	0
19-Mar-2017	0
20-Mar-2017	13
21-Mar-2017	0
22-Mar-2017	12
23-Mar-2017	13
24-Mar-2017	25
25-Mar-2017	0
26-Mar-2017	0
27-Mar-2017	20
28-Mar-2017	18
29-Mar-2017	20
30-Mar-2017	0
31-Mar-2017	0
MONTH TOTAL	**353**
1-Apr-2017	0
2-Apr-2017	0
3-Apr-2017	0
4-Apr-2017	16
5-Apr-2017	18
6-Apr-2017	17
7-Apr-2017	31
8-Apr-2017	7
9-Apr-2017	0
10-Apr-2017	18
11-Apr-2017	23
12-Apr-2017	22
13-Apr-2017	15
14-Apr-2017	0
15-Apr-2017	0
16-Apr-2017	0

17-Apr-2017	0
18-Apr-2017	17
19-Apr-2017	15
20-Apr-2017	19
21-Apr-2017	25
22-Apr-2017	0
23-Apr-2017	0
24-Apr-2017	12
25-Apr-2017	0
26-Apr-2017	23
27-Apr-2017	15
28-Apr-2017	18
29-Apr-2017	0
30-Apr-2017	0
MONTH TOTAL	**311**
1-May-2017	8
2-May-2017	21
3-May-2017	17
4-May-2017	15
5-May-2017	21
6-May-2017	0
7-May-2017	0
8-May-2017	13
9-May-2017	15
10-May-2017	9
11-May-2017	14
12-May-2017	28
13-May-2017	0
14-May-2017	0
15-May-2017	15
16-May-2017	15
17-May-2017	17
18-May-2017	22
19-May-2017	0
20-May-2017	0
21-May-2017	0
22-May-2017	0
23-May-2017	10
24-May-2017	15
25-May-2017	13
26-May-2017	19
27-May-2017	0
28-May-2017	0
29-May-2017	22
30-May-2017	13
31-May-2017	17
MONTH TOTAL	**339**
1-Jun-2017	38
2-Jun-2017	26
3-Jun-2017	0
4-Jun-2017	0

5-Jun-2017	24
6-Jun-2017	25
7-Jun-2017	17
8-Jun-2017	15
9-Jun-2017	23
10-Jun-2017	0
11-Jun-2017	0
12-Jun-2017	0
13-Jun-2017	4
14-Jun-2017	1
15-Jun-2017	1
16-Jun-2017	0
17-Jun-2017	0
18-Jun-2017	0
19-Jun-2017	12
20-Jun-2017	9
21-Jun-2017	25
22-Jun-2017	15
23-Jun-2017	19
24-Jun-2017	0
25-Jun-2017	0
26-Jun-2017	0
27-Jun-2017	13
28-Jun-2017	14
29-Jun-2017	0
30-Jun-2017	0
MONTH TOTAL	**281**
1-Jul-2017	2
2-Jul-2017	0
3-Jul-2017	19
4-Jul-2017	15
5-Jul-2017	19
6-Jul-2017	12
7-Jul-2017	0
8-Jul-2017	0
9-Jul-2017	0
10-Jul-2017	19
11-Jul-2017	17
12-Jul-2017	17
13-Jul-2017	16
14-Jul-2017	16
15-Jul-2017	2
16-Jul-2017	0
17-Jul-2017	14
18-Jul-2017	15
19-Jul-2017	17
20-Jul-2017	16
21-Jul-2017	21
22-Jul-2017	0
23-Jul-2017	0
24-Jul-2017	17

25-Jul-2017	14
26-Jul-2017	9
27-Jul-2017	16
28-Jul-2017	18
29-Jul-2017	0
30-Jul-2017	0
31-Jul-2017	23
MONTH TOTAL	**334**
1-Aug-2017	16
2-Aug-2017	17
3-Aug-2017	13
4-Aug-2017	20
5-Aug-2017	0
6-Aug-2017	0
7-Aug-2017	16
8-Aug-2017	21
9-Aug-2017	27
10-Aug-2017	23
11-Aug-2017	14
12-Aug-2017	3
13-Aug-2017	0
14-Aug-2017	9
15-Aug-2017	18
16-Aug-2017	24
17-Aug-2017	0
18-Aug-2017	12
19-Aug-2017	0
20-Aug-2017	0
21-Aug-2017	20
22-Aug-2017	16
23-Aug-2017	13
24-Aug-2017	21
25-Aug-2017	18
26-Aug-2017	0
27-Aug-2017	0
28-Aug-2017	14
29-Aug-2017	14
30-Aug-2017	14
31-Aug-2017	19
MONTH TOTAL	**382**
1-Sep-2017	17
2-Sep-2017	0
3-Sep-2017	0
4-Sep-2017	29
5-Sep-2017	30
6-Sep-2017	22
7-Sep-2017	26
8-Sep-2017	16
9-Sep-2017	0
10-Sep-2017	0
11-Sep-2017	22

12-Sep-2017	26
13-Sep-2017	23
14-Sep-2017	24
15-Sep-2017	16
16-Sep-2017	0
17-Sep-2017	0
18-Sep-2017	16
19-Sep-2017	19
20-Sep-2017	27
21-Sep-2017	23
22-Sep-2017	22
23-Sep-2017	0
24-Sep-2017	0
25-Sep-2017	22
26-Sep-2017	28
27-Sep-2017	16
28-Sep-2017	25
29-Sep-2017	17
30-Sep-2017	0
MONTH TOTAL	**466**
1-Oct-2017	0
2-Oct-2017	0
3-Oct-2017	22
4-Oct-2017	20
5-Oct-2017	17
6-Oct-2017	0
7-Oct-2017	4
8-Oct-2017	0
9-Oct-2017	29
10-Oct-2017	30
11-Oct-2017	30
12-Oct-2017	27
13-Oct-2017	17
14-Oct-2017	0
15-Oct-2017	0
16-Oct-2017	6
17-Oct-2017	8
18-Oct-2017	17
19-Oct-2017	24
20-Oct-2017	0
21-Oct-2017	1
22-Oct-2017	0
23-Oct-2017	19
24-Oct-2017	23
25-Oct-2017	26
26-Oct-2017	22
27-Oct-2017	19
28-Oct-2017	0
29-Oct-2017	0
30-Oct-2017	29
31-Oct-2017	21

MONTH TOTAL	**411**
1-Nov-2017	20
2-Nov-2017	31
3-Nov-2017	24
4-Nov-2017	0
5-Nov-2017	0
6-Nov-2017	26
7-Nov-2017	24
8-Nov-2017	26
9-Nov-2017	17
10-Nov-2017	23
11-Nov-2017	4
12-Nov-2017	0
13-Nov-2017	21
14-Nov-2017	23
15-Nov-2017	23
16-Nov-2017	30
17-Nov-2017	28
18-Nov-2017	5
19-Nov-2017	0
20-Nov-2017	25
21-Nov-2017	22
22-Nov-2017	16
23-Nov-2017	25
24-Nov-2017	27
25-Nov-2017	4
26-Nov-2017	0
27-Nov-2017	37
28-Nov-2017	29
29-Nov-2017	20
30-Nov-2017	15
MONTH TOTAL	**545**
1-Dec-2017	18
2-Dec-2017	6
3-Dec-2017	0
4-Dec-2017	15
5-Dec-2017	21
6-Dec-2017	24
7-Dec-2017	21
8-Dec-2017	21
9-Dec-2017	0
10-Dec-2017	0
11-Dec-2017	31
12-Dec-2017	24
13-Dec-2017	25
14-Dec-2017	27
15-Dec-2017	22
16-Dec-2017	0
17-Dec-2017	0
18-Dec-2017	22
19-Dec-2017	28

20-Dec-2017	16
21-Dec-2017	14
22-Dec-2017	0
23-Dec-2017	0
24-Dec-2017	0
25-Dec-2017	0
26-Dec-2017	0
27-Dec-2017	0
28-Dec-2017	0
29-Dec-2017	0
30-Dec-2017	0
31-Dec-2017	0
MONTH TOTAL	**335**

Total Trucks 2017	**4381**

APPENDIX 5

DUNLOE SAND QUARRY SUMMARY OF 2016 ACID SULPHATE SOIL MONITORING RESULTS

Holcim (Australia) Pty Ltd
799 Pacific Hwy
Chatswood NSW 2067
Australia

ABN 87 099 732 297
Phone +61 2 9412 6600
www.holcim.com.au

Dunloe Sands Quarry

Summary of Acid Sulphate Soils Monitoring Results

Sample Number	Identification				Net Acidity (mol. H+/t)
	Borehole/ Testpit	From (m)	To (m)	Date Sampled	
S1	1	0.00	0.50	12-Sep-16	10
S2	1	0.50	1.00	12-Sep-16	3
S3	1	1.00	1.50	12-Sep-16	58
S4	1	1.50	2.00	12-Sep-16	146
S5	1	2.00	2.50	12-Sep-16	96
S6	1	2.50	3.00	12-Sep-16	79
S7	1	3.00	3.50	12-Sep-16	73
S8	1	3.50	4.00	12-Sep-16	35
S9	1	4.00	4.50	12-Sep-16	39
S10	1	4.50	5.00	12-Sep-16	38
S11	1	5.00	5.50	12-Sep-16	22
S12	1	5.50	6.00	12-Sep-16	127
S13	1	6.00	6.50	12-Sep-16	38
S14	1	6.50	7.00	12-Sep-16	50
S15	1	7.00	7.50	12-Sep-16	34
S16	1	7.50	8.00	12-Sep-16	42
S17	1	8.00	8.50	12-Sep-16	0
S18	1	8.50	9.00	12-Sep-16	0
S19	1	9.00	9.50	12-Sep-16	0
S20	1	9.50	10.00	12-Sep-16	0
S21	1	10.00	10.50	12-Sep-16	0
S22	1	10.50	11.00	12-Sep-16	0
S23	1	11.00	11.50	12-Sep-16	0
S24	1	11.50	12.00	12-Sep-16	0
S25	1	12.00	12.50	12-Sep-16	0
S26	1	12.50	13.00	12-Sep-16	0
S27	1	13.00	13.50	12-Sep-16	0
S28	1	13.50	14.00	12-Sep-16	0
S29	1	14.00	14.50	12-Sep-16	0
S30	1	14.50	15.00	12-Sep-16	0
S31	1	15.00	15.50	12-Sep-16	0
S32	1	15.50	16.00	12-Sep-16	163
S33	1	16.00	16.50	12-Sep-16	139
S34	1	16.50	17.00	12-Sep-16	55
S35	2	0.00	0.50	12-Sep-16	27
S36	2	0.50	1.00	12-Sep-16	2
S37	2	1.00	1.50	12-Sep-16	149
S38	2	1.50	2.00	12-Sep-16	168
S39	2	2.00	2.50	12-Sep-16	110
S40	2	2.50	3.00	12-Sep-16	175
S41	2	3.00	3.50	12-Sep-16	49

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Sample Number	Identification				Net Acidity (mol. H+/t)
	Borehole/ Testpit	From (m)	To	Date Sampled	
S42	2	3.50	4.00	12-Sep-16	46
S43	2	4.00	4.50	12-Sep-16	24
S44	2	4.50	5.00	12-Sep-16	22
S45	2	5.00	5.50	12-Sep-16	32
S46	2	5.50	6.00	12-Sep-16	28
S47	2	6.00	6.50	12-Sep-16	39
S48	2	6.50	7.00	12-Sep-16	44
S49	2	7.00	7.50	12-Sep-16	0
S50	2	7.50	8.00	12-Sep-16	0
S51	2	8.00	8.50	12-Sep-16	0
S52	2	8.50	9.00	12-Sep-16	0
S53	2	9.00	9.50	12-Sep-16	0
S54	2	9.50	10.00	12-Sep-16	0
S55	2	10.00	10.50	12-Sep-16	0
S56	2	10.50	11.00	12-Sep-16	0
S57	2	11.00	11.50	12-Sep-16	0
S58	2	11.50	12.00	12-Sep-16	0
S59	2	12.00	12.50	12-Sep-16	0
S60	2	12.50	13.00	12-Sep-16	0
S61	2	13.00	13.50	12-Sep-16	0
S62	2	13.50	14.00	12-Sep-16	13
S63	2	14.00	14.50	12-Sep-16	365
S64	2	14.50	15.00	12-Sep-16	509
S65	3	0.00	0.50	13-Sep-16	78
S66	3	0.50	1.00	13-Sep-16	3
S67	3	1.00	1.50	13-Sep-16	47
S68	3	1.50	2.00	13-Sep-16	61
S69	3	2.00	2.50	13-Sep-16	16
S70	3	2.50	3.00	13-Sep-16	88
S71	3	3.00	3.50	13-Sep-16	55
S72	3	3.50	4.00	13-Sep-16	47
S73	3	4.00	4.50	13-Sep-16	31
S74	3	4.50	5.00	13-Sep-16	31
S75	3	5.00	5.50	13-Sep-16	22
S76	3	5.50	6.00	13-Sep-16	37
S77	3	6.00	6.50	13-Sep-16	42
S78	3	6.50	7.00	13-Sep-16	40
S79	3	7.00	7.50	13-Sep-16	0
S80	3	7.50	8.00	13-Sep-16	0
S81	3	8.00	8.50	13-Sep-16	0
S82	3	8.50	9.00	13-Sep-16	0
S83	3	9.00	9.50	13-Sep-16	0
S84	3	9.50	10.00	13-Sep-16	0
S85	3	10.00	10.50	13-Sep-16	0
S86	3	10.50	11.00	13-Sep-16	0
S87	3	11.00	11.50	13-Sep-16	0
S88	3	11.50	12.00	13-Sep-16	0
S89	3	12.00	12.50	13-Sep-16	0

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Sample Number	Identification				Net Acidity (mol. H+/t)
	Borehole/ Testpit	From (m)	To	Date Sampled	
S90	3	12.50	13.00	13-Sep-16	0
S91	3	13.00	13.50	13-Sep-16	0
S92	3	13.50	14.00	13-Sep-16	0
S93	3	14.00	14.50	13-Sep-16	0
S94	3	14.50	15.00	13-Sep-16	623
S95	3	15.00	15.50	13-Sep-16	1013
S96	3	16.00	16.50	13-Sep-16	875
S97	4	0.00	0.50	13-Sep-16	68
S98	4	0.50	1.00	13-Sep-16	8
S99	4	1.00	1.50	13-Sep-16	82
S100	4	1.50	2.00	13-Sep-16	96
S101	4	2.00	2.50	13-Sep-16	77
S102	4	2.50	3.00	13-Sep-16	80
S103	4	3.00	3.50	13-Sep-16	25
S104	4	3.50	4.00	13-Sep-16	24
S105	4	4.00	4.50	13-Sep-16	45
S106	4	4.50	5.00	13-Sep-16	25
S107	4	5.00	5.50	13-Sep-16	47
S108	4	5.50	6.00	13-Sep-16	42
S109	4	6.00	6.50	13-Sep-16	35
S110	4	6.50	7.00	13-Sep-16	36
S111	4	7.00	7.50	13-Sep-16	31
S112	4	7.50	8.00	13-Sep-16	28
S113	4	8.00	8.50	13-Sep-16	0
S114	4	8.50	9.00	13-Sep-16	0
S115	4	9.00	9.50	13-Sep-16	0
S116	4	9.50	10.00	13-Sep-16	0
S117	4	10.00	10.50	13-Sep-16	0
S118	4	10.50	11.00	13-Sep-16	0
S119	4	11.00	11.50	13-Sep-16	0
S120	4	11.50	12.00	13-Sep-16	0
S121	4	12.00	12.50	13-Sep-16	0
S122	4	12.50	13.00	13-Sep-16	0
S123	4	13.00	13.50	13-Sep-16	50
S124	4	13.50	14.00	13-Sep-16	41
S125	5	0.00	0.50	13-Sep-16	45
S126	5	0.50	1.00	13-Sep-16	6
S127	5	1.00	1.50	13-Sep-16	86
S128	5	1.50	2.00	13-Sep-16	83
S129	5	2.00	2.50	13-Sep-16	70
S130	5	2.50	3.00	13-Sep-16	71
S131	5	3.00	3.50	13-Sep-16	42
S132	5	3.50	4.00	13-Sep-16	49
S133	5	4.00	4.50	13-Sep-16	28
S134	5	4.50	5.00	13-Sep-16	42
S135	5	5.00	5.50	13-Sep-16	27
S136	5	5.50	6.00	13-Sep-16	39
S137	5	6.00	6.50	13-Sep-16	35

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Sample Number	Identification				Net Acidity (mol. H+/t)
	Borehole/ Testpit	From (m)	To	Date Sampled	
S138	5	6.50	7.00	13-Sep-16	42
S139	5	7.00	7.50	13-Sep-16	0
S140	5	7.50	8.00	13-Sep-16	0
S141	5	8.00	8.50	13-Sep-16	0
S142	5	8.50	9.00	13-Sep-16	0
S143	5	9.00	9.50	13-Sep-16	0
S144	5	9.50	10.00	13-Sep-16	0
S145	5	10.00	10.50	13-Sep-16	0
S146	5	10.50	11.00	13-Sep-16	0
S147	5	11.00	11.50	13-Sep-16	0
S148	5	11.50	12.00	13-Sep-16	0
S149	5	12.00	12.50	13-Sep-16	0
S150	5	12.50	13.00	13-Sep-16	0
S151	5	13.00	13.50	13-Sep-16	14
S152	5	13.50	14.00	13-Sep-16	176
S153	5	14.00	14.50	13-Sep-16	143
S154	5	14.50	15.00	13-Sep-16	140
S155	6	0.00	0.50	13-Sep-16	45
S156	6	0.50	1.00	13-Sep-16	18
S157	6	1.00	1.50	13-Sep-16	38
S158	6	1.50	2.00	13-Sep-16	39
S159	6	2.00	2.50	13-Sep-16	37
S160	6	2.50	3.00	13-Sep-16	39
S161	6	3.00	3.50	13-Sep-16	20
S162	6	3.50	4.00	13-Sep-16	36
S163	6	4.00	4.50	13-Sep-16	28
S164	6	4.50	5.00	13-Sep-16	26
S165	6	5.00	5.50	13-Sep-16	24
S166	6	5.50	6.00	13-Sep-16	41
S167	6	6.00	6.50	13-Sep-16	28
S168	6	6.50	7.00	13-Sep-16	31
S169	6	7.00	7.50	13-Sep-16	0
S170	6	7.50	8.00	13-Sep-16	0
S171	6	8.00	8.50	13-Sep-16	0
S172	6	8.50	9.00	13-Sep-16	0
S173	6	9.00	9.50	13-Sep-16	0
S174	6	9.50	10.00	13-Sep-16	0
S175	6	10.00	10.50	13-Sep-16	0
S176	6	10.50	11.00	13-Sep-16	0
S177	6	11.00	11.50	13-Sep-16	0
S178	6	11.50	12.00	13-Sep-16	0
S179	6	12.00	12.50	13-Sep-16	0
S180	6	12.50	13.00	13-Sep-16	0
S181	6	13.00	13.50	13-Sep-16	0
S182	6	13.50	14.00	13-Sep-16	0
S183	6	14.00	14.50	13-Sep-16	0
S184	6	14.50	15.00	13-Sep-16	0
S185	6	15.00	15.50	13-Sep-16	359

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Sample Number	Identification				Net Acidity (mol. H+/t)
	Borehole/ Testpit	From (m)	To (m)	Date Sampled	
S186	6	15.50	16.00	13-Sep-16	953
S187	6	16.00	16.50	13-Sep-16	1720
S188	6	16.50	17.00	13-Sep-16	1596
S189	6	17.00	17.50	13-Sep-16	1140
S190	6	17.50	18.00	13-Sep-16	1605

Source: Soil Surveys, Geotechnical Investigation – Holcim Dunloe Sands Quarry, Pottsville, dated 24 November 2016.