Air Quality Management Plan

For the Central Coast Sands Quarry

Document Control

Status	Date	Prepared	Checked	Authorised
Revision 1	28 November 2014	Martin Doyle	Gary Graham	Martin Doyle
Revision 2	24 August 2017	Andrew Driver	Nathan Grant	Andrew Driver
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1. Introduction

This Air Quality Management Plan (the Plan) has been prepared by Hanson Construction Materials (Hanson) and SLR Pty Ltd (SLR) for the Central Coast Sands Quarry (the Quarry). The Minister for Planning and Infrastructure conditionally approved the extended operation of the Quarry, Somersby, NSW, until 30 June 2044 (Project Application MP 08_0173).

The following report details the assessment criteria, the monitoring locations and procedures, and the compliance checking protocols for subsequent reporting in accordance with the Department of Planning, Industry and Environment (DPIE) (previously the Department of Planning and Environment (DPE)) and the Environment Protection Authority (EPA) requirements.

1.1. Project Overview

The Quarry is situated to the north of Reservoir Road, Somersby NSW. The Quarry is currently an active sand quarry operation, bordered by numerous residential lots to the north, east and south. Mooney Mooney Creek Dam (part of the Central Coast water supply system) is located to the west.

Orchid and poultry farm operations dominate the land uses in the surrounding area. Access to the site is gained via Reservoir Road to the south of the Quarry site. Operations at the Quarry with the potential to generate dust including the following:

- Use of excavator to extract and load recoverable sand to haulage trucks.
- Haulage of material on internal roads to the processing plant.
- Dumping of material at the processing plant.
- Loading of material into the trommel hopper.
- Processing of material.
- Loading stockpiles with product.
- Loading trucks with product.
- Haulage of product offsite.
- Rehabilitation works on bund and within the Quarry site.

This Plan details the measures that will be implemented to ensure adverse air quality impacts do not occur at offsite sensitive receptor locations. Please refer to **Table 10** for a summary of the measures that will be implemented to comply with the relevant air quality criteria.

2. Statutory Requirements

2.1. Secretary's Requirements

Table 1 provides a summary of the specific conditions required to be adhered to, as outlined within the Project Approval, together with the relevant section(s) of this AQMP indicating where the requirements have been addressed.

Table 1: Conditions of Approval

Required Element (Approval MP 08_0173)	Relevant Section
The Proponent shall ensure that all reasonable and feasible avoidance and mitigation measures are employed so that particulate matter emissions generated by the project do not exceed the criteria [as specified] at any residence on privately-owned land.	**Section 4**
Schedule 3, Condition 14 – Operating Conditions The Proponent shall:	
a) implement best management practices to minimise the dust emissions of the project;	**Section 8**
b) regularly assess meteorological and air quality monitoring data and relocate, modify and/or stop operations on site as may be required to ensure compliance with the relevant conditions of this approval;	**Section 7, Section 8, Section 9**
c) minimise the air quality impacts of the project during adverse meteorological conditions and extraordinary events (defined in table noted for 6 of this AQMP);	**Section 7, Section 8, Section 9**
d) implement all reasonable and feasible measures to minimise the release of greenhouse gas emissions from the site;	**Section 8**
e) minimise the area of surface disturbance and maximise progressive rehabilitation of the site;	**Section 8, Section 9**
f) carry out regular air quality monitoring to determine whether the project is complying with the relevant conditions of the approval, to the satisfaction of the Secretary.	**Section 8**
Schedule 3, Condition 15 – Air Quality Management Plan The Proponent shall prepare and implement an Air Quality Management Plan for the project to the satisfaction of the Secretary. This plan must:	
a) describe the measures that would be implemented to ensure: ▪ compliance with the relevant conditions of this approval; ▪ best management practice is employed; and, ▪ the air quality impacts of the project are minimised during adverse meteorological conditions and extraordinary events.	**Whole of document**
b) describe the proposed air quality management system.	**Whole of document, Section 8**
c) include an air quality monitoring program that:	**Section 7, Section 9**

Required Element (Approval MP 08_0173)	Relevant Section
▪ is capable of evaluating the performance of the project; ▪ includes a protocol for determining any exceedances of the relevant conditions of approval; ▪ effectively supports the air quality management system; and ▪ evaluates and reports on the adequacy of the air quality management system.	
Schedule 3, Condition 16 – Meteorological Monitoring For the life of the project, the Proponent shall ensure that there is a suitable meteorological station operating in the vicinity of the site that	
complies with the requirements in the Approved Methods for Sampling of Air Pollutants in New South Wales guideline.	**Section 7**
Schedule 5, Condition 2 – Management Plan Requirements The Proponent shall ensure that the Management Plans required under this approval are prepared in accordance with any relevant guidelines, and include:	
a) detailed baseline data;	**Section 5**
a description of: ▪ the relevant statutory requirements (including any relevant approval, licence or lease conditions); ▪ any relevant limits or performance measures/criteria; and ▪ the specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the project or any management measures;	**Section 2, Section 4, Section 11**
b) a description of the measures that would be implemented to comply with the relevant statutory requirements, limits, or performance measures/criteria;	**Section 8**
c) a program to monitor and report on the: ▪ impacts and environmental performance of the project; ▪ effectiveness of any management measures in (c) above;	**Section 7, Section 9, Section 11**
d) a contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible;	**Section 9**
e) a program to investigate and implement ways to improve the environmental performance of the project over time;	**Section 8, Section 11**
f) a protocol for managing and reporting any: ▪ incidents; ▪ complaints; ▪ non-compliances with statutory requirements; and ▪ exceedances of the impact assessment criteria and/or performance criteria; and	**Section 11**
g) a protocol for periodic review of the plan.	**Section 11**

2.2. Environment Protection Licence Requirements

The EPA regulates the operations conducted at the CCSQ through an Environment Protection Licence (EPL 3751) issued under the Protection of the Environment Operations Act 1997 (POEO Act). EPL conditions for the AQMP are outlined in **Table 2** below together with the relevant section(s) of the AQMP indicating where the requirements have been addressed.

Table 2 EPL Requirements

Required Element (EPL 3751)	Relevant Section
Section 3, L5 Potentially Offensive Odour L5.1 The licensee must not cause or permit the emission of offensive odour beyond the boundary of the premises. L5.2 No condition of this licence identifies a potentially offensive odour for the purposes of Section 129 of the Protection of the Environment Operations Act 1997 Note: Section 129 of the POEO Act 1997, provides that the licensee must not cause or permit the emission of any offensive odour from the premises but provides a defence if the emission is identified in the relevant EPL as a potentially offensive odour and the odour was emitted in accordance with the conditions of a licence directed at minimising odour.	**Section 8**
Section 4, O2 Maintenance of plant and equipment O2.1 All plant and equipment installed at the premises or used in connection with the licensed activity: a) must be maintained in a proper and efficient conditions; and b) must be operated in a proper and efficient manner	**Section 8**
Section 4, O3 Dust O3.1 The premises must be maintained in a condition which minimises or prevents the emission of dust from the premises.	**Section 8**

It is noted that no conditions exist within the EPL that specifically require the monitoring of air quality pollutants.

3. Sensitive Receptor Locations

The Quarry is situated in a rural environment surrounded by numerous medium sized residential acreages to the north, east and south. Mooney Mooney Creek Dam (part of the Central Coastal water supply system) is located to the west. Orchid farms and chicken sheds dominate the surrounding acreages.

Figure 1 identifies the nearest residences, nominated as "A" to "T". These "assessment locations" are most likely to experience the greatest potential impact in terms of air quality as they are the closest to the CCSQ operations. Receptor "A" is occupied by site personnel and is therefore noted to be a project-related residential location. The nearest (non-project-related) residential residences are "B", "C", and "D" located on Keighley Road which are 30 m, 40 m and 60 m respectively from the current extraction area. Resident "R" is the closest receiver to the processing area.

Figure 1: Location of Nearest Sensitive Receptors

Table 3 details the sensitive receptors considered within this assessment, as indicated in **Figure 1**.

Table 3: Details of Closest Non-Project Related Residences

Residence Number	Easting MGA (m)	Northing MGA (m)	Distance (m) and Direction to the Residence
A	339,176	6,305,315	30 m E of project site
B	339,297	6,305,657	30 m N of project site
C	339,490	6,305,608	40 m NE of project site
D	339,545	6,305,635	60 m NE of project site
E	339,654	6,305,593	200 m NE of project site
F	339,774	6,305,568	300 m E of project site
G	339,652	6,305,507	140 m E of project site
H	339,908	6,305,290	440 m E of project site
I	339,988	6,305,293	520 m E of project site
J	339,805	6,305,226	340 m ESE of project site
K	339,860	6,305,137	430 m ESE of project site
L	339,822	6,305,045	450 m SE of project site
M	339,940	6,304,957	610 m SE of project site
N	339,766	6,304,967	705 m E of project site
O	339,483	6,304,994	450 m E of project site
P	339,501	6,304,821	480 m SE of project site
Q	339,194	6,304,818	206 m SSE of project site
R	339,015	6,304,836	130 m S of project site
S	338,933	6,304,621	360 m S of project site
T	338,863	6,304,466	520 m SSW of project site

4. Air Quality Criteria

Air quality impact assessment criteria relevant to the Quarry operations are provided in *Schedule 3, Condition 14* and Tables 3, 4, 5 and 6 of *Approval 08_0173*.

These criteria are prescribed by the NSW EPA in their document, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (2005) (Approved Methods) and apply at any residence on privately-owned land. Note the Approved Methods was updated in 2016 with a revised PM_{10} annual average assessment criteria and the addition of $PM_{2.5}$ 24-hour and annual average assessment criteria. These are included here.

Respirable crystalline silica (RCS) is also relevant to the Quarry. Neither the Approved Methods or Approval 08_0173 provide a criterion for RCS and therefore this AQMP adopts EPA Victoria's assessment criterion for RCS (as $PM_{2.5}$) for the mining and extractive industries[1].

In accordance with the Approval, the operations at the CCSQ and any associated operations must not cause any exceedances of the air quality impact assessment criteria outlined in **Table 4**.

Table 4: Long term Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion	Source
Total suspended particulate (TSP) matter	Annual	90 µg/m^3 (a)	Approval 08_0173
Particulate matter < 10 µm (PM_{10})	Annual	25 µg/m^3 (a)	Approved Methods (2016)
	24-Hour	50 µg/m^3 (a)	Approval 08_0173
Particulate matter < 2.5 µm ($PM_{2.5}$)	Annual	25 µg/m^3 (a)	Approved Methods (2016)
	24-Hour	8 µg/m^3 (a)	Approved Methods (2016)
			Approval 08_0173
Respirable Crystalline Silica (as $PM_{2.5}$)(d)	Annual	3 µg/m^3	EPA Victoria
Deposited dust(c)	Annual	Maximum increase in deposited dust level: 2 g/m^2/month(b) Maximum total deposited dust level 4 g/m^2/month(a)	Approval 08_0173

Notes:

a Total incremental increase in concentrations due to the project plus background concentrations due to all other sources.

b Incremental increase in concentrations due to the project on its own.

c Deposited dust is to be assessed as insoluble solids as defined by Standards Australia, AS/NZS 3580.10.1:2003 *Methods for* Sampling *and Analysis of Ambient Air – Determination of Particulate Matter - Deposited Matter - Gravimetric Method*.

d Crystalline silica must be analysed in accordance with a test method approved by the Department of Health.

[1] *Protocol for Environmental Management: Mining and Extractive Industries*, EPA Victoria, 2007.

5. Dispersion Modelling Results

In 2012, SLR Consulting Australia (SLR) prepared an Air Quality Impact Assessment for the Somersby Quarry Extension[2] on behalf of Hanson [hereafter CCSQ AQIA (2012)]. CCSQ AQIA (2012) presents the results of an air dispersion modelling assessment undertaken for the CCSQ, detailed baseline monitoring data for the site, and an analysis of the local meteorology and topography for the local area.

The results of the modelling study predicted that operations at CCSQ would comply with the relevant criteria, provided that specific design and operational safeguards are implemented.

In summary:

- Dust deposition levels were predicted to be below the air quality criterion at all surrounding sensitive receptor locations.
- Cumulative annual average PM_{10} concentrations were predicted to satisfy the air quality criterion at all surrounding sensitive receptor locations.
- Cumulative annual average TSP concentrations were predicted to satisfy the air quality criterion at all surrounding sensitive receptor locations.
- Cumulative 24-hour average PM_{10} concentrations were predicted to satisfy the air quality criterion at all surrounding sensitive receptor locations.

6. Baseline Air Quality

6.1. Baseline Dust Desposition

No baseline dust deposition monitoring was performed for the Quarry.

6.2. Baseline PM10 Concentrations

No baseline PM_{10} monitoring was performed for the Quarry. Regional PM_{10} real-time data is available from the Office of Environment and Heritage's (OEH) Richmond Air Quality Monitoring Station (AQMS). This air quality monitoring site is located inside the campus of the University of Western Sydney, Hawkesbury, approximately 55 km southwest of the CCSQ. In lieu of any site-specific data, data from this AQMS was used within the CCSQ AQIA (2012) as an approximation of regional air quality surrounding the CCSQ.

Background PM_{10} concentrations used within the CCSQ AQIA (2012) were based on data reported for the 2008 calendar year and are presented in **Figure 2**.

[2] *Somersby Quarry Extension – Air Quality Impact Assessment,* SLR Consulting Australia, 2012. Report 30.1872 R2.

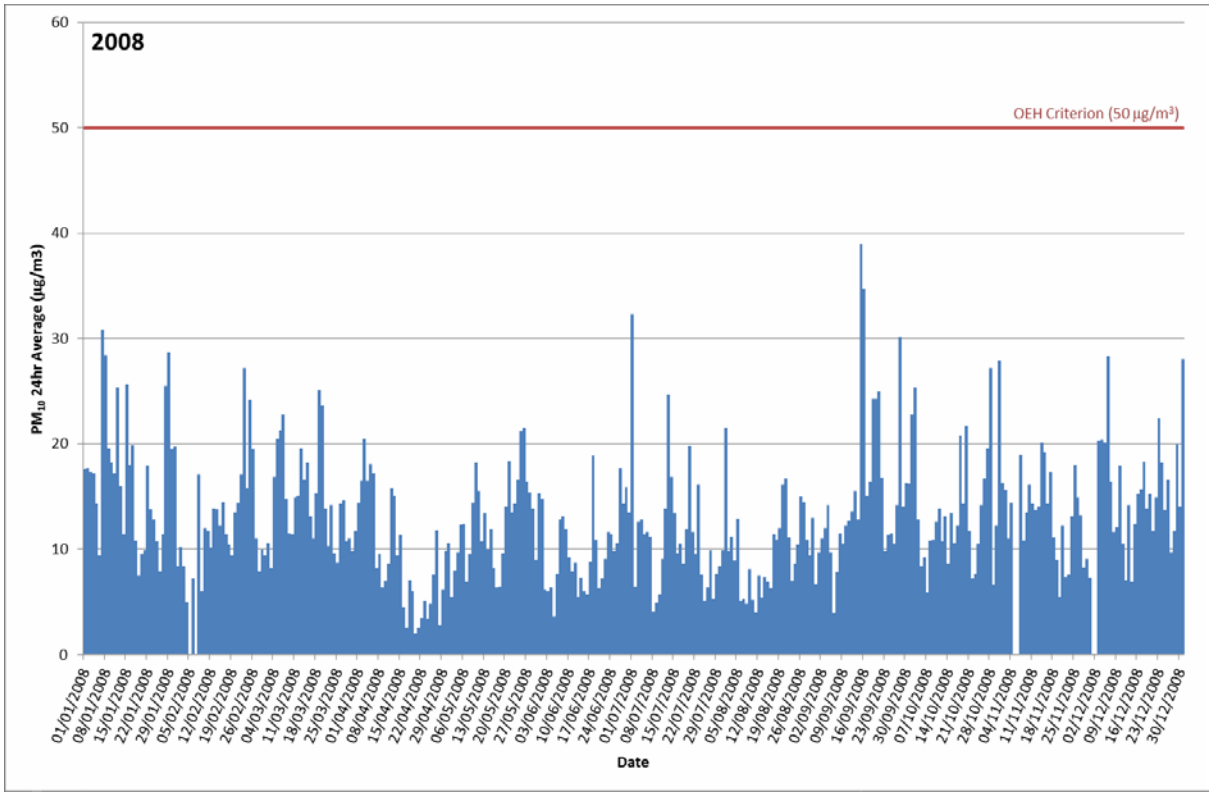

Figure 2: PM_{10} (24-Hour Average) Monitoring Results for Richmond, 2008

The analysis of PM_{10} monitoring data measured at Richmond AQMS during the year 2008 (see **Figure 2**) indicated that the highest 24-hour average PM_{10} concentration was 39.0 µg/m^3 recorded on 15 September 2008. The mean PM_{10} concentration recorded during 2008 was 13.0 µg/m^3.

More recent PM_{10} monitoring data recorded at the Richmond AQMS between 2013 and 2018 is presented in **Table 5**. The results indicate that the 24-hour average PM_{10} criterion was approached in 2015 and exceeded in 2013, 2016, 2017 and 2018, indicating the potential for regional increases in particulate matter concentrations which may be further impacted upon by the operation of the CCSQ.

Table 5: 24-Hour Average PM10 Monitoring Data – Richmond AQMS 2008 – 2013

Parameter	Year					
	2013	2014	2015	2016	2017	2018
Data Points	357	353	353	352	350	351
Mean (µg/m^3)	17.3	15.4	12.8	16.0	16.0	18.7
Minimum (µg/m^3)	4.1	2.9	2.5	1.8	1.7	4.2
Percentiles (µg/m^3)						
25th	11.1	10.5	7.7	10.0	10.7	10.9
50th	14.6	14.0	11.6	14.3	14.2	16.4
75th	20.4	19.1	16.0	18.9	19.2	22.5
90th	27.8	23.4	21.4	26.0	24.7	28.4
95th	35.0	26.1	25.6	30.9	28.7	34.5
97th	38.5	29.2	26.5	32.8	31.3	37.9
98th	43.3	31.6	27.2	34.2	32.4	47.6
99th	66.3	33.9	30.8	42.2	35.9	61.1
Maximum 1 (µg/m^3)	104.6	40.0	49.3	102.8	51.5	116.3
Maximum 2 (µg/m^3)	92.7	36.6	35.8	52.8	40.3	111.3
Maximum 3 (µg/m^3)	70.5	34.9	35.6	45.7	38.3	68.7
Data Capture (%)	97.8	96.7	96.7	96.2	95.9	96.2

6.3. Baseline TSP Concentrations

No baseline TSP monitoring data are available for the CCSQ site. In regions where road traffic is not the dominant particulate source, such as rural areas, the PM_{10} sub-set is typically approximately 50% of total suspended particulates (TSP) in the ambient air[3]. In the absence of monitoring data for TSP, the annual average TSP concentration for the region was derived for the purposes of the CCSQ AQIA (2012) by multiplying the annual average PM_{10} concentration by a factor of two, which gave 26 µg/m^3.

From examination of data in **Table 5** for years 2014 to 2018 it can be seen that using the same approach, background annual average TSP concentrations may be greater than 37 µg/m^3.

6.4. Baseline RCS Concentrations

Baseline RCS concentration data are not available for the CCSQ site or for any location in close proximity. For the purposes of the CCSQ AQIA (2012), data collected in Victoria were used to estimate an annual average background concentration of 0.7 µg/m^3.[4]

[3] '*Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*', US EPA, 2001.

[4] '*Health Risk Assessment of Crystalline Silica from Alex Fraser's proposed Recycling/Transfer Station of Construction Waste, Clarinda, Melbourne*'. Toxikos Pty Ltd, 2005.

7. Meteorological Conditions

Meteorological data is collected at two Automatic Weather Station (AWS) near to the CCSQ:

- Mangrove Mountain AWS (station number 61375) approximately 10km to the northeast of the CSQ.
- Gosford AWS (station number 61366) approximately 10 km southeast of the CCSQ.

Meteorological data from these stations were not used in the CCSQ AQIA (2012) as it was considered that they would not represent local meteorological conditions. Data from Norah Head AWS would be heavily influenced by sea breezes and would likely experience a higher percentage of higher wind speeds than the CCSQ. Data collected at the Mangrove Mountain AWS will be affected by the surrounding complex topographical environment, with numerous ridges and gullies affecting both wind direction and speed during both daytime and stable night-time conditions. Although the CCSQ is also located in complex terrain, the site-specific nature of the measurements required for this AQMP will likely not be met through the use of proxy data from up to 10 km from the site.

For the purposes of the CCSQ AQIA (2012), meteorological modelling using the CSIRO TAPM model was performed to compile a 1-year, site-specific meteorological file for the purposes of air quality modelling. A summary of the annual wind behaviour predicted by TAPM for the site is presented as wind roses in **Figure 3**, which indicates that winds experienced at the site are predominantly light to moderate (between 1.5 m/s and 6 m/s) and wind direction is seasonally dependent. Winds are predicted to occur reasonably evenly from all quadrants except the northeast quadrant, from which winds occur infrequently. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur 3% of the time throughout the modelling period of 2008.

The seasonal wind roses indicate that typically:

- In summer, winds are predicted to be light to moderate from north-eastern quadrant (approximately 55% combined) with very few winds from the west.
- In autumn, winds are predicted to be light to moderate with winds from the northeast and southeast directions predominating.
- In winter, winds are predicted to be light to moderate and are experienced predominantly from the west-southwest to north.
- In spring, winds are predicted to be light to moderate from the north-eastern quadrant (approximately 43% combined).

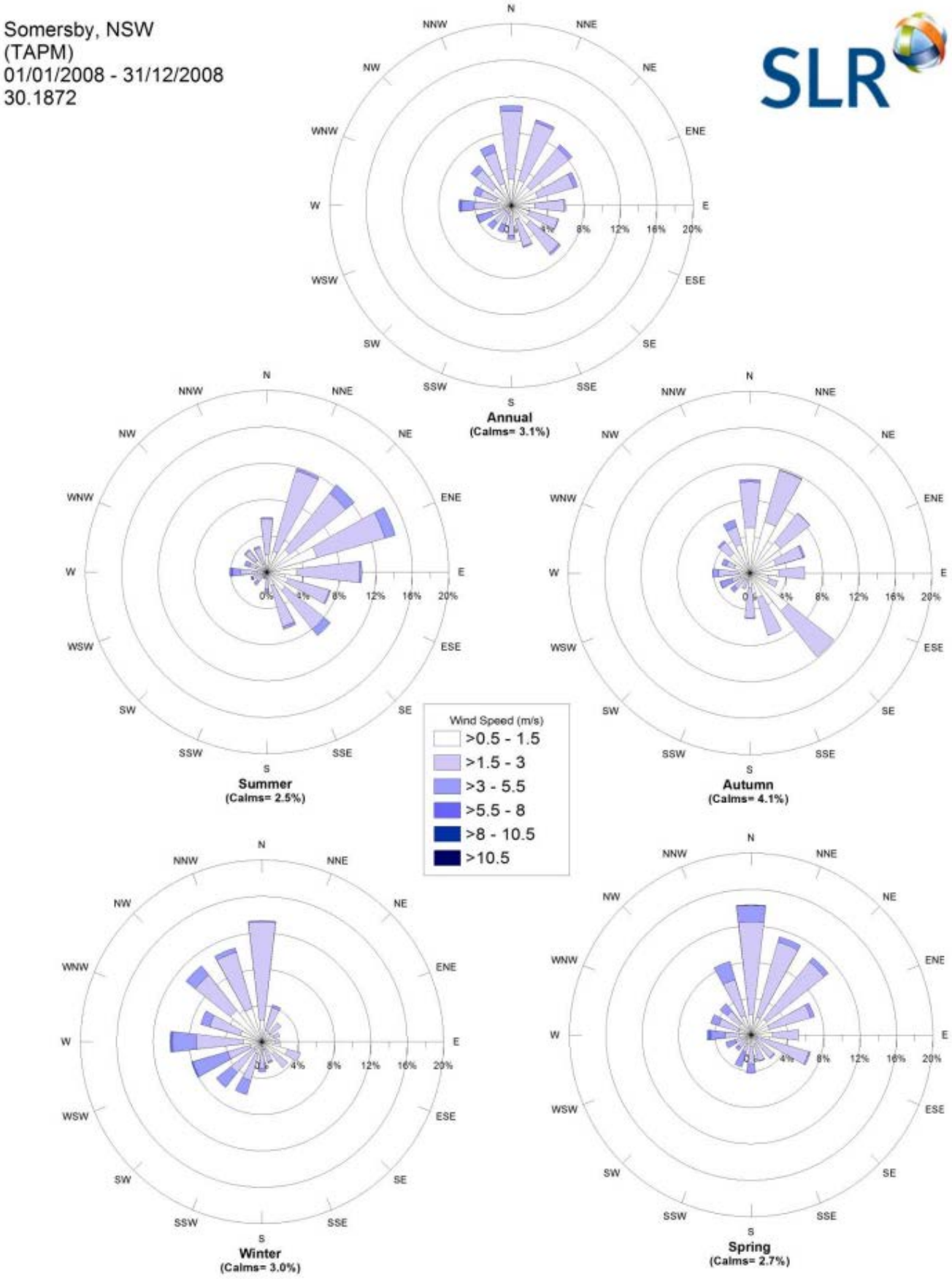

Figure 3: TAPM Predicted Annual and Seasonal Wind Roses, CCSQ 2008

8. Air Quality Monitoring Program

The air quality monitoring program is designed to ensure that air quality is measured at representative locations in the vicinity of the Quarry. Data from the monitoring program will be used to determine the impact of the quarrying operations on the surrounding air environment and private properties in the vicinity of the Quarry, and the compliance status of the CCSQ operations in relation to Approval conditions.

It is noted that EPL conditions do not require the monitoring of air quality or meteorological conditions. However, the Project Approval conditions do require that these are regularly monitored and reported and used in the ongoing management of potential impacts arising from the Quarry's operations.

8.1. General Requirements of the Air Quality Monitoring Program

The current Air Quality Monitoring Program includes monitoring of dust deposition rates, particulate matter (as PM_{10}) concentrations, and meteorological conditions. Data from this monitoring will help determine the compliance status of the Quarry.

All monitoring must be conducted in accordance with the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales* (2016) (Approved Methods) or note where deviations from the requirements within this document are proposed.

All monitoring locations must conform to the requirements of the following Australian Standard, subject to local site constraints:

- AS/NZS 3580.1.1:2016 Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment, subject to local site constraints.

Any deviations from the standard must be noted in the siting documentation.

Air quality monitoring must be undertaken by a suitably qualified person. The air quality monitoring procedures employed throughout the monitoring programme will be guided by the requirements of the relevant Australian Standards where applicable, as listed below:

- AS/NZS 3580.10.1:2016 Method for sampling and analysis of ambient air - Determination of particulate matter – Deposited matter – Gravimetric method.
- AS/NZS 3580.9.11:2016 Method for sampling and analysis of ambient air - PM_{10} Beta Attenuation Monitors.
- AS/NZS 3580.14.1:2014 Method for sampling and analysis of ambient air - Meteorological monitoring for ambient air quality monitoring applications.

All air quality monitoring equipment and meteorological instrumentation employed throughout the monitoring program must carry current NATA or manufacturer calibration certificates.

The following records of monitoring must be kept in respect of any samples required to be collected for the purposes of this AQMP:

- Date(s) on which the sample was taken.
- Time(s) at which the sample was collected.

- Location at which the sample was taken.
- Name of the person who collected the sample.

Monitoring records must be maintained and kept for a period of at least 4 years.

All air quality monitoring samples must be analysed and reported by a NATA accredited laboratory.

8.2. Dust Deposition Monitoring

Dust Deposition Gauges (DDGs) record dust fallout and are a useful measure of changing air quality in the vicinity of fugitive dust sources such as quarries and mines. Three (3) DDGs are installed at the CCSQ.

DDGs are to be exposed for 30 days (± 2 days) and analysed for Insoluble Solids and Ash Residue. Equipment and monitoring methods must comply with the Approved Methods and AS/NZS 3580.10.1:2016. Monitoring must be conducted by suitably trained personnel.

The size of the dust deposition flask should be a minimum of 4L in volume[5].

If dust deposition rates of greater than 4 g/m^2/month are measured by any of the DDGs, further assessment of likely contributors to these exceedances (such as meteorological conditions, regional air quality and any abnormal site operations occurring during the period) are to be examined.

8.3. Suspended Particulate Monitoring

8.3.1. Particulate (as PM10) using an EBAM

Suspended particulate monitoring is conducted using an environmental beta attenuation monitor (EBAM), which continuously measures the PM_{10} size fraction and is installed adjacent to DDG 2 (in proximity to Residence C). The EBAM is used to gather real-time data on the effectiveness of dust suppression controls as outlined in **Section 9** and to provide real-time feedback to permit management and mitigation measures to be enacted as outlined in **Section 10**.

PM_{10} sampling is to be conducted continuously, 12 months per year and the EBAM is to be located in accordance with AS/NZS 3580.1.1:2016 and maintained and calibrated in accordance with AS/NZS 3580.9.11:2016 and as per the manufacturer's recommendations by a suitably qualitied technician.

8.3.2. Particulate (as TSP)

TSP concentrations will be derived from the on-site PM_{10} concentration measurements recorded by the EBAM using the multiplier of 2 as outlined in **Section 8** and as adopted within the CCSQ AQIA [2012]. The annual average PM_{10} measurement recorded by the EBAM will be multiplied by a factor of 2 to estimate the annual average TSP concentration for comparison to the criterion listed in **Section 4**.

[5] Mangrove Mountain AWS and Gosford AWS indicate maximum monthly rainfall is expected in February and March and averages approximately 150 mm in each. When used with a compliant standard DDG funnel (150 mm diameter), approximately 2.6 L of rain water will be collected. After particularly heavy rain events, dust deposition flasks may be changed over to prevent over-filling and therefore loss of sample, with the results of the analyses summed to provide a total dust deposition rate for the monitoring period.

8.3.3. Crystalline Silica

Monitoring of crystalline silica is not included in this AQMP. Annual average PM_{10} measurements as recorded by the EBAM unit will be multiplied by a factor of 0.06 to estimate the annual average RCS concentration for comparison with the adopted criterion.

The factor of 0.06 was determined from an analysis of results of an on-site PM_{10} and RCS (as PM_{10}) monitoring campaign undertaken at the CCSQ between December 2018 and February 2019 (refer **Appendix A**).

8.4. Meteorological Monitoring

An on-site Automatic Weather Station (AWS) is to be located in accordance with AS 3580.14:2014, near to site offices. The AWS is to provide Project site specific weather data including wind speed and direction, rainfall, temperature and humidity.

Real-time data from the station is to be made available to site personnel to assist in operational monitoring and to enable proactive response to increasing PM_{10} levels being recorded by the EBAM (see **Section 9**).

The station is to be located, maintained and calibrated in accordance with AS3580.14:2014 and as per the manufacturer's recommendations by a suitably qualitied technician.

8.5. Summary of Air Quality Monitoring Program

The Air Quality Monitoring Program consists of the following:

- Three (3) dust deposition gauges.
- One (1) PM_{10} EBAM.
- One (1) on-site AWS.

A summary of the air quality and meteorological programme is provided in **Table 6** and the locations are illustrated in **Figure 4**.

Table 6: CCSQ Air Quality Monitoring Network

Site No.	Location	Coordinates (m)	Parameter	Instrument	Frequency
DDG 1	Southeast corner of Project site, in proximity to Residence Q	339,002, 6,304,978	Dust Deposition	DDG	30 days (± 2 days)
DDG 2	Northeast of the Project site, in proximity to Residence C	339,489, 6,305,560	Dust Deposition	DDG	30 days (± 2 days)
DDG 3	Northern corner of the expansion boundary, in proximity to Residence B	339,150, 6,305,624	Dust Deposition	DDG	30 days (± 2 days)
EBAM	Adjacent to DDG 2	339,489, 6,305,560	PM_{10}	EBAM	Continuous
AWS	Proximity to Site Offices	338,679, 6,305,025	Meteorological Parameters	AWS	Continuous

Figure 4: Monitoring Locations

9. Mitigation Measures

9.1. Best Practice Measures

The potential for atmospheric emissions during quarry operations can be minimised through the implementation of a range of best practice mitigation measures, including good site management, good housekeeping measures, appropriate vehicle and equipment maintenance, and implementation of spills and leaks management procedures.

Examples of relevant Best Available Techniques (BAT) mitigation measures for general dust control are summarised below:

- Water sprays as a control method for particulate matter emissions.
- Spraying of the shovel / bucket for excavators / front-end loaders (FELs) when loading trucks.
- Spraying the bucket of trucks before loading and direct water spraying of trucks.
- Wheel-wash / shaker grids and visual inspection of trucks prior to exiting construction sites onto public roads.
- Vacuuming / sweeping of dirt track-out out onto public roads.
- Ensure engine exhausts from all heavy moving machinery are not directed onto stockpile or road surfaces.
- Ceasing operations such as loading and unloading, and surface grading during strong wind conditions. An average wind speed of 15 m/s (measured at 10 m above ground) is commonly used as the trigger for stopping certain operations.
- Practising thorough truck washing, especially washing of tyres, to prevent the tracking of dusty materials onto sealed roadways.
- Covering loads of potentially dusty materials transported by road in open-topped trucks.
- Ensuring vehicle and equipment maintenance areas, and fuel/chemical storage areas are appropriately bunded to capture any spills or leaks, and spill kits appropriately located and maintained around the site. The timely clean-up of spills and leaks will ensure off-site air quality impacts (i.e. odour impacts) are not realised.

9.2. Site Specific Mitigation Measures

The following site specific mitigation measures are employed at the Quarry and are provided in the Statement of Commitments for the Project:

- Driver Code of Practice informing all drivers of dust suppression measures (e.g. compliance with site vehicle speed restrictions etc.).
- Employing watering at a rate of 2 litres/m^2/application to all internal haul roads.
- Periodic water application to other exposed areas.
- Minimising exposed areas to the maximum extent possible.
- Progressive rehabilitation / stabilisation of available areas of disturbance.
- Installation of appropriately sized, high efficiency motors to be used on pumps and equipment.
- Variable speed drives provided on electric motors.

- Timer switches on electrical appliances across the site.
- Sensor lights installed to reduce energy use.
- Required use of wheel wash before exiting the Quarry.

9.3. Daily Site Inspections

Daily site inspections will be carried out during quarrying operations. Daily environmental inspections will include, but not be limited to:

- Visual inspection of airborne dust.
- Ensure roads leaving the site are free of soil/sand, and prevention of soil/sand tracking onto the road network.
- Inspection of the erosion and sediment controls.
- Inspection of the waste storage areas.
- Inspection of any rehabilitated areas (where relevant).
- Ensure all hazardous goods, including fuel and oil, are adequately stored or bunded.
- Ensure spill kits are appropriately located and stocked.

Any environmental inspection reports should include the above observations, with remedial or corrective actions noted (as appropriate). Any remedial or corrective actions should be reported to the Quarry Manager as soon as is practicable.

9.4. Summary of Quarry Dust Control Mitigation Measures

Table 7: Proactive Dust Mitigation Measures

Source	Control Measures
Wind-Blown Dust Sources	
Erosion and Sedimentation Controls	▪ Erosion and sedimentation controls are regularly inspected to ensure that erosion and sedimentation controls do not become a potential source of dust emission.
Areas disturbed by quarrying operations	▪ Only the minimum area necessary for quarrying is disturbed at any one time. ▪ Completed quarry land areas are rehabilitated as soon as practicable after the completion of quarrying using soil and overburden found on-site to reproduce the topography of the terrain. ▪ Regular assessment of meteorological conditions is made to identify conditions which would be unfavourable in terms of dust levels. ▪ Areas susceptible to wind erosion are revegetated on a needs basis to avoid wind erosion of disturbed areas.
Stockpiles	▪ Periodic application of water to stockpiles as required.
Quarry-Generated Dust Sources	
Haul Road Dust	▪ All haul roads and trafficked areas are watered using water cart to minimise the generation of dust. ▪ clearly defined edges of all haul roads with marker posts or equivalent to control their locations. ▪ enforce speed limits on all on-site vehicles to minimise wheel-generated dust. ▪ Quarry employees and contractors are required to reduce speed on haul roads during high winds.
Minor Roads	▪ CCSQ will enforce speed limits on all on-site vehicles to minimise wheel-generated dust. ▪ Minor roads used regularly for access will be watered. ▪ The use of dust suppressant will be explored, where practical, for minor roads.
Topsoil Stockpile	▪ Soil stockpiles not required for more than three months would be revegetated.
Truck Loading	▪ Material drop heights during loading and unloading are reduced as far as practical. ▪ Direct water spraying of trucks is also undertaken before leaving the site.
Material Processing Plant	
Processing Areas	▪ Processing of sand is a wet process and does not result in dust generation. ▪ Water carts are used as required.
Plant and Equipment	
Plant and Equipment	▪ All plant and equipment installed at the quarry is maintained and operated in a proper and efficient condition. ▪ Truck queuing and unnecessary trips are minimised through logistical planning.

Source	Control Measures
	▪ Stationary trucks switch off engines (where possible) where idling time on-site is likely to exceed 2 minutes and trucks avoid using the local road network during peak traffic periods where possible. ▪ Fixed plant and fuel storage areas and handling areas are located as far as practicable away from sensitive receptor locations. ▪ Vehicle and equipment maintenance areas, and fuel/chemical storage areas are appropriately bunded and spill kits are strategically located to ensure timely clean-up should accidental spills/leaks occur. ▪ Where possible, the delivery of liquid fuels is to utilise reciprocal feeds so that tank vapours are displaced into the delivery vehicle rather than being emitted to the atmosphere as a fugitive emission. ▪ Empty containers are managed and disposed of in appropriate manner.
Excessive Dust Events[1]	
Exposed Areas	▪ Water carts employed for dust suppression as required, including on weekends and public holidays.
Areas Disturbed by Quarrying Operations	▪ Where relocation is not possible, temporary halting of activities and resuming when weather conditions have improved (following assessment by the Quarry Manager).
Stockpile Areas	▪ Relocation or modification of exposed operations such as topsoil removal or overburden dumping.
Haul Roads	▪ Deployment of additional water cart movements to control haul road dust. ▪ Relocation of exposed haul truck routes.
Processing Activities, Loading and Unloading Activities	▪ Temporary halting of activities and resuming when weather conditions have improved (following assessment by the Quarry Manager).

Note 1: An excessive dust event includes prolonged visual dust in a particular area, receipt of dust monitoring results in exceedance of the project criteria, and/or exceedance of a trigger level (wind speed or EBAM (refer **Section 10**).

10. Contingency Plan

10.1. Proactive Response Procedure

The Quarry Manager and/or Supervisor will perform visual checks and review monitoring data and meteorological data on a regular basis (i.e. daily for meteorological conditions and on a monthly basis for review of dust monitoring results) to ensure that operations are relocated, modified and/or halted as required to ensure adverse air quality impacts are not detected at off-site sensitive receptor locations.

The EBAM, which provides real-time monitoring of PM_{10} levels, will be set up for SMS alarm capability. *Trigger levels* at which SMS notifications will be sent to the Quarry Manager will be based on 15-minute average concentrations, so that the Quarry Manager is able to respond with management and mitigation measures to prevent the 24-hour average and annual average concentrations from exceeding the relevant criteria in **Section 4**.

Shorter term averaging periods tend to result in greater fluctuations of, and greater maximums of, concentration. This is reflected in the assessment criteria where longer term averages have lower criteria. As a result, the 15-minute average PM_{10} concentrations can report concentrations greater than the 24-hour average, without the 24-hour average criterion necessarily being exceeded. The trigger level for the EBAM should therefore alert site management to the realistic potential for an exceedance of the 24-hour average criterion should the dust emission continue. An overly conservative trigger level has the potential to be ignored due to frequent apparent 'false alarms'.

A basis for setting an initial trigger level is to use the 24-hour average criterion, adjusted using a peak to mean ratio of 2.5, calculated using $c(t) = c(t_0)\ (t/t_0)^{-0.2}$, where t = 0.25 hours and t_0 = 24 hours.

Based on the 24-hour average PM_{10} criterion of 50 µg/m^3, this gives an **initial** trigger level of 125 µg/m^3.

The trigger level should be updated under the following circumstances:

- Increase the trigger level if:
  - the trigger level is reached frequently, but the 24-hour average concentration remains less than 50% of the criterion.
- Decrease the trigger level if:
  - the trigger level is reached infrequently, but the 24-hour average concentration exceeds or regularly approaches the criterion.

10.2. Non-Compliance Response Procedure

In the event of a measured exceedance of the relevant air quality criteria (considering relevant averaging periods for each criterion) or a complaint being received with regard to particulate matter concentrations or dust deposition rates, the following actions will be undertaken:

- The situation will be investigated to determine possible emission sources including investigation into the prevailing wind conditions experienced at the time of the complaint to identify the possible source of the dust emissions.
- Where the source is identified at the Quarry site, additional controls will be implemented, or operational activities altered until a favourable outcome can be achieved.
- The Quarry Manager should be informed of any corrective action taken or complaint received.
- A full and complete record of the incident, actions and sign-off by an authorised person will be recorded in a log book.
- The Quarry Manager and/or the Environmental Officer shall notify the Secretary and any other relevant agencies as soon as practicable, after becoming aware of the incident (taking into account relevant averaging periods for the relevant air quality criteria).
- Within 7 days of the incident, Hanson will provide the Secretary and any relevant agencies with a detailed report of the incident.

Where a significant pollution incident occurs that may have an impact on air quality, reference will also be made to the "*Central Coast Sand Quarry Pollution Incident Response Management Plan"* (PIRMP) for procedures relating to management of pollution incidents.

10.3. Continued Non-Compliance with Air Quality Criteria

Where dust levels consistently exceed the relevant air quality criteria, air quality mitigation measures for excessive dust events should be implemented (as described in **Table 7**) including:

- Deployment of additional water carts.
- Relocation of exposed haul truck routes.
- Relocation or halting of dust-generating sources and quarrying activities where possible.
- Relocation or modification of exposed operations such as topsoil removal.
- Alter or cease the use of equipment at the site and the loading and dumping of materials to minimise the generation of particulate matter.
- Review the EBAM trigger levels downwards (as per **Proactive Response Procedure**) to provide earlier warning of increasing dust levels.

In addition, further air quality control measures should be investigated, and operations moderated until dust levels return to an acceptable level and/or the source of the exceedances can be determined and managed appropriately.

11. Response Procedures

11.1. Complaints Handling Procedure

Hanson must operate a telephone complaints line during its operating hours and must notify the public of the complaints line telephone number.

All complaints received regarding operational air quality will be responded to within 24 hours by the appropriate Project Site personnel.

Hanson will keep a record of any complaint made to the Quarry or any employee or any agent of Hanson in relation to air quality from the site. Records must be produced to any authorised officer of the EPA if requested. Records will include:

- Date and time of complaint.
- Method by which the complaint was made.
- Personal details of the complainant (if provided).
- Nature of the complaint.
- Action taken by Hanson and any follow up actions.
- If no action was taken, the reason why no action was taken.
- Weather conditions and a summary of the EBAM PM_{10} monitoring data corresponding to the time of the complaint will also be noted in the logbook for assessment purposes.

11.2. Landowner Response Procedure

In accordance with *Schedule 4, Condition 1 and 2* of the Approval, if air monitoring results exceed the relevant assessment criteria specified within this Plan, Hanson will, as soon as practicable after obtaining monitoring results, notify the Secretary and the affected landowners.

Hanson will then provide regular monitoring results to the landowners until results show compliance with the relevant criteria and send a copy of the NSW Health fact sheet entitled "*Mine Dust and You*" to the affected landowners and/or existing tenants of the land.

Schedule 4, Condition 2 of the Approval defines a procedure for an Independent Review in the case that owners of privately-owned land consider that the Project impacts are exceeding the relevant impact assessment criteria.

11.3. Community Consultation

Schedule 5, Condition 6 of the Approval states that Hanson shall establish a Community Consultative Committee (CCC) for the Project if directed by the Secretary.

The CCC must be operated in general accordance with the Guidelines for Establishing and Operating Community Consultative Committees for Mining Projects (Department of Planning, 2007) or its latest version to the satisfaction of the Secretary.

12. Reporting and Review

Air quality management reporting is designed to comply with Approval and EPL conditions, and provide stakeholder access to relevant air quality information and data.

12.1. Monitoring Reports

Air quality monitoring results will be reviewed by the Quarry Manager and/or Quarry Supervisor on a monthly basis. Investigations into any exceedances of the relevant air quality criteria will be undertaken and include analysis of corresponding meteorological conditions and activities undertaken at the Quarry.

Monitoring results will be made available to the public on the CCSQ website on a monthly basis.

Note: Exceedances of the EBAM 15-minute trigger levels do not constitute an exceedance of the criteria.

12.2. Incident Report

Schedule 5, Condition 7 of the Approval requires that Hanson notify the Secretary and any other relevant agencies of any incident associated with the Quarry immediately after they become aware of an incident. A detailed incident report should be submitted to the Secretary and relevant agencies within seven working days of the incident.

12.3. Annual Review

By the end of March each year, Hanson shall submit to the Secretary a report reviewing the annual environmental performance of the project. The contents of the required report are detailed in *Schedule 5, Condition 4 (a-f)* of the Approval.

12.4. Periodic Review

In line with *Schedule 5, Condition 9* of the Approval, by 30 June 2015, and every three years thereafter, an Independent Environmental Audit shall be carried out by a suitably qualified consultant.

Review of the management plan will also take place if monitoring records indicate that it is warranted or in the event of any significant change to air quality management procedures at the Project Site.

Any modifications to this Plan will be undertaken in consultation with the appropriate government agencies.

The AQMP shall be revised and/or updated, in accordance with *Schedule 5, Condition 5* of the Approval, within three (3) months of any of the following:

- Submission of an annual review.
- Submission of an incident report.
- Submission of an audit.
- Any modification to the conditions of this Approval.

Review of this Plan will also take place if monitoring records indicate that it is warranted or in the event of any significant change to operations or air quality management procedures at the Quarry. As outlined in Appendix A, if the RCS concentrations derived from the EBAM PM_{10} measurements approach (i.e. exceed 75% of) the criterion of 3 µg/m3 (as $PM_{2.5}$), the monitoring programme should be reviewed to assess the need to include $PM_{2.5}$ monitoring and the development of an updated RCS/$PM_{2.5}$ ratio in place of the current RCS/PM_{10} ratio.

Any modifications to this Plan will be undertaken in consultation with the appropriate government agencies.

12.5. Performance Monitoring

Compliance of this Plan with the Approval and EPL conditions and any other relevant agency requirements will be measured according to the following performance indicators:

- Compliance with relevant air quality criteria at monitoring locations.
- Compliance with relevant Australian Standards.
- The frequency and nature of complaints reported to the quarry in relation to air quality.
- Contractor and employee awareness of the company's Environmental Policy and this Plan.
- Compliance with this Plan, as indicated by statutory reporting.

13. Continual Improvement

Through the effective application of best practice principles to Quarry operations including, where cost-effective and practicable, the adoption of best practice technologies and air quality control measures, Hanson will continue to improve on the Quarry's environmental performance with progress to be monitored against performance indicators noted in **Section 4**.

Appendix A

Crystalline Silica Monitoring Campaign Analysis

Overview of RCS Campaign Monitoring Programme

PM_{10} monitoring was performed using a High Volume Air Sampler (HVAS) in general accordance with AS/NZS 3580.9.6:2015 Method for sampling and analysis of ambient air - Determination of suspended particulate matter - PM_{10} high volume sampler with size-selective inlet - Gravimetric method.

A PVC filter with a 0.5 µm pore size was used to collect daily 24-hour samples of PM_{10} over a period of approximately one month. Monitoring during rain-affected days was repeated such that 30 days of measurements under dry conditions were collected. The filter papers were collected and sent for analysis using x-ray diffraction (XRD) to analyse the mass of crystalline silica within the PM_{10} sample.

Note that the RCS Campaign Monitoring Programme provides data on the concentration of RCS within the PM_{10} size fraction, rather than based on the $PM_{2.5}$ size fraction which is the basis of the air quality criterion (see **Section 4**). While this approach could be viewed as conservative as it means that any RCS contained within the $PM_{2.5}$ -PM_{10} size fraction will be captured by the sampling, it does result in an increased uncertainty in derived RCS/PM ratio due to the larger sample size and in the compliance assessment when the derived RCS concentrations are assessed against the criterion. Therefore, should the RCS concentrations derived from the EBAM PM_{10} measurements approach (i.e. exceed 75% of) the criterion of 3 µg/m^3, the CCSQ Air Quality Monitoring Programme should be reviewed to assess the need to include $PM_{2.5}$ monitoring and a site-specific RCS/$PM_{2.5}$ ratio should be developed by repeating the campaign monitoring and fitting a $PM_{2.5}$ sampling head to the HVAS.

Monitoring Results

Table A1 provides the monitoring results and the ratio of crystalline silica (as PM_{10}) to PM_{10}, expressed as a percentage. Note that the majority of the RCS (as PM_{10}) concentrations were reported as *less than the limit of reporting* (LOR), therefore the reported masses have been used.

Figure A1 presents a plot of PM_{10} mass versus the % RCS of total PM_{10}. The figure indicates that all samples recorded RCS/PM_{10} ratios less than 6% except for one outlier result.

Given that RCS concentrations are not being directly monitored at the site and the site PM_{10} monitoring instrument is considered a dust management tool rather than a compliance monitor, a conservative factor of 0.06 is deemed appropriate to scale the annual average PM_{10} concentrations measured on site to indicate compliance with the annual average RCS (as $PM_{2.5}$) concentration.

Table A1: RCS Monitoring Campaign Results

Sample Period	Sample Number	Mass of PM_{10} on Filter (µg)	Mass of RCS (as PM_{10}) on Filter (µg)	RCS (as PM_{10}) / PM_{10}
8-9/12/2018	7045/1	72,500	1,220	1.7%
9-10/12/2019	7045/2	71,700	1,820	2.5%
10-13/2/2018	7045/3	104,700	5,120	4.9%
13-17/12/2018	7045/4	23,600	260	1.1%
17-19/12/2018	7045/5	43,500	1,720	4.0%
19-20/12/2018	7045/6	61,700	590	1.0%
2-3/01/2019	7045/7	60,500	2,820	4.7%
3-4/01/2019	7045/8	91,800	2,520	2.7%
4-5/01/2019	7045/9	200,900	5,620	2.8%
5-13/01/2019	7045/10	88,000	740	0.8%
12-13/01/2019	7045/11	99,400	360	0.4%
13-14/01/2019	7045/12	106,500	1,720	1.6%
14-15/01/2019	7045/13	89,200	2,120	2.4%
15-16/01/2019	7045/14	109,400	3,920	3.6%
16-18/01/2019	7045/15	181,400	1,820	1.0%
18-19/01/2019	7045/16	5,200	180	3.5%
19-23/01/2019	7045/17	107,200	2,220	2.1%
23-24/01/2019	7045/18	136,600	180	0.1%
24-25/01/2019	7045/19	0	0	-
25-26/01/2019	7045/20	121,300	1,420	1.2%
26-27/01/2019	7045/21	60,000	650	1.1%
27-28/01/2019	7045/22	0	0	-
28-29/01/2019	7045/23	66,200	260	0.4%
29-30/01/2019	7045/24	75,100	2,720	3.6%
30-31/01/2019	7045/25	91,900	2,820	3.1%
31-01/01/2019	7045/26	122,400	360	0.3%
1-2/02/2019	7045/27	135,100	60	0.0%
3-4/02/2019	7045/28	72,800	860	1.2%
4-5/02/2019	7045/29	54,100	1,220	2.3%
6-7/02/2019	7045/30	36,600	4,920	13.4%
			Average	2.4%
			90^{th} percentile	4.2%

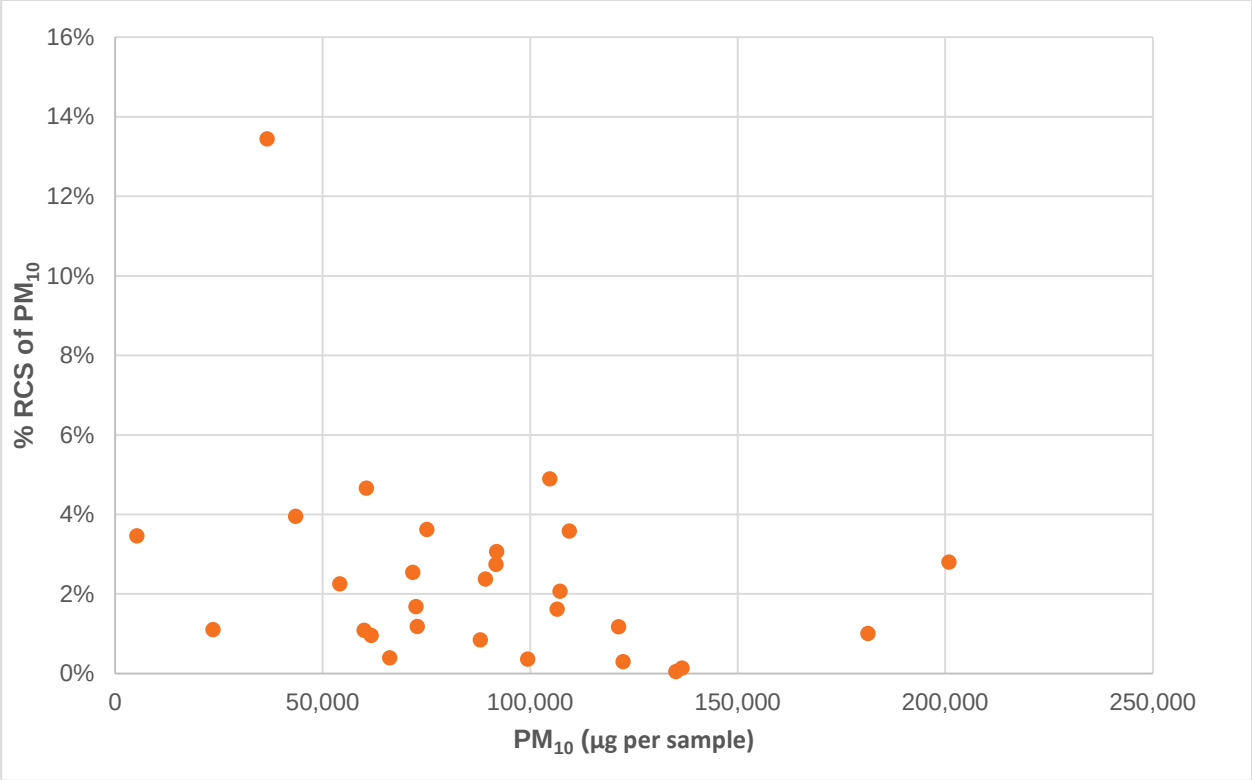

Figure A1: Total PM10 Mass per Sample Versus the Concentration of RCS Within the Sample

Appendix B

Consultation with EPA