global environmental solutions

Bayswater Concrete Batching Plant

Baseline Monitoring Report

277 Collier Road

Bayswater WA

Report Number 675.10267-R1

19 April 2013

WA Limestone
41 Spearwood Avenue
Bibra Lake WA 6163

Version: Revision 4

Bayswater Concrete Batching Plant

Baseline Monitoring Report

277 Collier Road

PRDECRED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
2 Lincoln Street Lane Cove NSW 2066 Australia

(PO Box 176 Lane Cove NSW 1595 Australia)
T: 61 2 9427 8100 F: 61 2 9427 8200
E: sydney@slrconsulting.com www.slrconsulting.com

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
675.10267	Revision 4	18 April 2013			
675.10267	Revision 0	26 July 2012	Michael Brecko	Martin Doyle	Martin Doyle
675.10267	Revision 1	30 August 2012	Michael Brecko	Martin Doyle	Martin Doyle
675.10267	Revision 2	3 February 2013	Michael Brecko	Martin Doyle	Martin Doyle
675.10267	Revision 3	19 February 2013	Michael Brecko	Gary Graham	Gary Graham

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by WA Limestone to install and maintain an Air Quality Monitoring Station (AQMS). The AQMS was equipped with a Tapered Element Oscillating Microbalance (TEOM), a High Volume Air Sampler (HVAS), Dust Deposition Gauges (DDG) and an on-site weather station.

The AQMS is located at 277 Collier Road, Bayswater WA. The site is within an established industrial area, with a residential area to the north. Surrounding the site is a number of existing businesses with a history of dust emissions. Refer to **Figure 1** for the monitoring site locality map with respect to the sensitive receptors.

The AQMS was successfully commissioned on 6 April 2012 with the exception of the meteorological weather station being commissioned on 16 May 2012.

The purpose of the AQMS is to determine baseline air quality data to support a planning application for the Bayswater Concrete Batching Plant. The State Administrative Tribunal (SAT) granted approval that a monitoring program for 3 months should be sufficient, ideally covering as much of the summer period as possible, to be representative of the worst conditions for dust/air quality for input into the predictive modelling.

An initial report was prepared by SLR (ref: 675.10267-R1) at the conclusion of the 3 month monitoring program to the SAT. Refer to **Section 5** for further details why SLR has continued to operate and maintain the AQMS TEOM, HVAS and weather station. DDG were concluded after 4 months of monitoring.

Subsequent to the publication of SLR Report 675.10267-R1 a series of report revisions (each suffixed as *-R1R1*, *-R1R2* and *-R1R3* respectively) have been published providing interim updated reports as the monitoring progressed. This report (ref: 675.10267-R1R4), and supersedes all earlier revisions.

1.1 Objectives

The objective of the AQMS is to monitor background particulate conditions for:

- Total suspended particulates (TSP) concentrations utilising a HVAS on a 1-day-in-6 monitoring cycle.
- Continuous particulate matter (with an aerodynamic diameter less than 10 microns [PM_{10}]) concentrations utilising a TEOM.
- Monthly dust deposition rates utilising DDGs.
- Local wind speed, wind direction and temperature at 10 metres (m) and temperature at 2 m above the ground using an on-site weather station.

1.2 Report Structure

As the objective of the monitoring program is to obtain representative baseline air quality data at the proposed development site for input into the predictive modelling, this report presents only details of the air quality data measured at the proposed development site for one year from 6 April 2012 to 6 April 2013, inclusive.

This report is structured with the following sections:

- **Section 2** of this report provides details of the methodologies used and the site selection criteria for the TEOM, HVAS and DDGs and their compliance for conducting the monitoring to each relevant Australian Standard.
- **Section 3** of this report provides details on the air quality compliance criteria and data validation and quality assurance guidelines.

- **Section 4** presents tabulated PM_{10}, TSP and Total Dust Deposition monitoring results for the monitoring period and compares the results to the relevant air quality compliance criteria. Graphical representation of the local meteorological conditions is also presented as Pollution Roses and Wind Roses utilising both WA Limestone observations and where required Bureau of Meteorology (BoM) Perth Airport observations.
- **Section 5** presents our discussions on the results measured and provides tabulated statistical and graphical representations for the WA Limestone AQMS.
- **Section 6** provides the conclusions drawn for the monitoring period and whether the overall objective of the baseline monitoring assessment was achieved.

Figure 1 WA Limestone AQMS Site Locality

Source: Google Earth

2 METHODOLOGY

The WA Limestone AQMS has a combined site classification of Peak and Neighbourhood Site and has a combined area classification of Industrial and Residential as per AS/NZS 3580.1.1:2007.

The UTM co-ordinates of the AQMS are 50J 398433.31m E and 6469736.57m S with an elevation of 26 m above sea level (ASL). Four DDGs have been located within the boundary perimeter as illustrated in **Figure 1**.

The AQMS has been commissioned and maintained in accordance with:

- AS/NZS 3580.1.1:2007 *Methods for sampling and analysis of ambient air – Part 1.1: Guide to siting air monitoring equipment.*
- AS/NZS 3580.9.3:2003 *Methods for sampling and analysis of ambient air – Method 9.3: Determination of suspended particulate matter-Total suspended particulate matter (TSP) – High volume sampler gravimetric method.*
- AS/NZS 3580.9.8:2008 *Methods for sampling and analysis of ambient air – Method 9.8: Determination of suspended particulate matter – PM_{10} continuous direct mass method using tapered element oscillating microbalance analyser*
- AS/NZS 3580.10.1:2003 *Methods for sampling and analysis of ambient air – Method 10.1: Determination of particulate matter – Deposited matter-Gravimetric method.*
- AS/NZS 3580.14:2011 *Methods for sampling and analysis of ambient air – Part 14: Meteorological monitoring for ambient air quality monitoring applications.*

Table 1 details the AQMS TEOM and HVAS site selection and **Table 2** details the DDG site selection and their compliance with the relevant parameters specified in AS/NZS 3580.1.1:2007. **Table 3 to Table 5** details the weather station site selection and instrument compliance with AS/NZS 3580.14:2011.

Refer to **Appendix A** for photographs of the WA Limestone AQMS TEOM, HVAS, weather station and DDG in relation to its local surroundings.

If any of the criteria specified in the site selection cannot be adhered to, AS/NZS 3580.1.1:2007 requires a statement in the monitoring report noting each criterion that has not been met.

The site selection chosen for the WA Limestone AQMS TEOM and HVAS meets all the requirements specified in AS/NZS 3580.1.1:2007.

The site selection chosen for the WA Limestone DDGs meets all the requirements specified in AS/NZS 3580.1.1:2007 with the exception of the height of the nearby obstacle above the sample inlet for DDG1, DDG3 and DDG4. The locations chosen were the most suitable locations available along the boundary perimeter of the site that met the majority of the criteria required.

The site selection chosen for the WA Limestone weather station meets all the requirements specified in AS/NZS 3580.14:2011 with the exception of the anemometer sensor which did not comply with the minimum distance of 10 times the height of the obstruction/tree. The location chosen was the most suitable location within the vacant facility to represent the local wind conditions. All sensors installed comply with AS/NZS 3580.14:2011 and manufacturer calibration certificates are available upon request.

Table 1 AQMS Site Selection – TEOM and HVAS

Parameter	Criteria	TEOM Result	HVAS Result	Compliance
Height of Sample Inlet above ground (H_g)	1.0 to 15 m	2.92 m	1.23 m	Yes
Height of nearby obstacle above sample inlet (H_o)	2 $H_o \le D_w$	7.1 m	8.8 m	Yes
Distance to nearby structure (D_w)	Minimum 1 m	40 m	40 m	Yes
Distance to source (D_s)	≥ 2 m & as close as practicable	40 m	40 m	Yes
Distance to nearby trees or object (dripline) (D_t)	≥ 10 m	20 m	20 m	Yes
Distance to roadside (D_r)	> 50 m for ≤ 10,000 vehicles per day	250 m	250 m	Yes
Clear sky angle (vertical)	120°	180°	180°	Yes
Air flow angle (horizontal) unrestricted	270° around Inlet or 180° Inlet on side of building	360°	360°	Yes

Table 2 AQMS Site Selection – DDGs

Parameter	Criteria	DDG1	DDG2	DDG3	DDG4	Compliance
Height of Sample Inlet above ground (H_g)	2.0 ± 0.2m	2.04 m	2.11 m	1.98 m	2.14 m	Yes
Height of nearby obstacle above sample inlet (H_o)	2 $H_o \le D_w$	8 m	8 m *	8 m	8 m	No
Distance to nearby structure (D_w)	Minimum 1 m	5 m	20 m	6 m	10 m	Yes
Distance to source (D_s)	≥ 5 m	5 m	20 m	6 m	10 m	Yes
Distance to nearby trees or object (dripline) (D_t)	≥ 10 m	20 m	50 m	50 m	15 m	Yes
Distance to roadside (D_r)	> 50 m for ≤ 10,000 vehicles per day	180 m	200 m	100 m	60 m	Yes
Clear sky angle (vertical)	120°	120°	>120°	120°	120°	Yes
Air flow angle (horizontal) unrestricted	360°	360°	360°	360°	360°	Yes

Key:
m metre
\> greater than
≥ greater than or equal to
< less than
≤ less than or equal to
° degrees
* denotes siting is in compliance with criteria

Table 3 AQMS Site Selection – Meteorological Weather Station

Parameter – Anemometer Sensor	Criteria	WA Limestone	Compliance
Anemometer sensor height	Height less than 2 m should be avoided	10 m	Yes
Height of nearby obstacle (H_o)	NA	10 m	NA
Height of nearby tree above mast base (H_t)	NA	5 m	NA
Distance to nearby obstacle (D_o)	10 times H_o	40 m	No
Distance to nearby tree (D_t)	10 times H_t	20 m	No
Obstruction angle at sensor height above horizon	Obstructions should not project above horizon by more than 6^o at the sensor height	0^o	Yes
Parameter – Temperature Sensor	**Criteria**	**WA Limestone**	**Compliance**
Height of temperature sensor (m)	Height less than 2 m should be avoided	2 m and 10 m	NA
Diameter of open level ground	At least 9m in diameter	> 50 m	Yes
Ground surface	Should be covered with non-irrigated or unwatered short grass or natural earth. Should not be concrete or asphalt or oil soaked	Covered with short grass and natural earth	Yes
Distance to large paved area	Should be at least 30m and not close to steep slopes, ridges or hollows	40 m	Yes
Distance to artificial or natural moisture sources (m)	Maximum distance available	> 250 m	NA

Key:
m metre
> greater than
≥ greater than or equal to
< less than
≤ less than or equal to
° degrees

Table 4 Instrument Performance Specifications for Wind Speed System

Parameter	Minimum requirements	WA Limestone	Compliance
Range	0.5 to 30 m/s	0.5 to 75 m/s	Yes
Total accuracy	1% or ± 0.2 m/s*	±0.2 m/s	Yes
Resolution	≤0.25 m/s	0.1 m/s	Yes
Starting threshold	≤0.4 m/s	0.3 m/s	Yes
Stall threshold	--	0.2 m/s	NA
Distance constant	≤3 m	3 m	Yes
Maximum averaging interval	10 min	10 min	Yes
Data sampling frequency	5 s	Continuous	Yes

* Whichever is greater

Key:
m/s metre per second
% percent
≤ less than or equal to
s second

Table 5 Instrument Performance Specifications for Wind Speed System

Parameter	Minimum requirements	WA Limestone	Compliance
Range – Mechanical	0 to 360°	0 to 360°	Yes
Range - Output	0 to 355°	0 to 360° **	Yes
Total accuracy*	± 3°	± 1°	Yes
Resolution	1°	1°	Yes
Starting threshold	≤0.5 m/s at 10°	0.35 m/s	Yes
Damping ratio	0.25 to 0.6	0.5	Yes
Maximum averaging interval	10 min	10 min	Yes
Minimum number of data samples	>60 for scalar/vector means >360 for sigma theta	Continuous	Yes

* Excludes measurements deadband range
** No gap in sensor unlike traditional potentiometers

Key:
° degrees
> greater than
≤ less than or equal to
m/s metre per second
min minute

3 RELEVANT CRITERIA

3.1 Air Quality Compliance Criteria

Table 6 specifies the PM_{10} National Environment Protection Measure (NEPM) Goal for Ambient Air Quality reporting which is adopted by the WA DEC. The NEPM reporting standard (criteria) allows for five exceedances per year and was developed by the National Environmental Protection Council (NEPC).

Table 6 also specifies the annual dust deposition rate criteria and total suspended particulate (TSP) criteria as specified in the "*Approved Methods & Guidance for the Modelling and Assessment of Air Pollutants in NSW*", NSW EPA 2005. WA DEC currently does not have an approved document specifying the dust deposition rate or TSP criteria.

Table 6 Summary of Air Quality Criteria

Pollutant	Averaging Time	Criteria
PM_{10}	24-hour	50 µg/m^3
	Annual	30 µg/m^3
TSP	Annual	90 µg/m^3
Dust Deposition	Annual	2 g/m^2/month (Maximum Increase in Deposited Dust Level)
	Annual	4 g/m^2/month (Maximum Total Deposited Dust Level)

Note: µg/m^3 micrograms per cubic metre of air
g/m^2/month grams per square metre per month

3.2 Continuous Data Validation and Quality Assurance Guidelines

SLR has used the guidelines summarised in **Table 7** and further detailed in **Section 3.3** to validate data and conduct appropriate average calculations on each continuous five minute sampling period to determine the 24-hour PM_{10} concentrations.

Table 7 Summary of Data Validation Guidelines

Data Validation	Action if data deemed unacceptable
Concentration less than -10 µg/m^3	If the concentration measured is less than negative 10 µg/m^3 for more than 10 minutes, the data set will be deemed invalid, and the concentration measured excluded from any averaging calculations. It is at the discretion of the operator validating the data set to determine if the concentrations leading up to and proceeding the invalid data set should also be deemed invalid and removed from any averaging calculations.
Concentration reported as zero (0) µg/m^3	If the concentration measured is reported as 0 µg/m^3 due to instrument error, i.e. power supply failure or routine maintenance, then the concentration measured and all associated readings for the 5-minute interval will be deemed invalid and will be excluded from any averaging calculations. If data has not been logged or is unavailable, then the concentration will be considered as missing data.
Main flow (3.0 ± 0.2 L/min)	If the main flow is not maintained within the specified range then the concentration measured will be deemed invalid and excluded from any averaging calculations.
Total flow (16.67 ± 1.0 L/min)	If the total flow is not maintained within the specified range then the concentration measured will be deemed invalid and excluded from any averaging calculations.
Auxiliary flow (13.7 ± 0.8 L/min)	If the auxiliary flow is not maintained within the specified range then the concentration measured will be deemed invalid and excluded from any averaging calculations.
Filter loading greater than 90%	If the filter loading is greater than 90% loading then the main flow and auxiliary flow shall be checked to ensure flows are within the specified ranges (main flow 3.0 ± 0.2 litres per minute (L/min) and auxiliary flow 13.7 ± 0.8 L/min). If flows are not within the specified range then the concentration measured shall be deemed invalid and excluded from any averaging calculations.
Noise greater than 0.1 µg	If the noise level is greater than 0.1 µg, it is the onus of the operator validating the data set to distinguish if third party sources have influenced the measured concentration. If deemed invalid the concentration measured will be excluded from any averaging

	calculations.
Frequency outside range (150 to 400 Hz)	If the frequency level is outside the specified range, then it is the onus of the operator validating the data set to determine if third party sources have influenced the measured concentration. If deemed invalid, the concentration measured will be excluded from any averaging calculations.
Environmental Enclosure Temperature (20°Cto 30°C)	If the temperature is not maintained between 20°C to 30°C, then it is the onus of the operator validating the data set to determine if the enclosure temperature has influenced the measured concentration. If deemed invalid, the concentration measured will be excluded from any averaging calculations.

Key:

%	percent
DEC	Department of Environment and Conservation
Hz	Hertz
L/min	litres per minute
ug	micrograms
µg/m^3	micrograms per cubic metre of air
WA	Western Australia

3.3 Continuous Data Quality Assurance Guidelines

3.3.1 Negative Concentrations

TEOM measurements are derived from the mass differences which are sensed by the oscillating tapered element as suspended particulate matter accumulates on the sample filter. However, simultaneously with particulate accumulation, some removal of the more volatile components deposited on the filter occurs. When the mass removal exceeds the mass accumulated, the tapered element will sense a reduction in mass and a negative value will be recorded. These negative values are real and represent evaporation of water or volatiles and usually only occur for short periods. These short term negative values should not be removed from the data base.

SLR adopted negative 10 micrograms per cubic meter (µg/m^3) as a threshold subjecting the data to validation and deemed the data invalid if the concentration occurred for more than 10 minute periods. Refer to **Table 8** for tabulated details of negative concentrations subjected to validation and the number of data points deemed invalid.

3.3.2 Zero (0) Concentrations or Missing Data

Zero concentrations are recorded during routine system maintenance or instrument power supply failure. Sometimes during instrument power supply failure the instrument does not log correctly until the instrument has properly self-reset and stabilised.

SLR excluded all concentrations measured as 0 µg/m^3 and all associated readings for the 5-minute interval from any averaging calculations due to instrument error, i.e. power supply failure or routine maintenance. Refer to **Table 8** for tabulated details of zero concentrations “missing data” subjected to validation and the number of data points deemed invalid.

3.3.3 Main Flow

The main flow is to be operated within the specified range of 3.0 ± 0.2 L/min. SLR utilised a calibrated volumetric flow meter to establish and check the main flow was within the specified criterion. Refer to **Table 8** for tabulated details of main flow subjected to validation and the number of data points deemed invalid.

3.3.4 Total Flow

The total flow is to be operated within the specified range of 16.67 ± 1.0 L/min. SLR utilised a calibrated volumetric flow meter to establish and check the total flow was within the specified criterion. Refer to **Table 8** for tabulated details of total flow subjected to validation and the number of data points deemed invalid.

3.3.5 Auxiliary Flow

The auxiliary flow is to be operated within the specified range of 13.7 ± 0.8 L/min. SLR utilised a calibrated volumetric flow meter to establish and check the total flow was within the specified criterion. Refer to **Table 8** for tabulated details of auxiliary flow subjected to validation and the number of data points deemed invalid.

SLR Report No 675.10267-R1 detailed that the auxiliary flow was not compliant with the specified range for 45% of the monitoring period. This has since been recognised as being incorrectly reported. Refer to **Section 5.1** for further details explaining auxiliary flow incorrect reporting.

3.3.6 Filter Loading

If the filter loading exceeds 90% load, then the main and auxiliary flow shall be checked to determine validity of the measured concentration. If flows are not within the specified range the measured concentration shall be deemed invalid and removed from any averaging calculations.

Refer to **Table 8** for tabulated details of filter loading subjected to validation and the number of data points deemed invalid. No flows were outside the specified main and auxiliary flows criterion when the filter loading was above 90% loading.

3.3.7 Noise Concentrations

During sampling the noise experienced by the analyser may be elevated due to a number of contributing factors such as nearby heavy machinery works or meteorological conditions such as thunder storms or sudden changes in temperature fluctuations. The noise level experienced by the analyser from such activities may influence the concentration measured.

SLR has put the onus back on the operator to determine if the data is deemed invalid when the noise concentration is above 0.1 µg. Refer to **Table 8** for tabulated details of noise concentrations subjected to validation and the number of data points deemed invalid. No noise data was deemed invalid when the concentration exceeded 0.1 µg.

3.3.8 Frequency Concentrations

During sampling the frequency experienced by the analyser may be elevated due to a number of contributing factors such as nearby heavy machinery works or meteorological conditions such as thunder storms. The frequency level experienced by the analyser from such activities may influence the concentration measured.

SLR has put the onus back on the operator to determine if the data is deemed invalid when the frequency concentration is outside the specified criterion 150 Hz to 400 Hz. Refer to **Table 8** for tabulated details of frequency concentrations subjected to validation and the number of data points deemed invalid. No frequency data was deemed invalid when the concentration exceeded 0.1 µg.

3.3.9 Environmental Enclosure Temperature

AS3580.9.8:2008 requires for the environmental enclosure to be maintained between 20 to 30^{o}C. This criterion is critical when the analyser experiences real time data noise interferences due to fast temperature fluctuations which can be minimised if the temperature stability is maintained within the analyser's monitoring station or appropriate enclosure. This is also critical in high humidity regions.

Refer to **Table 8** for tabulated details of enclosure temperature subjected to validation and the number of data points deemed invalid.

4 RESULTS

4.1 PM_{10} Monitoring Results

Table 8 Summary of TEOM Continuous Data Capture Results – 6 April 2012 to 6 April 2013

Parameter	No of Data Points Available	No of Data Points to be Validated	No of Data Points deemed Invalid "Missing Data"	% of Valid Data Points	Minimum	Average	Maximum	AS/NZS or Manufacturer Criteria
5-min avg. conc. (µg/m³)	105,263	1,241	1,241	98.8%	-68.0	23.1	365.1	--
Main flow (L/min)	105,263	1,241	1,241	98.8%	2.98	3.00	3.02	2.8 to 3.2
Total flow (L/min)	105,263	1,241	1,241	98.8%	16.34	16.51	16.68	15.67 to 17.67
Auxiliary flow (L/min)	105,263	1,241	1,241	98.8%	13.34	13.51	13.65	12.9 to 14.5
Filter loading (%)	105,263	3,449	1,241	98.8%	17.4	46.2	98.2	< 90%
Noise (µg)	105,263	2,370	1,241	98.8%	0.002	0.027	0.889	< 0.1*
Frequency (Hz)	105,263	1,241	1,241	98.8%	241.4	248.9	251.6	150 to 400*
Enclosure Temperature (°C)	105,263	1,244	1,241	98.8%	19.5	22.4	26.5	20 to 30
Accurate Data Capture	--	--	--	98.8%	--	--	--	--

* denotes manufacturers recommendations / operating criteria.

Key:

%	Percentage
<	less than
avg	Average
conc	Concentration
°C	degrees Celsius
Hz	Hertz
L/min	litres per minute
No	Number
µg/m³	micrograms per cubic metre
µg	micrograms

Table 9 Summary of PM_{10} 24-hr Average Concentration Results – Autumn 2012

March 2012	WA Limestone PM_{10} 24-hr Average Concentration (µg/m^3)	April 2012	WA Limestone PM_{10} 24-hr Average Concentration (µg/m^3)	May 2012	WA Limestone PM_{10} 24-hr Average Concentration (µg/m^3)	NEPM 24-hr Criteria (µg/m^3)
01-03-2012	*ND*	01-04-2012	*ND*	01-05-2012	22.6	50
02-03-2012	*ND*	02-04-2012	*ND*	02-05-2012	29.4	50
03-03-2012	*ND*	03-04-2012	*ND*	03-05-2012	27.3	50
04-03-2012	*ND*	04-04-2012	*ND*	05-05-2012	15.4	50
05-03-2012	*ND*	05-04-2012	*ND*	05-05-2012	15.4	50
06-03-2012	*ND*	06-04-2012	8.1	06-05-2012	19.6	50
07-03-2012	*ND*	07-04-2012	15.0	07-05-2012	Missing Data	50
08-03-2012	*ND*	08-04-2012	24.6	08-05-2012	31.2	50
09-03-2012	*ND*	09-04-2012	19.6	09-05-2012	13.5	50
10-03-2012	*ND*	10-04-2012	28.1	10-05-2012	25.6	50
11-03-2012	*ND*	11-04-2012	27.6	11-05-2012	21.5	50
12-03-2012	*ND*	12-04-2012	48.9	12-05-2012	24.3	50
13-03-2012	*ND*	13-04-2012	37.3	13-05-2012	29.8	50
14-03-2012	*ND*	14-04-2012	16.9	14-05-2012	18.5	50
15-03-2012	*ND*	15-04-2012	14.9	15-05-2012	19.3	50
16-03-2012	*ND*	16-04-2012	24.2	16-05-2012	32.6	50
17-03-2012	*ND*	17-04-2012	18.4	17-05-2012	21.7	50
18-03-2012	*ND*	18-04-2012	22.0	18-05-2012	21.4	50
19-03-2012	*ND*	19-04-2012	21.6	19-05-2012	14.6	50
20-03-2012	*ND*	20-04-2012	26.2	20-05-2012	15.4	50
21-03-2012	*ND*	21-04-2012	17.8	21-05-2012	44.3	50
22-03-2012	*ND*	22-04-2012	13.9	22-05-2012	46.0	50
23-03-2012	*ND*	23-04-2012	23.1	23-05-2012	35.4	50
24-03-2012	*ND*	24-04-2012	22.4	24-05-2012	35.3	50
25-03-2012	*ND*	25-04-2012	18.0	25-05-2012	32.2	50
26-03-2012	*ND*	26-04-2012	30.7	26-05-2012	29.2	50
27-03-2012	*ND*	27-04-2012	32.6	27-05-2012	19.5	50
28-03-2012	*ND*	28-04-2012	24.4	28-05-2012	15.8	50
29-03-2012	*ND*	29-04-2012	11.9	29-05-2012	17.9	50
30-03-2012	*ND*	30-04-2012	23.0	30-05-2012	21.7	50
31-03-2012	*ND*	---		31-05-2012	25.2	50
Average	**ND**	**Average**	**22.0**	**Average**	**24.7**	**50**

Key:
ND No data (beyond the boundaries of the monitoring program)
DEC Department of Environment and Conservation
hr hour
NEPM National Environment Protection Measure
PM_{10} Particulate matter less than 10 microns
µg/m^3 micrograms per cubic metre

Table 10 Summary of PM_{10} 24-hr Average Concentration Results – Winter 2012

June	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	July	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	August	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	NEPM 24-hr Criteria (µg/m³)
01-06-2012	18.9	01-07-2012	17.6	01-08-2012	18.5	50
02-06-2012	9.8	02-07-2012	15.4	02-08-2012	11.1	50
03-06-2012	12.2	03-07-2012	13.6	03-08-2012	17.9	50
04-06-2012	14.9	04-07-2012	17.5	04-08-2012	15.1	50
05-06-2012	14.1	05-07-2012	23.4	05-08-2012	11.8	50
06-06-2012	11.6	06-07-2012	18.2	06-08-2012	12.7	50
07-06-2012	8.1	07-07-2012	12.1	07-08-2012	22.0	50
08-06-2012	12.3	08-07-2012	6.9	08-08-2012	17.1	50
09-06-2012	10.4	09-07-2012	13.1	09-08-2012	13.9	50
10-06-2012	16.6	10-07-2012	10.0	10-08-2012	24.8	50
11-06-2012	24.3	11-07-2012	27.1	11-08-2012	23.1	50
12-06-2012	14.2	12-07-2012	37.2	12-08-2012	15.7	50
13-06-2012	28.6	13-07-2012	29.6	13-08-2012	26.0	50
14-06-2012	12.8	14-07-2012	19.9	14-08-2012	17.1	50
15-06-2012	17.0	15-07-2012	13.8	15-08-2012	19.9	50
16-06-2012	10.5	16-07-2012	14.7	16-08-2012	20.7	50
17-06-2012	14.1	17-07-2012	28.7	17-08-2012	14.5	50
18-06-2012	12.7	18-07-2012	17.0	18-08-2012	16.4	50
19-06-2012	15.0	19-07-2012	18.2	19-08-2012	20.1	50
20-06-2012	14.3	20-07-2012	20.5	20-08-2012	17.5	50
21-06-2012	23.2	21-07-2012	14.0	21-08-2012	19.6	50
22-06-2012	13.7	22-07-2012	16.3	22-08-2012	29.9	50
23-06-2012	11.8	23-07-2012	14.0	23-08-2012	19.4	50
24-06-2012	7.7	24-07-2012	26.5	24-08-2012	21.3	50
25-06-2012	7.0	25-07-2012	28.6	25-08-2012	14.8	50
26-06-2012	16.0	26-07-2012	21.1	26-08-2012	16.2	50
27-06-2012	22.0	27-07-2012	20.3	27-08-2012	15.9	50
28-06-2012	24.5	28-07-2012	18.1	28-08-2012	20.9	50
29-06-2012	24.9	29-07-2012	10.4	29-08-2012	20.1	50
30-06-2012	18.8	30-07-2012	11.1	30-08-2012	16.7	50
---	---	31-07-2012	24.0	31-08-2012	26.4	50
Average	**15.4**	**Average**	**18.7**	**Average**	**18.6**	**50**

Key:
DEC Department of Environment and Conservation
hr hour
NEPM National Environment Protection Measure
PM_{10} Particulate matter less than 10 microns
µg/m³ micrograms per cubic metre

Table 11 Summary of PM_{10} 24-hr Average Concentration Results – Spring 2012

September	WA Limestone PM_{10} 24-hr Average Concentration (µg/m^3)	October	WA Limestone PM_{10} 24-hr Average Concentration (µg/m^3)	November	WA Limestone PM_{10} 24-hr Average Concentration (µg/m^3)	NEPM 24-hr Criteria (µg/m^3)
01-09-2012	24.4	01-10-2012	20.2	01-11-2012	12.0	50
02-09-2012	15.9	02-10-2012	30.5	02-11-2012	29.7	50
03-09-2012	12.0	03-10-2012	28.6	03-11-2012	13.0	50
04-09-2012	22.7	04-10-2012	17.4	04-11-2012	14.8	50
05-09-2012	20.7	05-10-2012	14.6	05-11-2012	21.7	50
06-09-2012	31.0	06-10-2012	22.6	06-11-2012	20.5	50
07-09-2012	30.7	07-10-2012	18.1	07-11-2012	20.8	50
08-09-2012	11.2	08-10-2012	24.6	08-11-2012	25.2	50
09-09-2012	20.2	09-10-2012	15.6	09-11-2012	30.8	50
10-09-2012	32.9	10-10-2012	18.9	10-11-2012	20.3	50
11-09-2012	24.9	11-10-2012	25.7	11-11-2012	14.7	50
12-09-2012	26.6	12-10-2012	46.2	12-11-2012	22.6	50
13-09-2012	21.0	13-10-2012	26.1	13-11-2012	36.7	50
14-09-2012	18.8	14-10-2012	19.4	14-11-2012	35.6	50
15-09-2012	23.4	15-10-2012	16.7	15-11-2012	23.0	50
16-09-2012	22.9	16-10-2012	17.7	16-11-2012	26.9	50
17-09-2012	29.6	17-10-2012	21.3	17-11-2012	30.1	50
18-09-2012	28.6	18-10-2012	21.2	18-11-2012	30.4	50
19-09-2012	22.9	19-10-2012	24.0	19-11-2012	19.5	50
20-09-2012	26.4	20-10-2012	24.8	20-11-2012	27.8	50
21-09-2012	22.2	21-10-2012	22.6	21-11-2012	37.2	50
22-09-2012	21.8	22-10-2012	21.7	22-11-2012	36.5	50
23-09-2012	14.2	23-10-2012	31.5	23-11-2012	24.0	50
24-09-2012	22.5	24-10-2012	18.9	24-11-2012	24.9	50
25-09-2012	30.4	25-10-2012	22.2	25-11-2012	17.2	50
26-09-2012	32.8	26-10-2012	17.8	26-11-2012	19.8	50
27-09-2012	19.9	27-10-2012	17.1	27-11-2012	28.7	50
28-09-2012	18.0	28-10-2012	28.2	28-11-2012	20.4	50
29-09-2012	14.5	29-10-2012	25.9	29-11-2012	32.2	50
30-09-2012	14.6	30-10-2012	24.8	30-11-2012	23.2	50
---	---	31-10-2012	19.6	---	---	50
Average	**22.6**	**Average**	**22.7**	**Average**	**24.7**	**50**

Key:
DEC Department of Environment and Conservation
hr hour
NEPM National Environment Protection Measure
PM_{10} Particulate matter less than 10 microns
µg/m^3 micrograms per cubic metre

Table 12 Summary of PM_{10} 24-hr Average Concentration Results – Summer 2012/2013

December	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	January	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	February	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	NEPM 24-hr Criteria (µg/m³)
01-12-2012	20.2	01-01-2013	18.9	01-02-2013	33.2	50
02-12-2012	22.3	02-01-2013	23.7	02-02-2013	22.8	50
03-12-2012	26.7	03-01-2013	36.5	03-02-2013	29.4	50
04-12-2012	19.9	04-01-2013	49.7	04-02-2013	38.0	50
05-12-2012	24.2	05-01-2013	36.3	05-02-2013	35.3	50
06-12-2012	20.7	06-01-2013	26.9	06-02-2013	32.9	50
07-12-2012	28.2	07-01-2013	25.1	07-02-2013	30.1	50
08-12-2012	27.3	08-01-2013	34.2	08-02-2013	30.1	50
09-12-2012	31.0	09-01-2013	36.9	09-02-2013	25.5	50
10-12-2012	21.3	10-01-2013	31.9	10-02-2013	30.5	50
11-12-2012	36.7	11-01-2013	21.1	11-02-2013	34.9	50
12-12-2012	14.6	12-01-2013	20.3	12-02-2013	37.5	50
13-12-2012	17.5	13-01-2013	8.4	13-02-2013	42.7	50
14-12-2012	27.5	14-01-2013	18.9	14-02-2013	46.0	50
15-12-2012	14.6	15-01-2013	25.8	15-02-2013	39.8	50
16-12-2012	11.9	16-01-2013	16.6	16-02-2013	29.6	50
17-12-2012	21.2	17-01-2013	48.1	17-02-2013	31.2	50
18-12-2012	25.5	18-01-2013	22.1	18-02-2013	27.1	50
19-12-2012	33.4	19-01-2013	25.1	19-02-2013	40.1	50
20-12-2012	30.6	20-01-2013	25.2	20-02-2013	33.8	50
21-12-2012	42.2	21-01-2013	35.3	21-02-2013	38.4	50
22-12-2012	21.3	22-01-2013	33.1	22-02-2013	35.8	50
23-12-2012	16.4	23-01-2013	42.8	23-02-2013	24.5	50
24-12-2012	23.2	24-01-2013	36.7	24-02-2013	16.8	50
25-12-2012	23.8	25-01-2013	34.0	25-02-2013	31.2	50
26-12-2012	44.3	26-01-2013	26.8	26-02-2013	41.1	50
27-12-2012	25.5	27-01-2013	21.0	27-02-2013	33.2	50
28-12-2012	16.2	28-01-2013	19.5	28-02-2013	20.2	50
29-12-2012	25.5	29-01-2013	33.5	---	---	50
30-12-2012	23.0	30-01-2013	29.6	---	---	50
31-12-2012	21.4	31-01-2013	32.8	---	---	50
Average	**24.4**	**Average**	**28.7**	**Average**	**32.6**	**50**

Key:
DEC Department of Environment and Conservation
hr hour
NEPM National Environment Protection Measure
PM_{10} Particulate matter less than 10 microns
µg/m³ micrograms per cubic metre

Table 13 Summary of PM_{10} 24-hr Average Concentration Results – Autumn 2013

March 2013	WA Limestone PM_{10} 24-hr Average Concentration ($\mu g/m^3$)	April 2013	WA Limestone PM_{10} 24-hr Average Concentration ($\mu g/m^3$)	May 2013	WA Limestone PM_{10} 24-hr Average Concentration ($\mu g/m^3$)	NEPM 24-hr Criteria ($\mu g/m^3$)
01-03-2013	29.9	01-04-2013	15.3	01-05-2013	ND	50
02-03-2013	17.7	02-04-2013	18.5	02-05-2013	ND	50
03-03-2013	20.6	03-04-2013	25.4	03-05-2013	ND	50
03-03-2013	17.5	04-04-2013	27.2	04-05-2013	ND	50
05-03-2013	26.5	05-04-2013	27.0	05-05-2013	ND	50
06-03-2013	34.1	06-04-2013	23.2	06-05-2013	ND	50
07-03-2013	21.6	07-04-2013	ND	07-05-2013	ND	50
08-03-2013	23.3	08-04-2013	ND	08-05-2013	ND	50
09-03-2013	17.0	09-04-2013	ND	09-05-2013	ND	50
10-03-2013	21.3	10-04-2013	ND	10-05-2013	ND	50
11-03-2013	27.9	11-04-2013	ND	11-05-2013	ND	50
12-03-2013	24.7	12-04-2013	ND	12-05-2013	ND	50
13-03-2013	21.5	13-04-2013	ND	13-05-2013	ND	50
14-03-2013	20.6	14-04-2013	ND	14-05-2013	ND	50
15-03-2013	21.9	15-04-2013	ND	15-05-2013	ND	50
16-03-2013	11.0	16-04-2013	ND	16-05-2013	ND	50
17-03-2013	15.4	17-04-2013	ND	17-05-2013	ND	50
18-03-2013	28.7	18-04-2013	ND	18-05-2013	ND	50
19-03-2013	27.7	19-04-2013	ND	19-05-2013	ND	50
20-03-2013	30.9	20-04-2013	ND	20-05-2013	ND	50
21-03-2013	25.7	21-04-2013	ND	21-05-2013	ND	50
22-03-2013	27.1	22-04-2013	ND	22-05-2013	ND	50
23-03-2013	21.4	23-04-2013	ND	23-05-2013	ND	50
24-03-2013	20.3	24-04-2013	ND	24-05-2013	ND	50
25-03-2013	23.4	25-04-2013	ND	25-05-2013	ND	50
26-03-2013	22.7	26-04-2013	ND	26-05-2013	ND	50
27-03-2013	23.9	27-04-2013	ND	27-05-2013	ND	50
28-03-2013	25.2	28-04-2013	ND	28-05-2013	ND	50
29-03-2013	12.5	29-04-2013	ND	29-05-2013	ND	50
30-03-2013	13.4	30-04-2013	ND	30-05-2013	ND	50
31-03-2013	11.4	---	---	31-05-2013	ND	50
Average	**22.1**		**23.5**		**ND**	**50**

Key:
ND No data (beyond the boundaries of the monitoring program)
DEC Department of Environment and Conservation
hr hour
NEPM National Environment Protection Measure
PM_{10} Particulate matter less than 10 microns
$\mu g/m^3$ micrograms per cubic metre

Figure 2 WA Limestone 24-hour Average PM_{10} Concentration Results – Annual

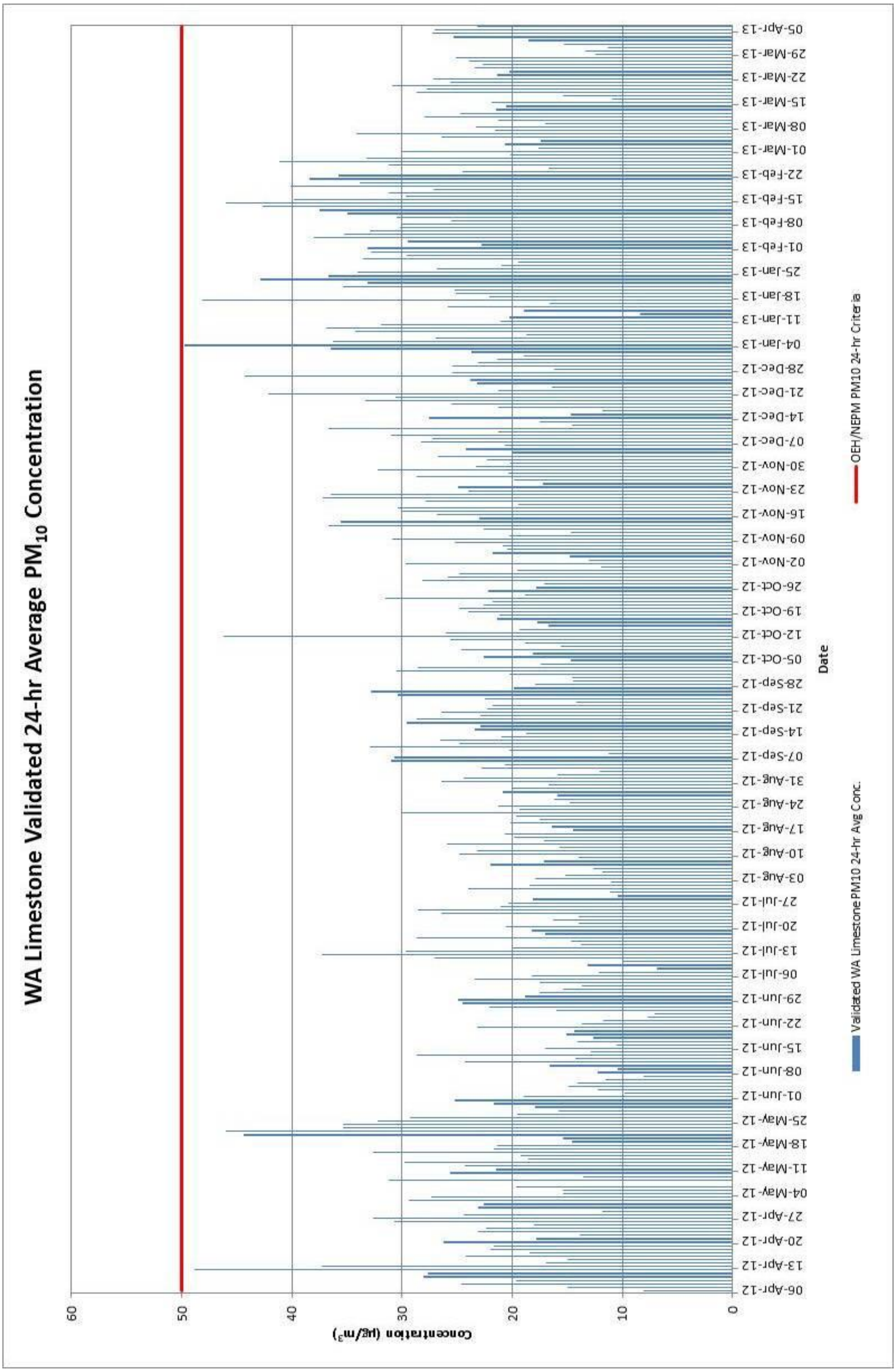
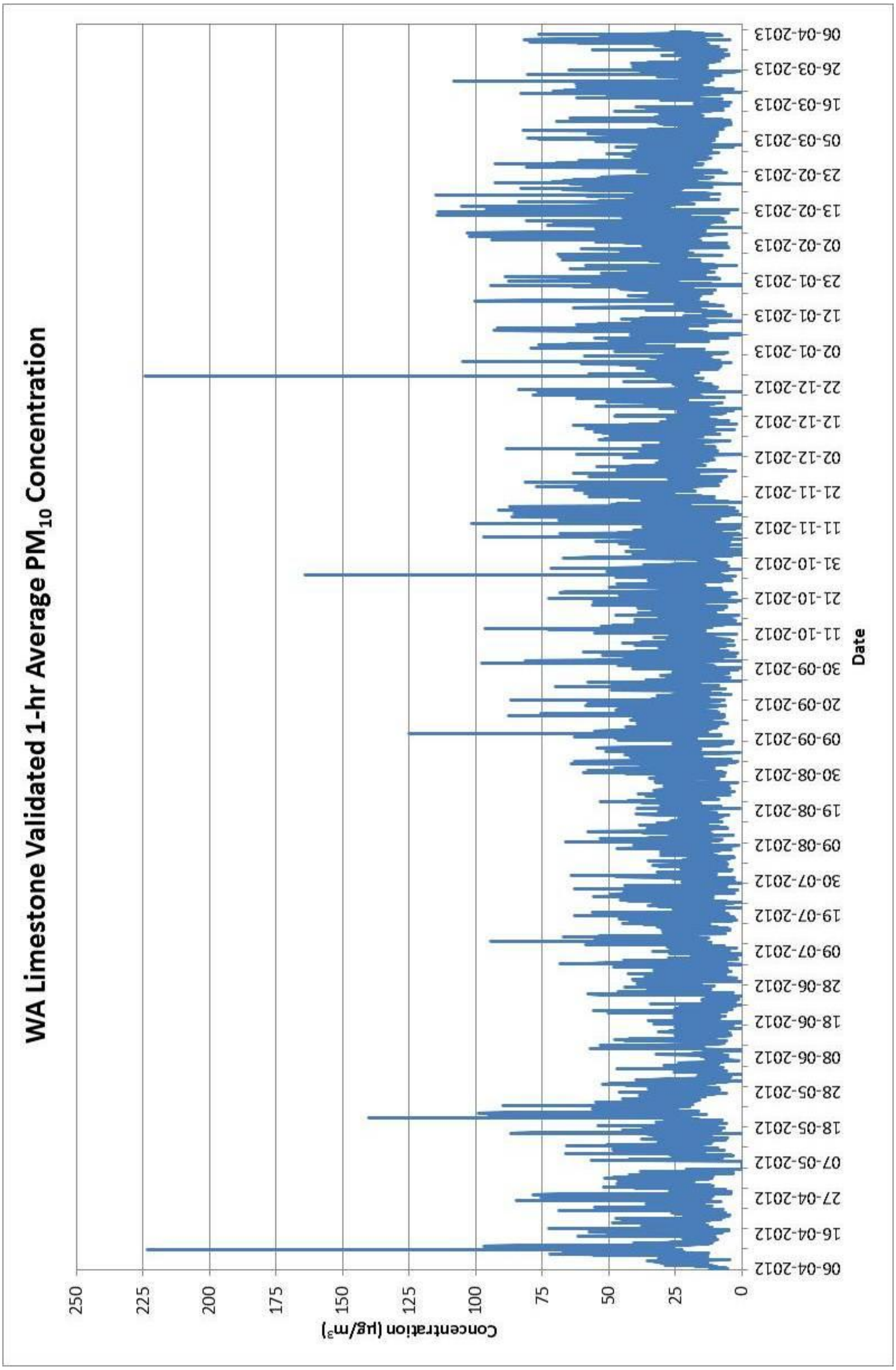


Figure 3 WA Limestone 1-hour Average PM_{10} Concentration Results – Annual



4.2 TSP Monitoring Results

Table 14 Summary of TSP Average Concentration vs PM_{10} 24-hr Average Concentration Results – 6 April 2012 to 29 March 2013

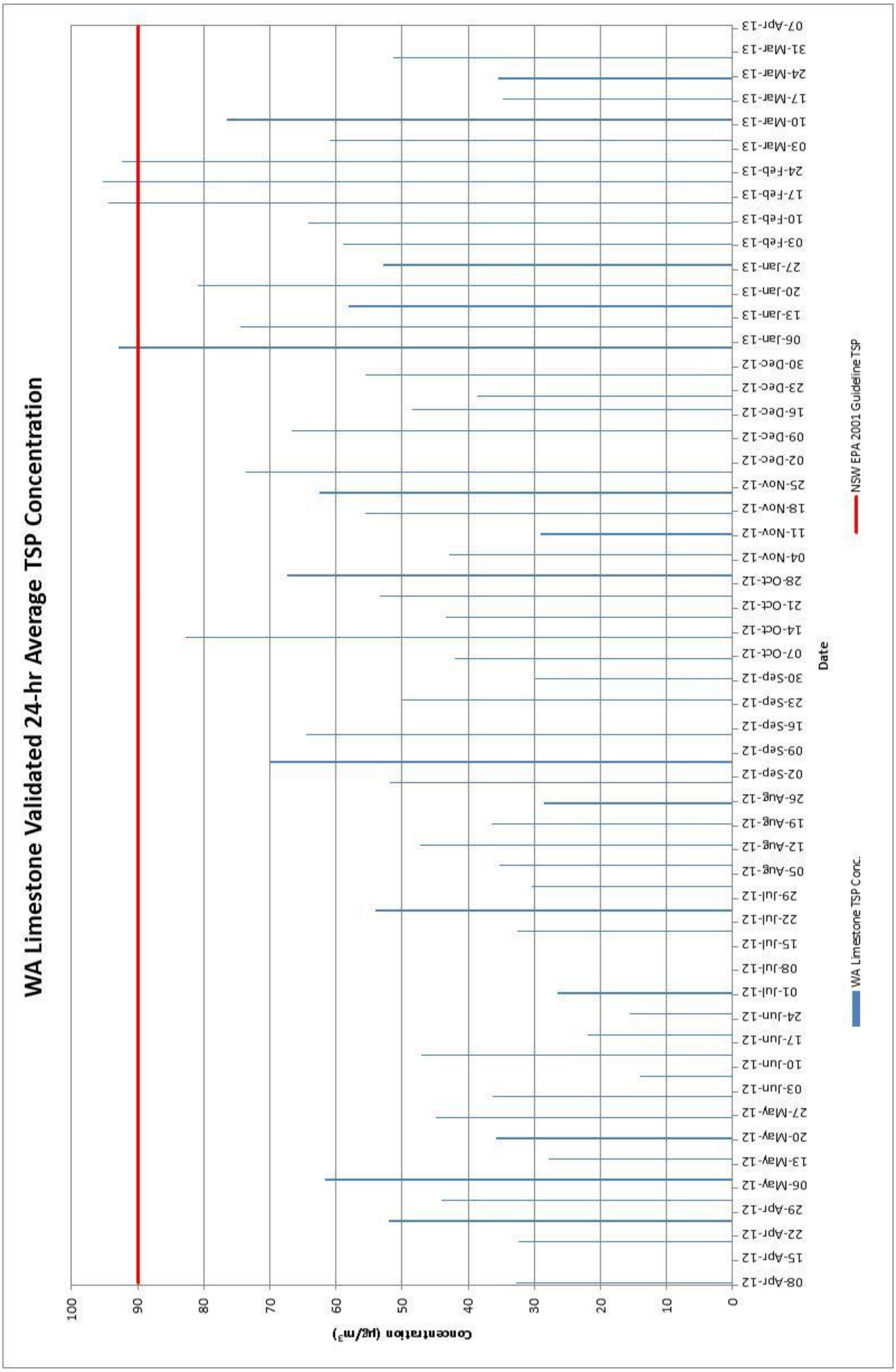
Date	WA Limestone TSP Average Concentration (µg/m³)	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	NSW EPA 2005 Annual Average TSP Criteria (µg/m³)	WA Limestone PM_{10} vs TSP Ratio
08-04-2012	32.7	24.6	90	75.1%
14-04-2012	No Data[1]	16.9	90	No Data
20-04-2012	32.4	26.2	90	81.0%
26-04-2012	52.1	30.7	90	59.0%
02-05-2012	44.1	29.4	90	66.6%
08-05-2012	61.6	31.2	90	50.6%
14-05-2012	27.8	18.5	90	66.7%
20-05-2012	35.8	15.4	90	42.9%
26-05-2012	44.89	29.2	90	65.1%
01-06-2012	36.23	18.9	90	52.2%
07-06-2012	13.94	8.1	90	58.2%
13-06-2012	47.02	28.6	90	60.9%
19-06-2012	21.88	15.0	90	68.7%
25-06-2012	15.44	7.0	90	45.6%
01-07-2012	26.54	17.6	90	66.2%
07-07-2012	NA	12.1	90	NA
13-07-2012	NA	29.6	90	NA
19-07-2012	32.5	18.2	90	56.0%
25-07-2012	54	28.6	90	53.0%
01-08-2012	30.4	18.5	90	60.7%
07-08-2012	35.3	22.0	90	62.2%
13-08-2012	47.2	26.0	90	55.0%
19-08-2012	36.4	20.1	90	55.3%
25-08-2012	28.5	14.8	90	51.8%
31-08-2012	51.9	26.4	90	50.8%
06-09-2012	69.9	31.0	90	44.3%
12-09-2012	No Data[2]	26.6	90	No Data
18-09-2012	64.5	28.6	90	44.4%
24-09-2012	49.9	22.5	90	45.1%
30-09-2012	29.9	14.6	90	48.7%
06-10-2012	42.1	22.6	90	53.6%
12-10-2012	82.7	46.2	90	55.8%
18-10-2012	43.3	21.2	90	48.9%

Date	WA Limestone TSP Average Concentration (µg/m³)	WA Limestone PM_{10} 24-hr Average Concentration (µg/m³)	NSW EPA 2005 Annual Average TSP Criteria (µg/m³)	WA Limestone PM_{10} vs TSP Ratio
24-10-2012	53.4	18.9	90	35.3%
30-10-2012	67.4	24.8	90	36.8%
05-11-2012	42.8	21.7	90	50.8%
11-11-2012	29.1	14.7	90	50.4%
17-11-2012	55.5	30.1	90	54.2%
23-11-2012	62.5	24.0	90	38.5%
29-11-2012	73.6	32.2	90	43.7%
05-12-2012	No Data[2]	24.2	90	No Data
11-12-2012	66.7	36.7	90	55.0%
17-12-2012	48.5	21.2	90	43.8%
23-12-2012	38.6	16.4	90	42.4%
29-12-2012	55.6	25.5	90	45.8%
04-01-2013	92.8	49.7	90	53.6%
10-01-2013	74.4	31.9	90	42.9%
16-01-2013	58	16.6	90	28.7%
22-01-2013	80.8	33.1	90	41.0%
28-01-2013	52.8	19.5	90	36.9%
03-02-2013	58.9	29.4	90	50.0%
09-02-2013	64.1	25.5	90	39.8%
15-02-2013	94.4	39.8	90	42.1%
21-02-2013	95.2	38.4	90	40.3%
27-02-2013	92.4	33.2	90	35.9%
05-03-2013	60.9	26.5	90	43.5%
11-03-2013	76.5	27.9	90	36.5%
17-03-2013	34.7	15.4	90	44.4%
23-03-2013	35.5	21.4	90	60.2%
29-03-2013	51.3	12.5	90	24.3%
Average	51.0	--	--	51.1%

Note:
No Data[1] denotes that the instrument program was reset due to power supply failure and the sample failed to run.
No Data[2] denotes that sampling was not performed for this period.
NA denotes monitoring was not performed as original scope of works (3 months monitoring) had been completed and new proposed scope of works had not been confirmed.

Key:
% Percentage
avg Average
µg/m³ micrograms per cubic metre

Figure 4 WA Limestone TSP Concentration Results



4.3 Dust Deposition Monitoring Results

Table 15 Summary of Dust Deposition Gauge Concentration Results – 14 March 2012 to 6 July 2012

Date	No of Days (30 ± 2 days)	DDG 1 Total Solids (g/m^2.month)	DDG 2 Total Solids (g/m^2.month)	DDG 3 Total Solids (g/m^2.month)	DDG 4 Total Solids (g/m^2.month)
14-03-2012 to 12-04-2012	29	2.3	1.6	2.7	3.4
12-04-2012 to 09-05-2012	27	3.3	0.8	2.9	3.0
09-05-2012 to 06-06-2012	28	2.6	1.9	1.4	1.5
06-06-2012 to 06-07-2012	30	7.5	0.5	5.2	2.4
Individual Average	--	3.9	1.2	3.0	2.6
Average (all 4 DDGs)					2.7
Maximum Total Deposited Dust Level	--	4	4	4	4

Key:
DDG Dust Deposit Gauge
g/m^2.month grams per metre square per month

4.4 Meteorological Monitoring Results

Figure 5 Pollution Rose – All Autumn Measurement (2012/2013)

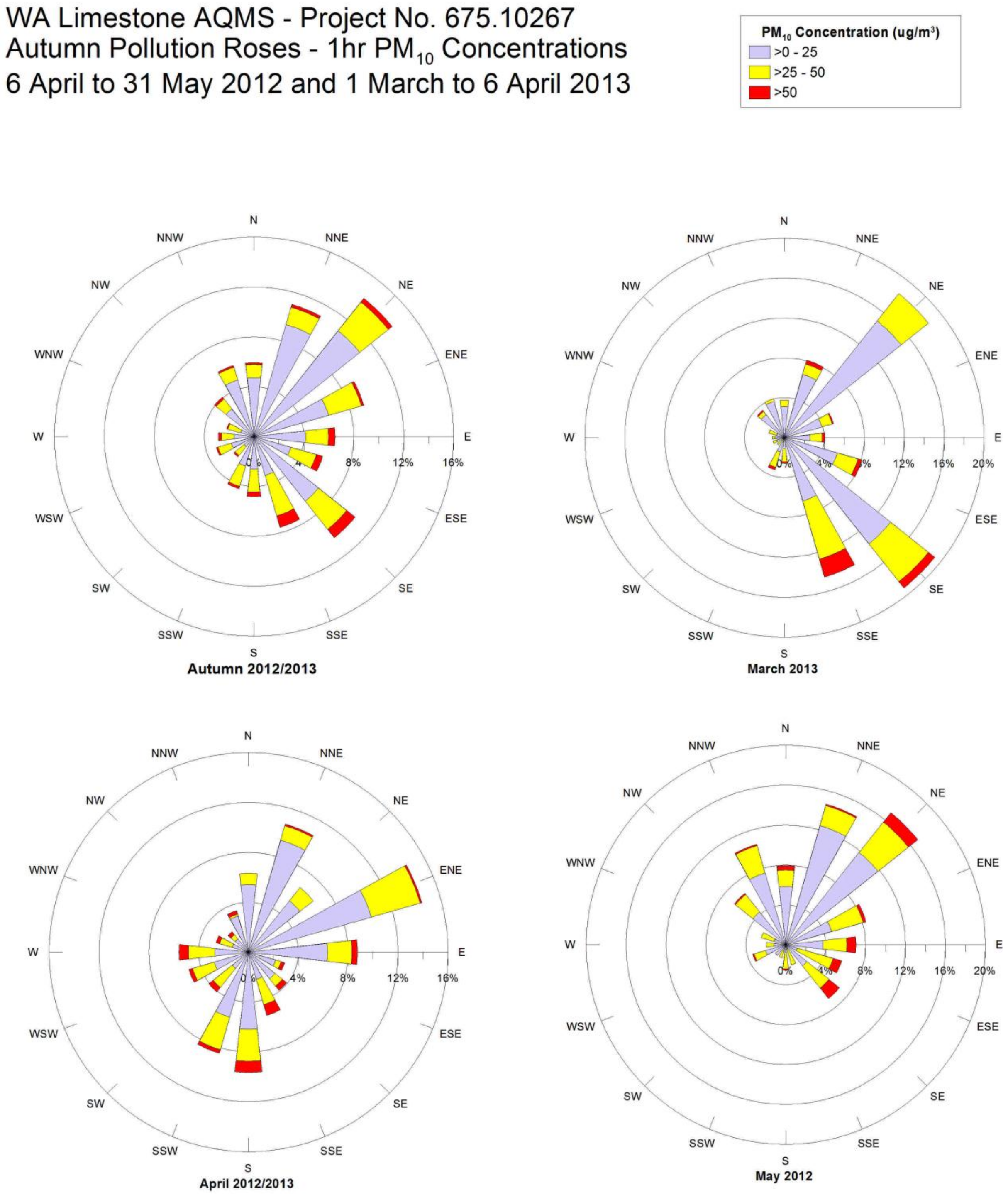


Figure 6 Pollution Rose – All Winter Measurements (2012)

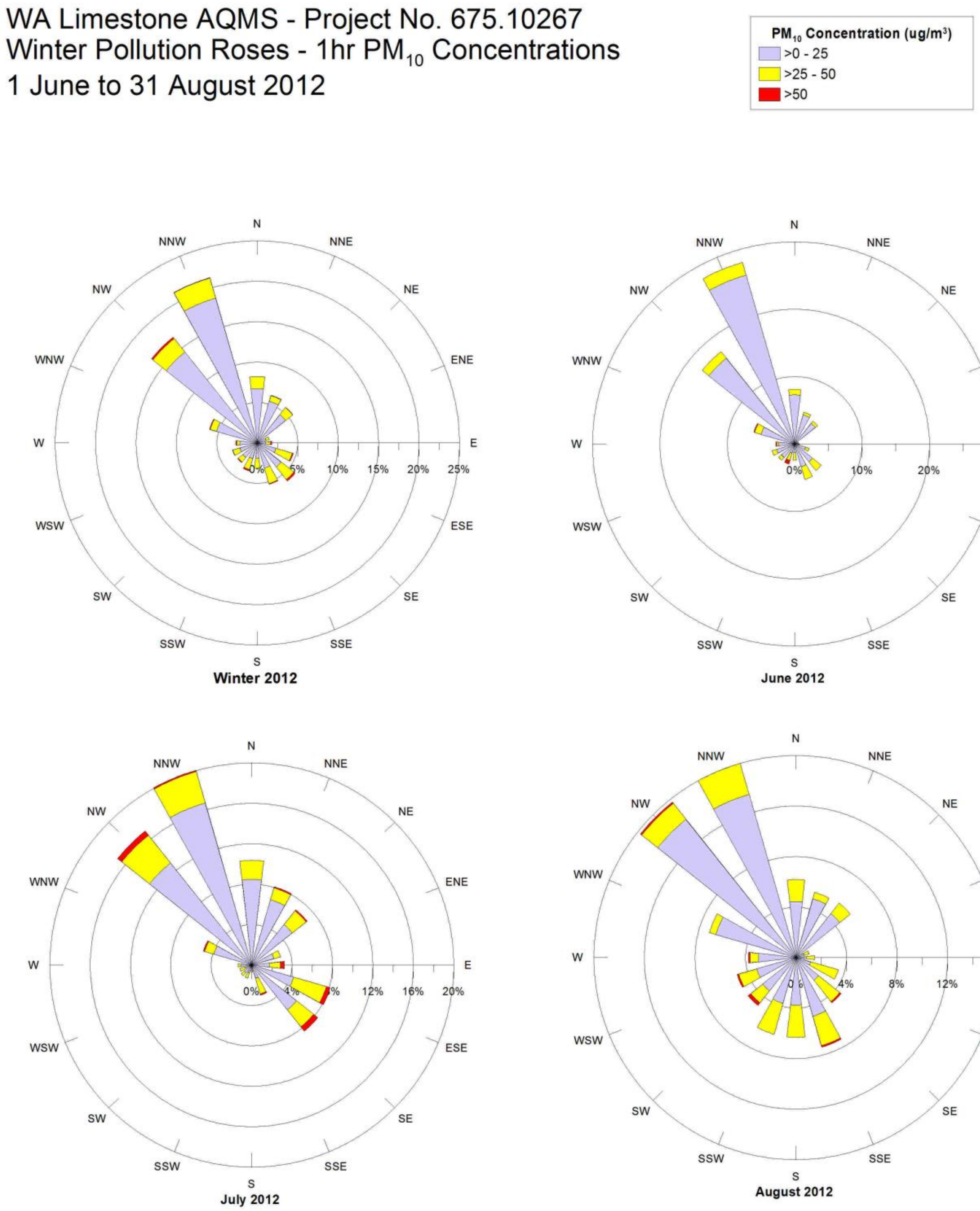


Figure 7 Pollution Rose – All Spring Measurements (2012)

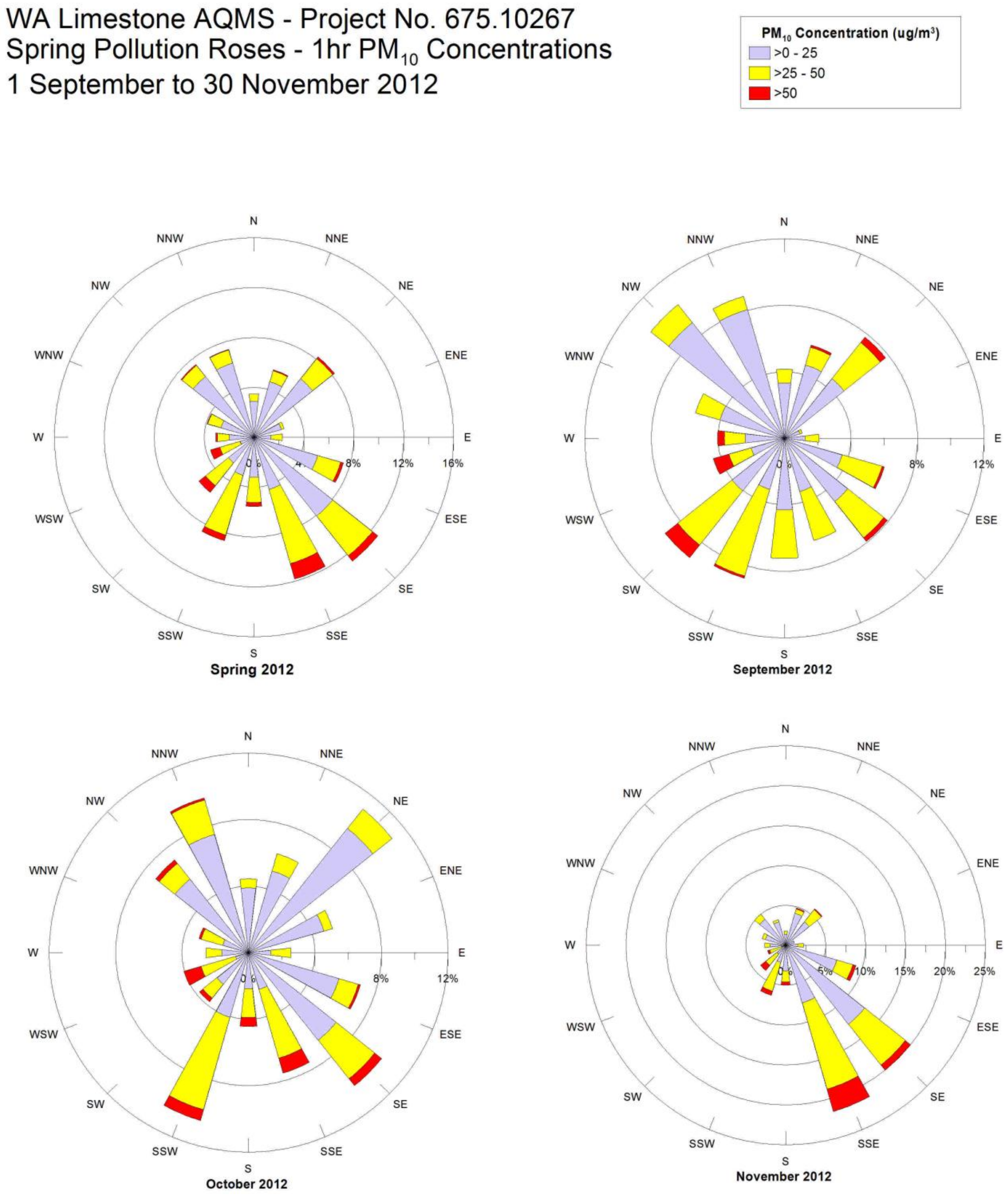


Figure 8 Pollution Rose – All Summer Measurements (2012/2013)

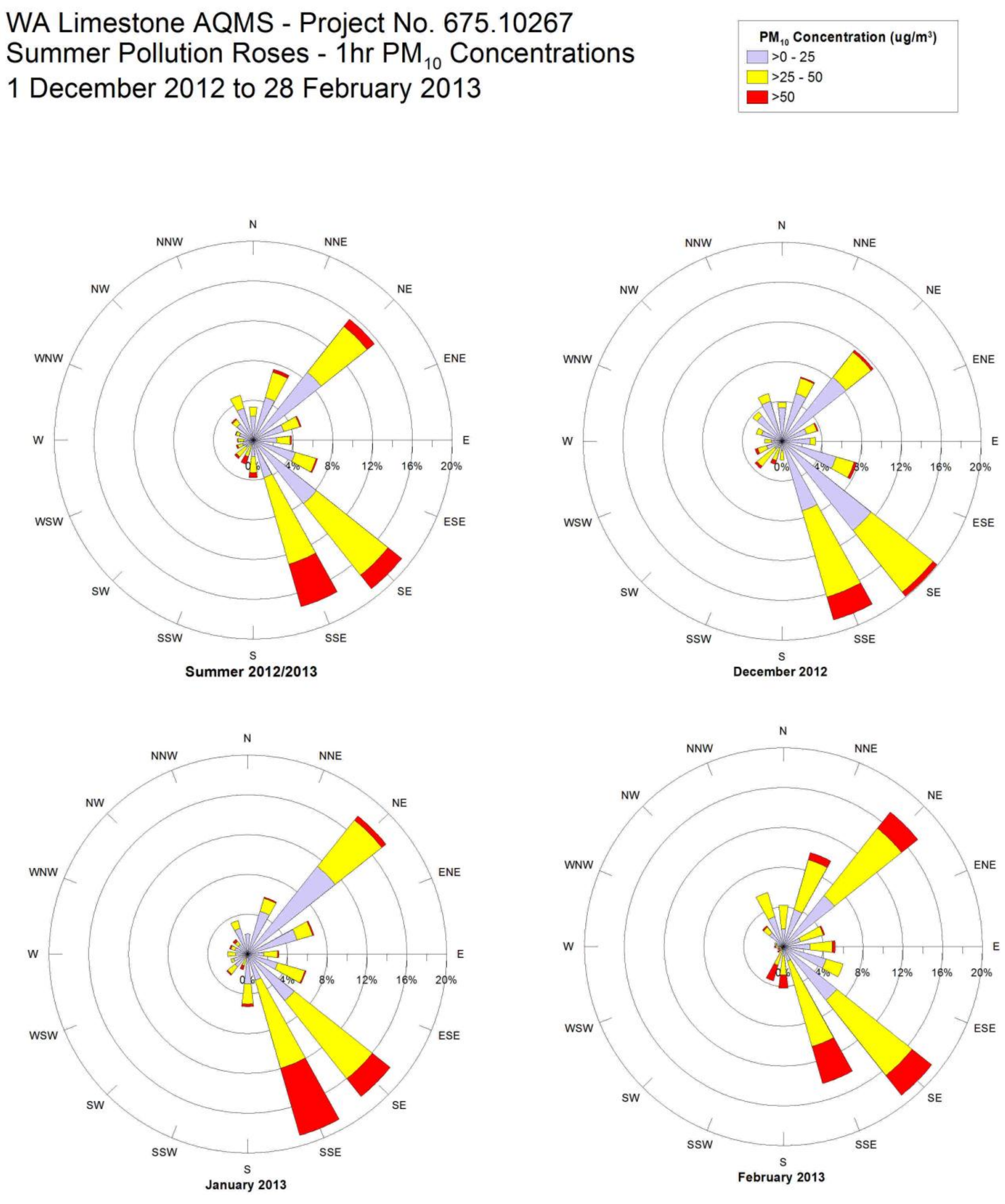


Figure 9 Pollution Rose – Annual

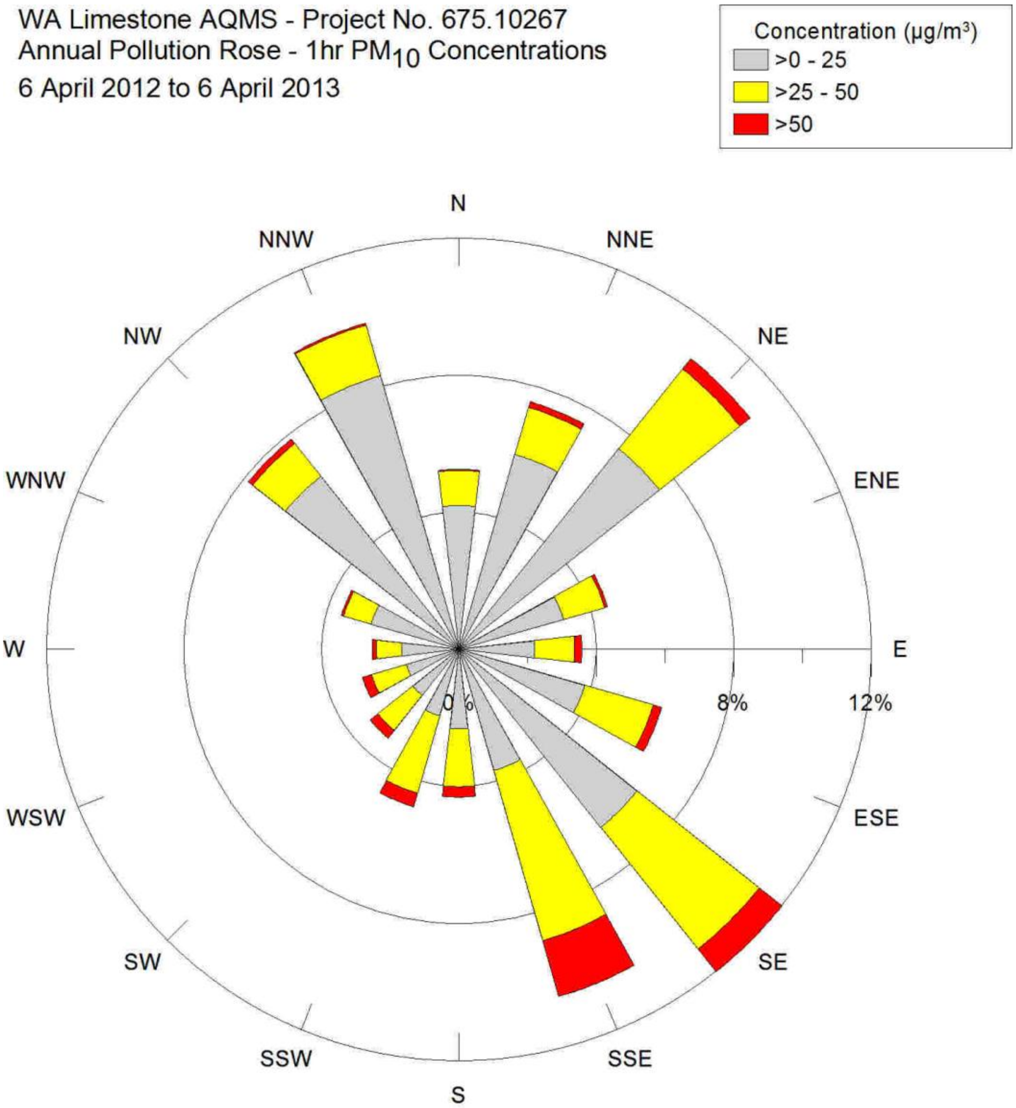


Figure 10 Wind Rose – Autumn 2012/2013

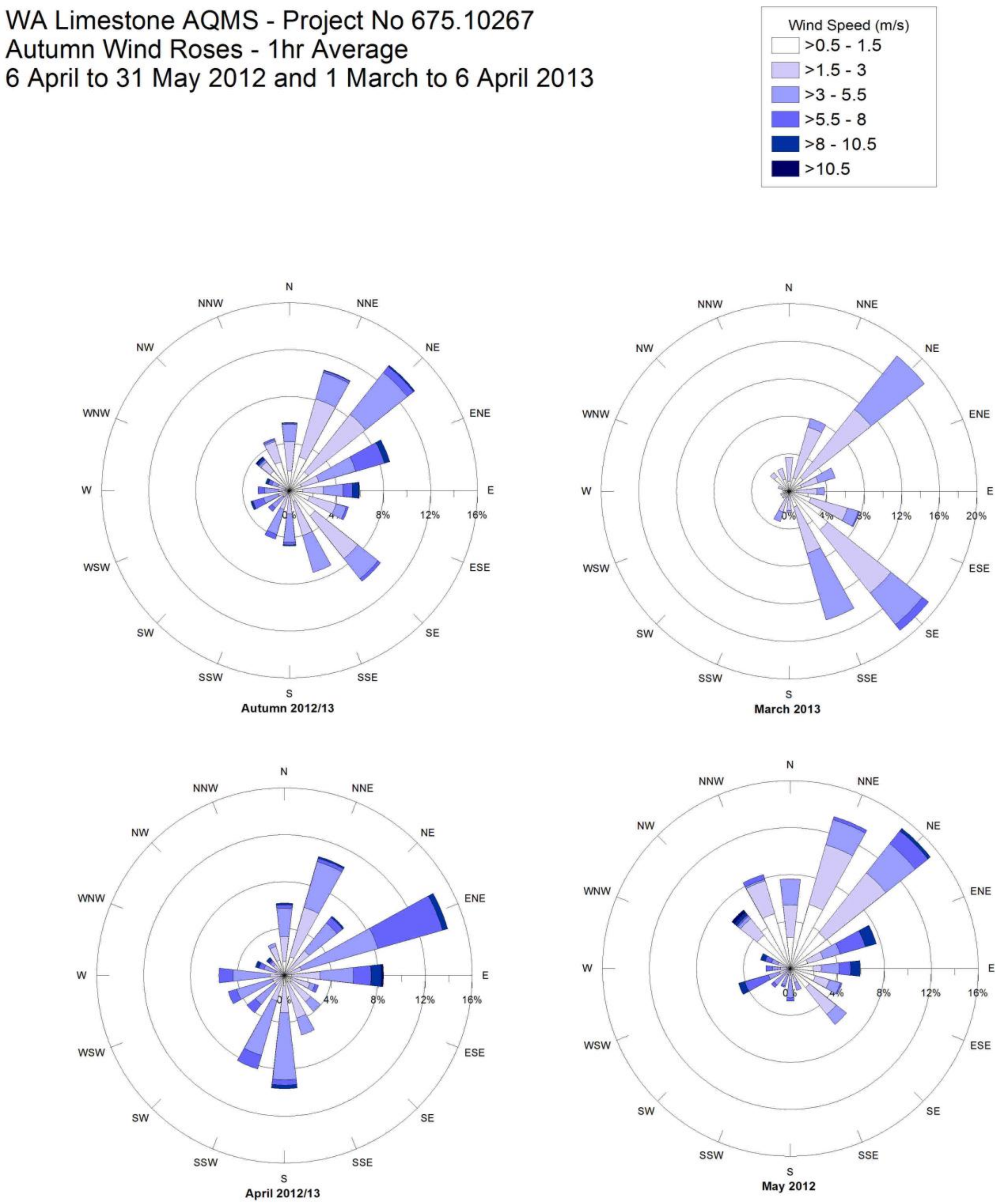


Figure 11 Wind Roses – Winter 2012

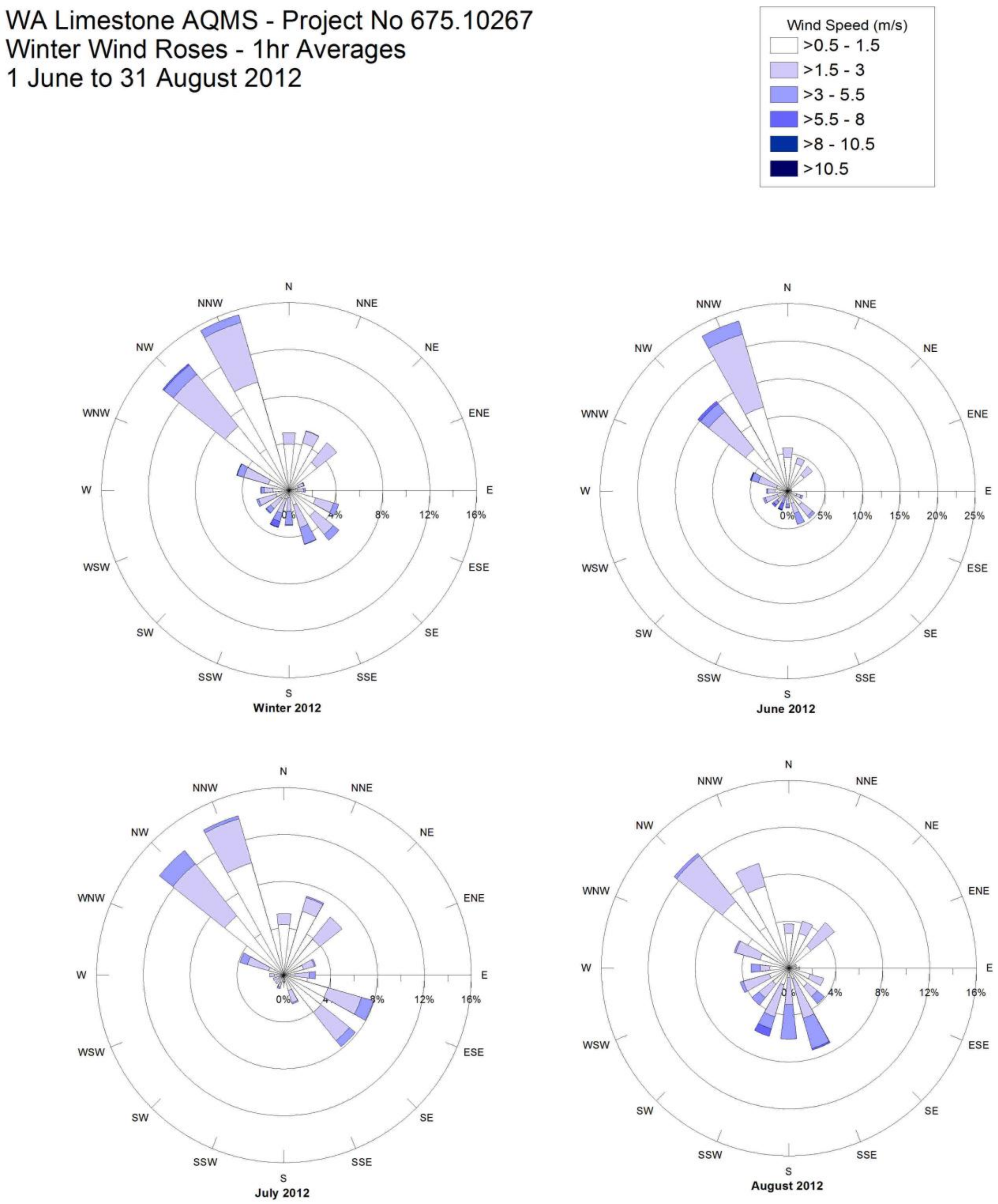


Figure 12 Wind Rose – Spring 2012

Figure 13 Wind Rose – Summer 2012/2013

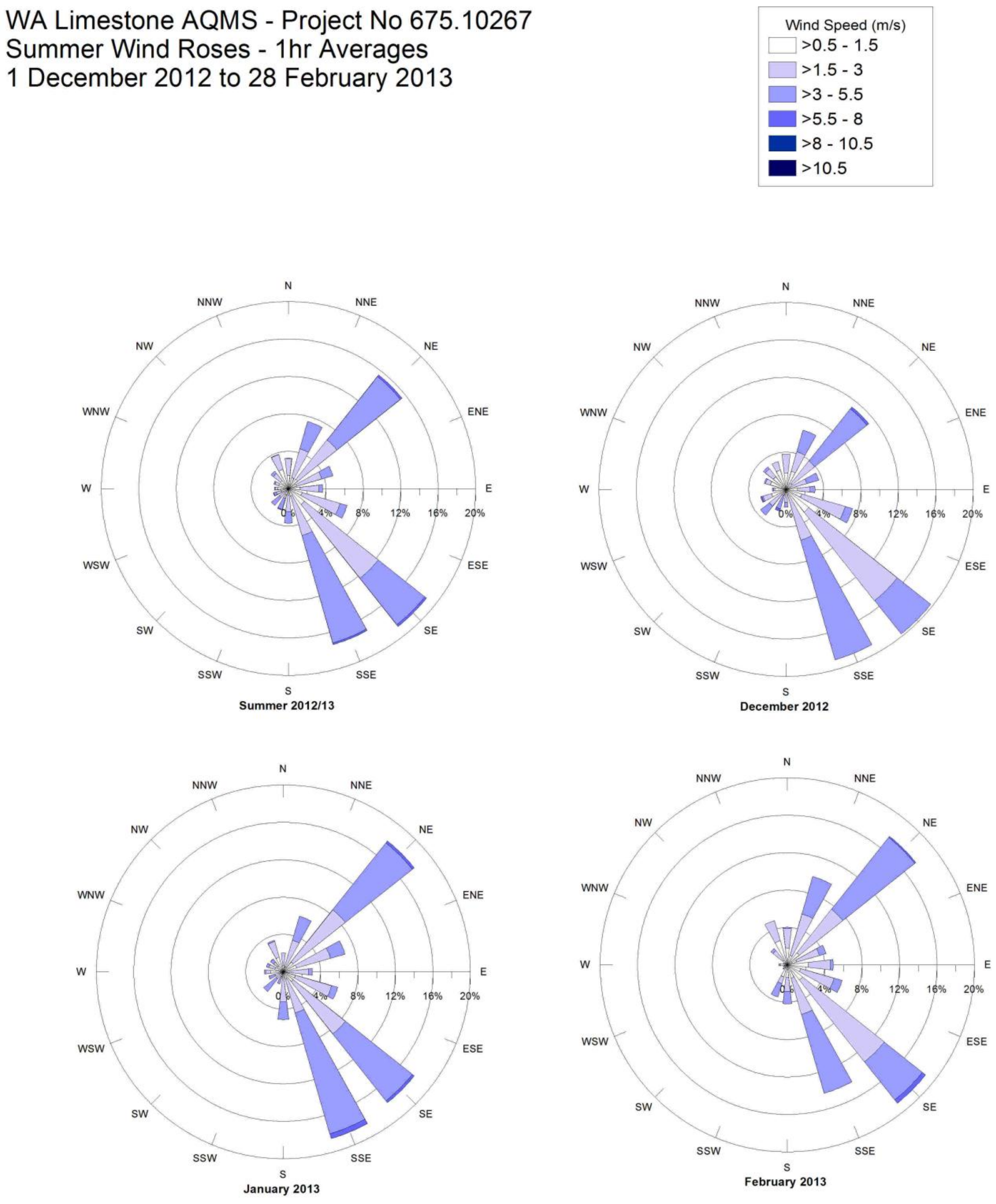
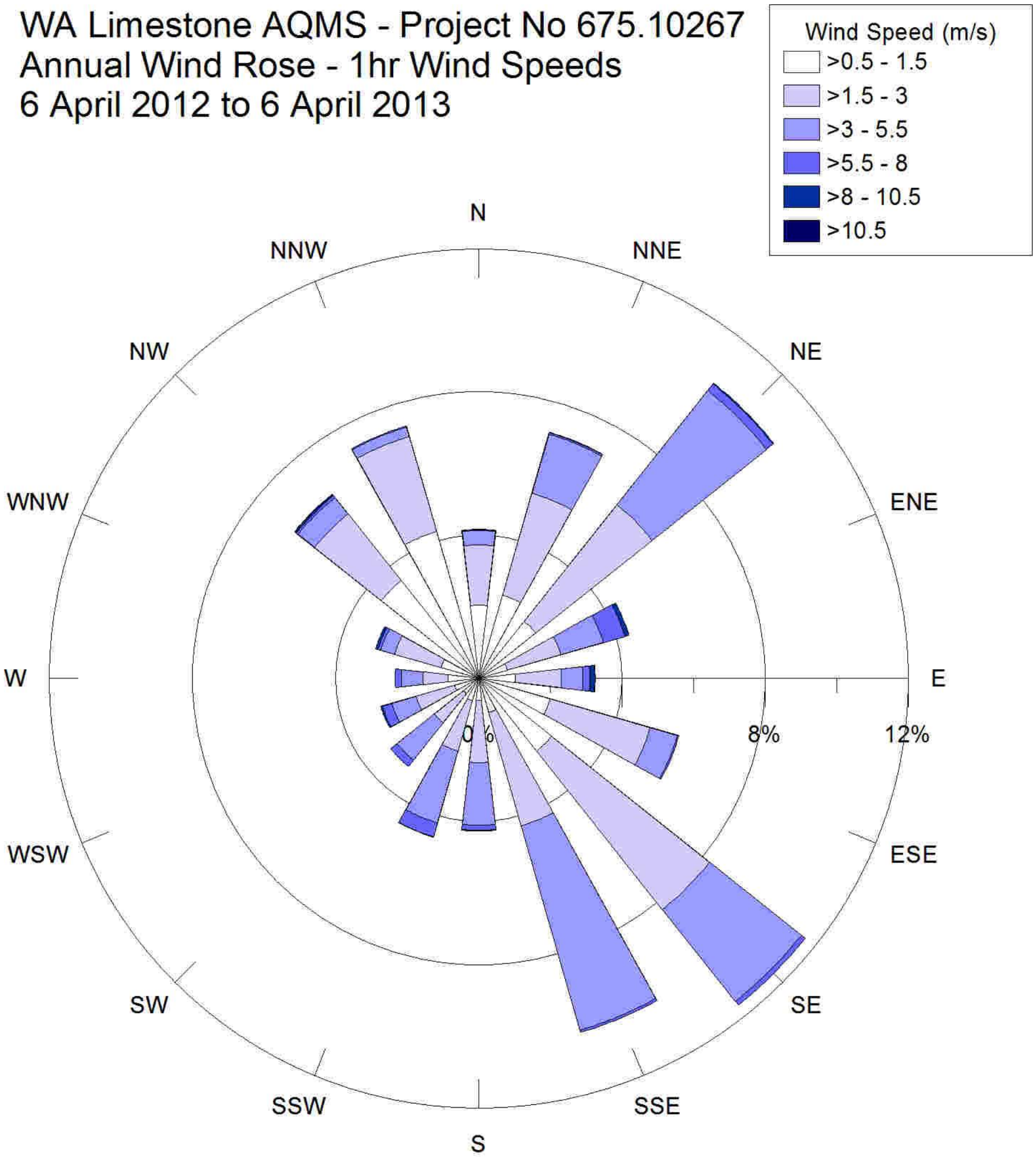


Figure 14 Wind Rose – Yearly (Entire Monitoring Period)



5 DISCUSSION

The WA Limestone AQMS TEOM and HVAS were commissioned on 6 April 2012 and have been recording continuous 5 minute average PM_{10} concentrations and 24-hour TSP concentrations, respectively, up to cessation on 6 April 2013.

The dust deposition rate results are for the monitoring period from 14 March 2012 to 6 July 2012. DDG monitoring was concluded after the initial 3 month monitoring period with one additional month of monitoring. The DDG data was considered less critical to achieving the overall objectives at the proposed development site and therefore further monitoring was not conducted.

As mentioned in **Section 1** an initial report was presented by SLR *Report No 675.10267-R1* at the conclusion of the 3 month monitoring program to the SAT. This report detailed monitoring results recorded at the WA Limestone AQMS and also referenced comparisons between WA Limestone AQMS and Western Australia (WA) Environment Protection Authority (EPA) AQMS. However the conclusions and relationships drawn in SLR's *Report No 675.10267-R1* for the 3 month monitoring period did not satisfy Council.

Council concluded that the relationships drawn by SLR between WA Limestone AQMS and WA EPA AQMS were not well established. It therefore could not approve the use of WA EPA AQMS summer 2011/12 data for input into the predictive modelling phase as being representative of the particulate levels experienced at the proposed development site. Council would also require, as a minimum, 12 months of monitoring data at the proposed development site to demonstrate compliance in accordance with the "*Approved Methods & Guidance for the Modelling and Assessment of Air Pollutants in NSW*", NSW EPA 2005.

As the objective of the monitoring program was to obtain representative baseline air quality data at the proposed development site to be utilised in the predictive modelling, SLR has since withdrawn any comparisons established between WA Limestone AQMS and WA EPA AQMS data in this report.

The basis for withdrawing the comparisons between the WA EPA AQMS is that WA Limestone has obtained 12 months of baseline air quality monitoring data at the proposed development site for input into the predictive modelling. This would therefore satisfy the minimum baseline monitoring requirements specified in the "*Approved Methods & Guidance for the Modelling and Assessment of Air Pollutants in NSW*", NSW EPA 2005. It would be considered that further information would not be required to support this data if all monitoring has been performed in accordance with the relevant standards unless Council deemed the monitoring data unsatisfactory for input into the predictive modelling.

Refer to **Section 5.1** to **Section 5.3** for further discussions of the monitoring data measured for each parameter at the WA Limestone AQMS.

5.1 TEOM Particulate Matter less than 10 microns (PM_{10}) Monitoring Results

The AQMS TEOM was commissioned and operated in accordance with *AS/NZS 3580.9.8:2008 Methods for sampling and analysis of ambient air – Method 9.8: Determination of suspended particulate matter – PM10 continuous direct mass method using tapered element oscillating microbalance analyser* on 6 April 2012 and has been recording continuous 5 minute average PM_{10} concentrations up to cessation on 8 April 2013.

As mentioned in **Section 3.3.5**, SLR indicated in their report *675.10267-R0* the auxiliary flow was reported as 45% of the data measured did not meet the specified criterion of 13.7 ± 0.8 L/min. It could not be determined at the point of issuing the report the cause of the non-compliance as all flows were calibrated on commissioning and quarterly intervals with a calibrated volumetric flow meter. These calibrations verified that the auxiliary flow, main flow and total flow were within the acceptable range specified in the Australian Standards (AS), however the TEOM instrument recorded flows that were below this criterion.

It has since been identified that the auxiliary flows reported were the auxiliary mass flow recording corrected for temperature, pressure and moisture. This would yield a flow lower than the specified criterion. Unfortunately SLR has not logged the auxiliary volumetric flow, however has utilised engineering calculations to back calculate the volumetric flow utilising the logged temperature, pressure and relative humidity recordings for each 5 minute recording to obtain representative auxiliary volumetric flow recordings. The back calculated flows have demonstrated that the auxiliary flows are within the specified criterion of 13.7 ± 0.8 L/min.

The TEOM had a data capture of 98.8% for the monitoring period from 6 April 2012 to 8 April 2013. The 1.2% that was not captured was mainly due to power supply interruptions during two severe storms in May which tripped the instruments power supply. Refer to **Table 8** for a detailed **summary** of the number of continuous data points that were required to be validated for continuous PM_{10} monitoring and details of the minimum, average and maximum recordings for each parameter monitored compared to the AS and manufacturers acceptable criteria or range.

Table 9 to **Table 12** inclusive, summarise the baseline PM_{10} 24-hr average concentration results for the Autumn 2012/13, Winter 2012, Spring 2012 and Summer 2012/13 monitoring period respectively, and compares the results to the NEPM PM_{10} 24-hr criteria. Each seasonal table includes a daily month by month breakdown of the 24-hour PM_{10} concentration results measured.

Figure 2 and **Figure 3** have been provided to illustrate the average 24-hour PM_{10} concentration results compared to the NEPM PM_{10} 24-hour criteria and the 1-hour average continuous PM_{10} concentration results for the monitoring period respectively.

This data has also been presented in graphical detail in the format of seasonal and monthly pollution roses. Refer to **Figure 5** to **Figure 8** for seasonal and monthly pollution roses for the WA Limestone AQMS. **Figure 9** illustrates the annual and seasonal pollution roses for the WA Limestone AQMS.

The annual 24-hour average PM_{10} concentration was 23.1 µg/m^3 for the monitoring period with a maximum of 49.7 µg/m^3 which was recorded on 4 January 2013. The maximum 24-hour PM_{10} concentration result recorded for WA Limestone did not exceed the maximum NEPM 24-hr criteria of 50 µg/m^3 for the monitoring period. Refer to **Table 16 to Table 20** for detailed statistical summaries of the seasonal PM_{10} 24-hr average concentration results for the monitoring period which also includes monthly statistical summaries.

Table 16 Statistical Summary of PM_{10} 24-hr Average Concentration Results – All Autumn Measurements (2012/2013)

WA Limestone AQMS PM_{10} 24-hr Average Concentration Results	March 2013	April 2012/13	May 2012	Autumn 2012/13	NEPM 24-hr Average PM_{10} Criteria
Mean 24-hr Concentration (µg/m^3)	22.1	22.8	24.7	23.8	---
Standard Deviation. (µg/m^3)	5.78	8.08	8.47	8.26	---
Skew (dimensionless)	-0.20	1.07	0.88	0.94	---
Kurtosis (dimensionless)	-0.31	2.66	0.38	1.16	---
Minimum 24-hr Concentration (µg/m^3)	11.0	8.1	13.5	8.1	---
1 Percentile (µg/m^3)	11.1	9.2	13.8	10.3	---
2 Percentile (µg/m^3)	11.2	10.3	14.1	12.2	---
3 Percentile (µg/m^3)	11.3	11.4	14.4	13.2	---
5 Percentile (µg/m^3)	11.9	12.8	14.9	13.8	---
10 Percentile (µg/m^3)	13.4	14.8	15.4	15.0	---
25 Percentile (µg/m^3)	19.0	17.9	18.7	18.0	---
50 Percentile (µg/m^3)	21.9	22.7	22.2	22.5	---
75 Percentile (µg/m^3)	26.1	26.8	29.7	27.7	---
90 Percentile (µg/m^3)	28.7	30.9	35.3	32.9	---
95 Percentile (µg/m^3)	30.4	35.2	40.3	37.6	---
97 Percentile (µg/m^3)	31.2	38.8	44.5	44.7	---
98 Percentile (µg/m^3)	32.2	42.1	45.0	45.7	---
99 Percentile (µg/m^3)	33.1	45.5	45.5	47.2	---
99.9 Percentile (µg/m^3)	34.0	48.5	46.0	48.7	---
Maximum 24-hr Concentration (µg/m^3)	34.1	48.9	46.0	48.9	50

Note: All values are reported as micrograms per cubic metre of air (µg/m^3) with the exception of skew and kurtosis (which are dimensionless).
Skew is dimensionless and provides a measure of the distributions asymmetry around the mean of the population. A positive skew value relates to a population dominated by values greater than the mean, and a negative skew value relates to a population dominated by values less than the mean.
Kurtosis is dimensionless and is a measure of the ‘peakedness’ of a population distribution compared to a normal distribution. A positive kurtosis value relates to a ‘peaked’ distribution and a negative kurtosis value relates to a ‘flat’ distribution.

Table 17 Statistical Summary of PM_{10} 24-hr Average Concentration Results – All Winter Measurements (2012)

WA Limestone AQMS PM_{10} 24-hr Average Concentration Results	June 2012	July 2012	August 2012	Winter 2012	NEPM 24-hr Average PM_{10} Criteria
Mean 24-hr Concentration (µg/m³)	15.4	18.7	18.6	17.6	---
Standard Deviation. (µg/m³)	5.55	6.85	4.39	5.83	---
Skew (dimensionless)	0.73	0.75	0.60	0.67	---
Kurtosis (dimensionless)	-0.13	0.41	0.31	0.48	---
Minimum 24-hr Concentration (µg/m³)	7.0	6.9	11.1	6.9	---
1 Percentile (µg/m³)	7.2	7.8	11.3	7.0	---
2 Percentile (µg/m³)	7.4	8.7	11.5	7.6	---
3 Percentile (µg/m³)	7.6	9.7	11.8	8.0	---
5 Percentile (µg/m³)	7.9	10.2	12.2	9.9	---
10 Percentile (µg/m³)	9.6	11.1	13.9	11.1	---
25 Percentile (µg/m³)	11.9	13.9	15.8	13.7	---
50 Percentile (µg/m³)	14.2	17.6	17.9	16.9	---
75 Percentile (µg/m³)	18.4	22.2	20.8	20.7	---
90 Percentile (µg/m³)	24.3	28.6	24.8	25.9	---
95 Percentile (µg/m³)	24.7	29.2	26.2	28.6	---
97 Percentile (µg/m³)	25.4	30.4	26.7	29.0	---
98 Percentile (µg/m³)	26.5	32.7	27.8	29.7	---
99 Percentile (µg/m³)	27.6	35.0	28.9	30.6	---
99.9 Percentile (µg/m³)	28.5	37.0	29.8	36.6	---
Maximum 24-hr Concentration (µg/m³)	28.6	37.2	29.9	37.2	50

Note: All values are reported as micrograms per cubic metre of air (µg/m³) with the exception of skew and kurtosis (which are dimensionless).
Skew is dimensionless and provides a measure of the distributions asymmetry around the mean of the population. A positive skew value relates to a population dominated by values greater than the mean, and a negative skew value relates to a population dominated by values less than the mean.
Kurtosis is dimensionless and is a measure of the ‘peakedness’ of a population distribution compared to a normal distribution. A positive kurtosis value relates to a ‘peaked’ distribution and a negative kurtosis value relates to a ‘flat’ distribution.

Table 18 Statistical Summary of PM_{10} 24-hr Average Concentration Results – All Spring Measurements (2012)

WA Limestone AQMS PM_{10} 24-hr Average Concentration Results	September 2012	October 2012	November 2012	Spring 2012	NEPM 24-hr Average PM_{10} Criteria
Mean 24-hr Concentration (µg/m³)	22.6	22.7	24.7	23.3	---
Standard Deviation. (µg/m³)	6.09	6.16	7.10	6.46	---
Skew (dimensionless)	-0.05	1.91	0.13	0.63	---
Kurtosis (dimensionless)	-0.73	5.89	-0.73	0.76	---
Minimum 24-hr Concentration (µg/m³)	11.2	14.6	12.0	11.2	---
1 Percentile (µg/m³)	11.5	14.9	12.3	11.9	---
2 Percentile (µg/m³)	11.7	15.2	12.6	12.0	---
3 Percentile (µg/m³)	11.9	15.5	12.9	12.7	---
5 Percentile (µg/m³)	13.0	16.1	13.8	14.3	---
10 Percentile (µg/m³)	14.5	17.1	14.8	14.8	---
25 Percentile (µg/m³)	19.1	18.5	20.3	19.1	---
50 Percentile (µg/m³)	22.6	21.7	23.6	22.6	---
75 Percentile (µg/m³)	26.5	25.2	30.0	27.4	---
90 Percentile (µg/m³)	30.8	28.6	35.7	31.0	---
95 Percentile (µg/m³)	32.0	31.0	36.6	34.2	---
97 Percentile (µg/m³)	32.8	32.9	36.7	36.6	---
98 Percentile (µg/m³)	32.8	37.4	36.9	36.8	---
99 Percentile (µg/m³)	32.9	41.8	37.0	38.1	---
99.9 Percentile (µg/m³)	32.9	45.7	37.1	45.3	---
Maximum 24-hr Concentration (µg/m³)	32.9	46.2	37.2	46.2	50

Note: All values are reported as micrograms per cubic metre of air (µg/m³) with the exception of skew and kurtosis (which are dimensionless).
Skew is dimensionless and provides a measure of the distributions asymmetry around the mean of the population. A positive skew value relates to a population dominated by values greater than the mean, and a negative skew value relates to a population dominated by values less than the mean.
Kurtosis is dimensionless and is a measure of the 'peakedness' of a population distribution compared to a normal distribution. A positive kurtosis value relates to a 'peaked' distribution and a negative kurtosis value relates to a 'flat' distribution.

Table 19 Statistical Summary of PM_{10} 24-hr Average Concentration Results – All Summer Measurements (2012/2013)

WA Limestone AQMS PM_{10} 24-hr Average Concentration Results	December 2012	January 2013	February 2013	Summer 2012/13	NEPM 24-hr Average PM_{10} Criteria
Mean 24-hr Concentration (µg/m^3)	24.4	28.7	32.6	28.4	---
Standard Deviation. (µg/m^3)	7.50	9.43	6.83	8.60	---
Skew (dimensionless)	0.91	0.27	-0.31	0.22	---
Kurtosis (dimensionless)	1.06	-0.05	0.04	-0.39	---
Minimum 24-hr Concentration (µg/m^3)	11.9	8.4	16.8	8.4	---
1 Percentile (µg/m^3)	12.7	10.9	17.7	11.5	---
2 Percentile (µg/m^3)	13.5	13.4	18.6	14.0	---
3 Percentile (µg/m^3)	14.3	15.8	19.5	14.6	---
5 Percentile (µg/m^3)	14.6	17.7	21.1	16.3	---
10 Percentile (µg/m^3)	16.2	18.9	24.0	18.6	---
25 Percentile (µg/m^3)	20.4	21.0	29.6	21.3	---
50 Percentile (µg/m^3)	23.2	26.9	33.0	27.4	---
75 Percentile (µg/m^3)	27.4	34.8	37.6	34.2	---
90 Percentile (µg/m^3)	33.4	36.9	40.4	39.8	---
95 Percentile (µg/m^3)	39.4	45.5	42.1	42.8	---
97 Percentile (µg/m^3)	42.4	48.2	43.3	44.8	---
98 Percentile (µg/m^3)	43.0	48.7	44.2	46.4	---
99 Percentile (µg/m^3)	43.6	49.2	45.1	48.3	---
99.9 Percentile (µg/m^3)	44.2	49.7	45.9	49.6	---
Maximum 24-hr Concentration (µg/m^3)	44.3	49.7	46.0	49.7	50

Note: All values are reported as micrograms per cubic metre of air (µg/m^3) with the exception of skew and kurtosis (which are dimensionless).
Skew is dimensionless and provides a measure of the distributions asymmetry around the mean of the population. A positive skew value relates to a population dominated by values greater than the mean, and a negative skew value relates to a population dominated by values less than the mean.
Kurtosis is dimensionless and is a measure of the 'peakedness' of a population distribution compared to a normal distribution. A positive kurtosis value relates to a 'peaked' distribution and a negative kurtosis value relates to a 'flat' distribution.

Table 20 Statistical Summary of PM_{10} 24-hr Average Concentration Results – Yearly (Entire Monitoring Period)

WA Limestone AQMS PM_{10} 24-hr Average Concentration Results	Autumn 2012/13	Winter 2012	Spring 2012	Summer 2012/13	Annual 2012/13	NEPM 24-hr Average PM_{10} Criteria
Mean 24-hr Concentration (µg/m³)	23.8	17.6	23.3	28.4	23.1	---
Standard Deviation. (µg/m³)	8.26	5.83	6.46	8.60	8.11	---
Skew (dimensionless)	0.94	0.67	0.63	0.22	0.66	---
Kurtosis (dimensionless)	1.16	0.48	0.76	-0.39	0.38	---
Minimum 24-hr Concentration (µg/m³)	8.1	6.9	11.2	8.4	6.9	---
1 Percentile (µg/m³)	10.3	7.0	11.9	11.5	8.1	---
2 Percentile (µg/m³)	12.2	7.6	12.0	14.0	10.1	---
3 Percentile (µg/m³)	13.2	8.0	12.7	14.6	10.9	---
5 Percentile (µg/m³)	13.8	9.9	14.3	16.3	11.8	---
10 Percentile (µg/m³)	15.0	11.1	14.8	18.6	13.8	---
25 Percentile (µg/m³)	18.0	13.7	19.1	21.3	17.2	---
50 Percentile (µg/m³)	22.5	16.9	22.6	27.4	22.0	---
75 Percentile (µg/m³)	27.7	20.7	27.4	34.2	28.0	---
90 Percentile (µg/m³)	32.9	25.9	31.0	39.8	34.0	---
95 Percentile (µg/m³)	37.6	28.6	34.2	42.8	37.2	---
97 Percentile (µg/m³)	44.7	29.0	36.6	44.8	41.2	---
98 Percentile (µg/m³)	45.7	29.7	36.8	46.4	43.9	---
99 Percentile (µg/m³)	47.2	30.6	38.1	48.3	46.1	---
99.9 Percentile (µg/m³)	48.7	36.6	45.3	49.6	49.4	---
Maximum 24-hr Concentration (µg/m³)	48.9	37.2	46.2	49.7	49.7	50

Note: All values are reported as micrograms per cubic metre of air (µg/m³) with the exception of skew and kurtosis (which are dimensionless).
Skew is dimensionless and provides a measure of the distributions asymmetry around the mean of the population. A positive skew value relates to a population dominated by values greater than the mean, and a negative skew value relates to a population dominated by values less than the mean.
Kurtosis is dimensionless and is a measure of the 'peakedness' of a population distribution compared to a normal distribution. A positive kurtosis value relates to a 'peaked' distribution and a negative kurtosis value relates to a 'flat' distribution.

Refer to **Figure 10 to Figure 13** for graphical representation of seasonal wind roses which also illustrate individual monthly wind roses for the meteorological conditions as measured at the WA Limestone AQMS Data was obtained from the Bureau of Meteorology (BoM) Perth Airport with the for the period 6 April 2012 and up to 16 May 2012. **Figure 14** represents the annual wind rose which also summarises the associated seasonal wind roses measured at the WA Limestone AQMS.

The predominant winds for each season have been recognised as follows;

- Autumn is predominantly of a north easterly component
- Winter is predominately of a north north west component
- Spring is predominantly of a south south east component and
- Summer is predominantly of a south south east component.
- Annual predominant winds were of experienced from several sectors, the north east, south east and north west sectors.

5.2 Total Suspended Particulate (TSP) Monitoring Results

The HVAS was calibrated and operated in accordance with AS/NZS 3580.9.3:2007 on 6 April 2012. TSP sampling began on 8 April 2012 on a six day cycle for one year with the exception of 7 July and 13 July not being sampled. Sampling did not occur for this period because discussions were still taking place to determine if the monitoring would continue after the cessation of the 3 month monitoring program. Samples for 12 September and 5 December were also not conduct due to operator error and the results reported as No Data. A field blank was allocated to represent the three month sampling period and thereafter as required. The field blank analytical result was below the laboratory limit of detection of 0.1 milligrams per filter (mg/filter).

Analysis of the TSP filters was performed by ALS NATA accredited laboratories. **Table 14** summarises the TSP average concentration results for the monitoring period and provides a comparison ratio of PM_{10} to TSP concentration.

The annual average TSP concentration result for the monitoring period was 51.0 µg/m^3 with a maximum 24-hr concentration of 95.2 µg/m^3 for the monitoring period. The maximum 24-hr TSP concentration results for the monitoring period marginally exceeded the NSW EPA annual criteria of 90 µg/m^3, however the annual average TSP concentration was in compliance with the annual criteria. This elevated result may be influenced from a mulching fire across the road from the facility on the 18 February 2013.

The average PM_{10} to TSP concentration ratio was 51.1% for results reported.

5.3 Dust Deposition Gauge (DDG) Monitoring Results

Four DDG were commissioned and maintained in accordance with AS/NZS 3580.10.1:2003 with the exception of the second month of monitoring not meeting the required 30 ± 2 days criteria. However an additional sample (1 month monitoring) was taken to compensate for this non-compliance.

Refer to **Figure 1** for site locality of the four DDGs. The DDG monitoring commenced on the 14 March 2012 and was completed on the 6 July 2012. The DDG data was considered less critical to achieving the overall objectives at the proposed development site and therefore further monitoring was not conducted.

Analysis of the DDGs was performed by ALS NATA accredited laboratories.

Refer to **Table 15** for a summary of the DDG concentration results for the four month monitoring period. The average DDG concentration for WA Limestone baseline monitoring was 2.7 grams per square metre per month (g/m^2/month) which was in compliance with the 4 g/m^2/month maximum total deposited dust level. All individual monthly deposition rates were also in compliance with the 4 g/m^2/month maximum total deposited dust level.

6 CONCLUSIONS

WA Limestone commissioned SLR to establish and operate an AQMS in accordance with the relevant Australian Standards. The scope of measurement was to quantify background TSP concentrations, continuous PM_{10} concentrations and dust deposition rates. An on-site weather station was also erected to measure local meteorological conditions at the site and to enable subsequent analysis of the measured concentrations / deposition rates.

The AQMS was operational on 6 April 2012 and the on-site weather station was operational on 16 May 2012. The baseline air quality data measured at the WA Limestone AQMS was in compliance with all relevant standards with the exception of some siting requirements that could not be adhered to. These deviations have been further detailed in **Section 2** of this report.

Table 21 summarises the WA Limestone AQMS concentration results measured for the monitoring period to cessation on 6 April 2013. All parameters measured were in compliance with the maximum concentration criteria specified for the monitoring period.

Predominant wind directions for each month of monitoring as well as seasonal and annual trends have been illustrated in the form of wind and pollution roses in **Section 4**. The annual predominant winds ranged over several sectors and therefore the baseline dust can also be considered to be sourced from all neighbouring sites and beyond.

SLR considers that the site specific baseline air quality monitoring data measured at the WA Limestone AQMS achieved the objectives required and satisfies the minimum requirements specified in the "*Approved Methods & Guidance for the Modelling and Assessment of Air Pollutants in NSW*", NSW EPA 2005. The measured monitoring data at WA Limestone AQMS therefore should satisfy the SAT to grant approval to use this data for input in the predictive modelling. The predictive modelling will determine compliance and impact on sensitive receptors for the development approval of a concrete batching plant at 277 Collier Road, Bayswater WA.

Table 21 Summary of WA Limestone Air Quality Baseline Results

Date	WA Limestone AQMS	Criteria / Goal
Maximum PM_{10} Conc. (µg/m^3)	49.7	50
Autumn Maximum PM_{10} Conc. (µg/m^3)	48.9	50
Winter Maximum PM_{10} Conc. (µg/m^3)	37.2	50
Spring Maximum PM_{10} Conc. (µg/m^3)	46.2	50
Summer Maximum PM_{10} Conc. (µg/m^3)	49.7	50
Annual Average PM_{10} Conc. (µg/m^3)	23.1	30
Annual Average TSP Conc. (µg/m^3)	51.0	90
Average DDG Conc. (g/m^2/month)	2.7	4

Key:

AQMS	Air Quality Monitoring Station
Conc.	Concentration
DEC	Department of Environment and Conservation
g/m^2.month	micrograms per square metre per month
hr	hour
NEPM	National Environment Protection Measure
PM_{10}	Particulate matter less than 10 microns
TSP	Total suspended particulate
µg/m^3	micrograms per cubic metre
µg/m^2	micrograms per square metre

7 REFERENCES

- AS/NZS 3580.1.1:2007 *Methods for sampling and analysis of ambient air – Part 1.1: Guide to siting air monitoring equipment.*
- AS/NZS 3580.9.3:2003 *Methods for sampling and analysis of ambient air – Method 9.3: Determination of suspended particulate matter-Total suspended particulate matter (TSP)-High volume sampler gravimetric method.*
- AS/NZS 3580.9.8:2008 *Methods for sampling and analysis of ambient air – Method 9.8: Determination of suspended particulate matter – PM10 continuous direct mass method using tapered element oscillating microbalance analyser*.
- AS/NZS 3580.10.1:2003 *Methods for sampling and analysis of ambient air – Method 10.1: Determination of particulate matter – Deposited matter-Gravimetric method.*
- AS/NZS 3580.14:2011 *Methods for sampling and analysis of ambient air – Part 14: Meteorological monitoring for ambient air quality monitoring applications*.
- National Environmental Protection Council (NEPC), *National Environmental Protection Measure (NEPM) for Ambient Air Quality, 1998.*
- NSW DEC *"Approved Methods & Guidance for the Modelling and Assessment of Air Pollutants in NSW*", NSW EPA, 2005
- SLR Consulting Australia Pty Ltd Report 675.10267-R1 (2012)

APPENDIX A

DDG-1

DDG-2

DDG-3

DDG-4

WA Limestone AQMS – Weather Station, TEOM & HVAS

Bayswater Concrete Batching Plant

Revised Air Quality Impact Assessment

277 Collier Road, Bayswater WA

Report Number 675.10817-R1

21 November 2014

WA Limestone

41 Spearwood Avenue

Bibra Lake, WA 6163

Version: Revision 0

Bayswater Concrete Batching Plant

Revised Air Quality Impact Assessment

277 Collier Road, Bayswater WA

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
589 Hay Street JOLIMONT WA 6014

T: 61 8 9422 5900 F: 61 8 9422 5901
E: perth@slrconsulting.com www.slrconsulting.com

DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
675.10817-R1	Revision 0	21 November 2014	F. Rahaman	G. Graham K. Lawrence	G. Graham

Table of Contents

Table of Contents

Table of Contents

APPENDICES

TABLES

Table of Contents

FIGURES

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by WA Limestone (the Proponent) to undertake an Air Quality Impact Assessment (AQIA) for the proposed concrete batching plant (CBP) in Bayswater, Western Australia (WA). The proposed concrete batching plant is located at 277 Collier Road in Bayswater (hereafter referred to as the 'Project Site'), approximately 8 kilometres (km) north-east of Perth CBD.

1.1 Background

SLR prepared an air quality impact assessment for the proposed CBP in June 2013. Subsequent to the completion of that report, review and acceptance by the City of Bayswater Council (Council) and the granting of planning approval (with conditions), the Proponent has revised the proposed CBP design to include the latest available technology to minimise potential particulate emissions from the facility. Of note, the proposed maximum (500 m^3/day) and average (135 m^3/day) production rates have not changed since the 2013 assessment. This assessment has been commissioned as an update of the previous AQIA (SLR 2013) and has been prepared to reflect the changes in the estimated particulate emissions from the proposed operation due to the revised design and the associated impacts predicted at surrounding sensitive receptors.

The process emissions have been calculated using the emission factors published by United States Environmental Protection Agency for *Concrete Batching* (USEPA 2006). The emission factors have been supplemented by the control efficiencies published by Environment Australia for *Concrete Batching and Concrete Product Manufacturing* (EA 1999), consistent with SLR (2013).

This report layout is as follows:

- Project setting and brief project description (**Section 2**)
- Identification and description of potential air emission sources and any applicable emissions controls (**Section 2.4**).
- Description of local topographic features, sensitive receptor locations and neighbouring industries (**Section 3**).
- Establishment of air quality assessment criteria (**Section 3**).
- Analysis of climate and dispersion meteorology for the region (**Section 5**).
- Description of existing air quality environment (**Section 6**).
- Compilation of a comprehensive emissions inventory for proposed operations (**Section 7**).
- Atmospheric dispersion modelling and analysis of results (**Section 8**).

For ease of interpretation between the initial AQIA (SLR 2013) and this revised report, the following provides a brief summary of the key changes in the design of the CBT.

1.2 Brief Summary of Key Changes and Assumptions

Section 2.4 provides a summary of the identification of potential emissions to air. Reference is drawn to the following:

- **Improved CBT Process Design:** The raw materials for the CBT are now delivered directly to underground 'drive-over' storage bins, as opposed to 'on surface' storage as previously designed and assessed in SLR 2013. The raw materials are now delivered directly into the storage hoppers and from that point there is no handling of materials and the system is fully enclosed. There is provision for limited and temporary storage of 'overflow' materials in 'at surface' walled storage bins, but these are provided to manage emissions in the extraordinary circumstance of excess delivery and not routine use. The temporary storage bins will be designed with three walls (see **Figure 3**) and water sprays for dust suppression during their infrequent use. The transfer of materials from the temporary storage bins will be performed by a front end loader, but the frequency of this source of emissions is significantly reduced from that previously assessed.
- **Emissions Estimation:** The source of emission rates used in this assessment is consistent with that adopted in SLR 2012 report, and subsequently reviewed by Council. A summary of the changes to the estimated rate of emissions to air associated with the revised CBP design is presented in **Section 9.4**, and the quantified changes in the emission rates associated with Scenario 1 (500 m^3/day production rate) and Scenario 2 (135 m^3/day production rate) are presented in **Table 28** and **Table 29** respectively.
- **Modelling Assessment:** The modelling assessment presented in this report is consistent with that adopted in SLR 2012. Please note that in previous assessment (SLR 2012) hourly emission rates were scaled down during the off-peak hours. However in this assessment an average constant emission rate for all operating hours was adopted for this assessment as daily operating hours for a number of activities were minimal (<0.1 hr per day).
- **Predicted Impacts:** A comparison between the impacts predicted in SLR 2012 and this revised assessment is provided in **Section 8.4**. It will be noted that the predicted impacts associated with the revised design are lower than previously assessed and approved.

2 PROJECT BACKGROUND

Operations at the Project Site will involve the handling and mixing of raw materials in a batch process before the concrete is transported to the desired locations. SLR conducted an initial air quality impact assessment for this project in January 2013 based on preliminary information for the CBP. In June 2013, WA Limestone reengaged SLR to finalise the air quality impact assessment report to include changes in the final design for the CBP and to include background monitoring data collected from an on-site ambient air quality monitoring station.

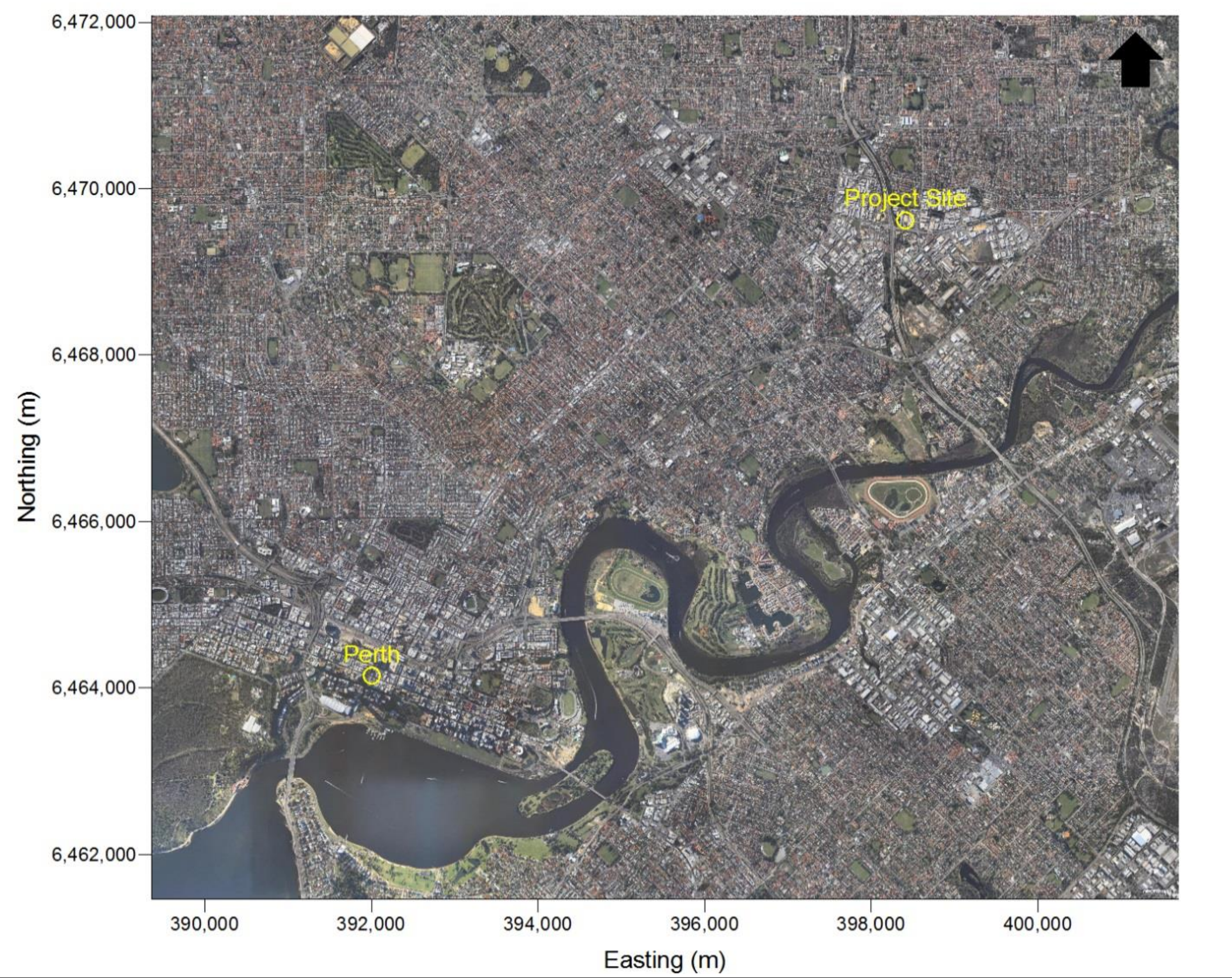
Since the 2013 study was performed, a number of changes have been made to the proposed CBP design. The key design changes include:

- 97.7% reduction in Front End Loader (FEL) movement;
- 76.7% reduction in aggregate delivery times;
- 80% reduction in material bin areas exposed to wind erosion;
- 18% reduction in haul road length for aggregate delivery;
- 10% increase in haul road length for cement transfer; and
- 8% reduction in haul road length for agitator truck movements within the site.

2.1 Regional Project Site Location

The Project Site is located at 277 Collier Road in Bayswater, approximately 8 km north north-east of Perth CBD. The location of the Project Site with respect to the location of Perth CBD is shown in **Figure 1**.

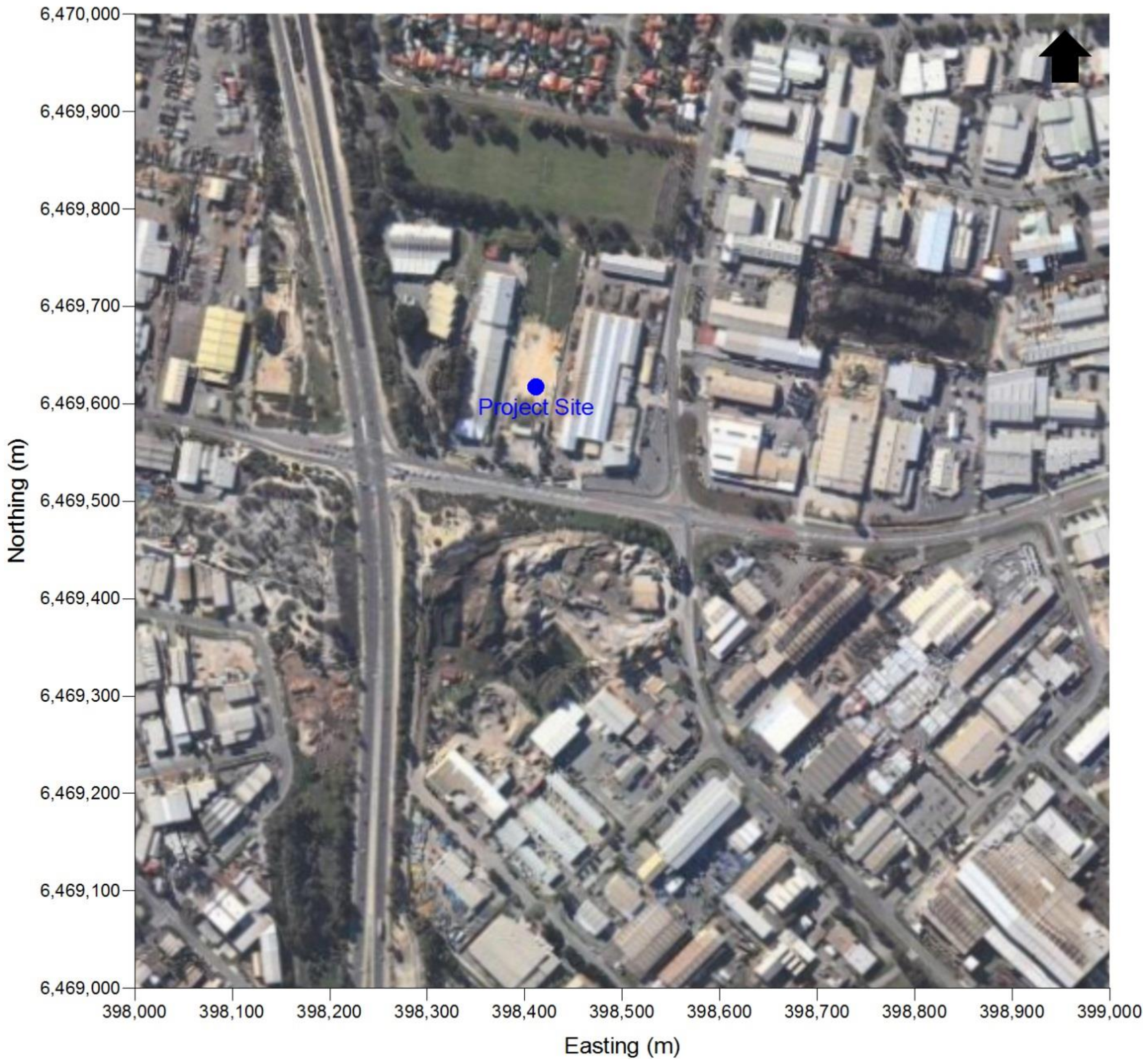
Figure 1 Regional Location of the Project Site



2.2 Local Project Location

The Project Site is located in an industrial area as shown in **Figure 2**. The nearest residential area is located just over 200 m to the north (refer to **Section 3.3** for further discussion on sensitive receptors).

Figure 2 Location of the Project Site and Surrounding Land Use



2.3 Process Description

The proposed activities to be conducted at the Project Site include the following:

- receipt of raw materials;
- handling and storage of raw materials;
- feeding/replenishment of raw materials;
- weighing and dispensing of raw materials;
- batch mixing;
- truck loading;
- final slump and wash down; and
- concrete delivery.

The full site layout including the locations of these activities within the Project Site is shown in **Appendix A**.

2.4 Identification of Potential Air Emissions

2.4.1 Potential Emission Sources

Atmospheric pollutants likely to be generated by the proposed activities at the Project Site include fugitive emissions of particulates (assessed as total suspended particulate (TSP), PM_{10}[1], and deposited dust) in addition to those generated through the combustion of fossil fuels in vehicle engines (oxides of nitrogen (NO_X), sulphur dioxide (SO_2), volatile organic compounds (VOCs), carbon monoxide (CO) and PM_{10}).

It is considered appropriate to assume that the emissions due to combustion of fuel at the Project Site will be negligible compared to the existing background levels, particularly from traffic on Tonkin Highway and Collier Road. Hence, the potential emissions of fuel combustion products have not considered further in this assessment.

The key potential emission sources and major pollutants identified for the proposed CBP are summarised in **Table 1** and discussed further below.

Table 1 Summary of Potential Emission Sources

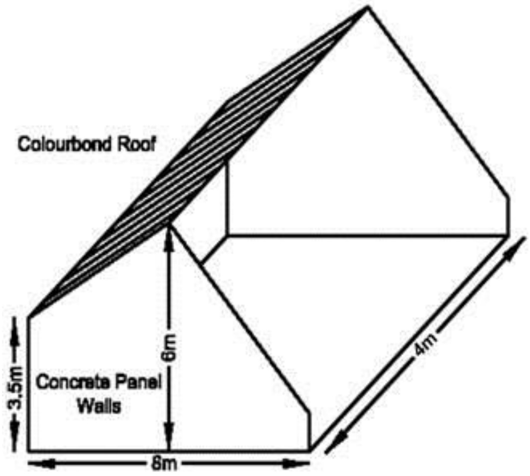
Emission Source/Activity	Emission Type	Pollutants
Trucks dumping aggregates and sand	Material handling	TSP, PM_{10}
Front end loader on aggregates and sand	Material handling	TSP, PM_{10}
Miscellaneous transfer points (including conveying)	Material handling	TSP, PM_{10}
Mixer loading	Material handling	TSP, PM_{10}
Road haulage	Wheel-generated dust	TSP, PM_{10}
Temporary overflow aggregate and sand storage bins	Wind erosion	TSP, PM_{10}

- **Trucks Dumping Aggregates/Sand** – The aggregate and sand will be brought to the Project Site using trucks, which will dump the aggregate and sand into the underground drive-over storage bins. It is anticipated that the action of trucks dumping raw materials will give rise to particulate emissions. For the purpose of this assessment, the emissions associated with the dumping of aggregate and sand have been collectively assessed as emissions from dumping of aggregate only.
- **Temporary Overflow Storage Bins** – The purpose of the temporary overflow storage bins is to provide additional storage capacity in the event of the delivery of aggregates / sand beyond the storage capacity of the underground 'drive-over' storage bins. As such they are anticipated that their use would be very infrequent. The temporary overflow storage bins will be constructed using concrete, with the walls rising at least 3.5 m in height and steel/colourbond windshield covering three sides of the bins up to a total height of six metres (see **Figure 3**).

  The temporary overflow storage bins have the potential to give rise to particulate emissions due to wind erosion. For the purpose of this assessment, the emissions associated with the wind erosion of aggregate and sand have been collectively assessed as emissions from wind erosion of aggregate only.

[1] PM_{10} is used to describe particulate matter with an aerodynamic diameter of 10 microns (µm) or less. Correspondingly, TSP (Total Suspended Particulate) describes particulate matter which is less than 30 µm diameter.

Figure 3 Proposed Structure of the Aggregate Bins



Source: WA Limestone

- **Material Handling using Front End Loader** –The FEL will only be used to transport material from the temporary overflow aggregate/sand storage bins and reclaimer to the loading hopper. The action of the FEL on the raw materials is anticipated to give rise to particulate emissions from the material handled. In addition, the wheel-generated dust due to the FEL's movement on the surface within the Project Site is likely to give rise to particulate emissions.
- **Mixer Loading** – The mixer will be loaded with raw materials, as required. Even though water will be added with other raw materials, particulate emissions are likely to be emitted at the point of addition of dry raw materials. Emission controls from this source are discussed in the following section.
- **Miscellaneous Transfer Points (Including Conveying)** – The miscellaneous transfer points associated with the proposed CBP that are anticipated to give rise to particulate emissions are:
  - the transfer point at the weigh hopper (for sand and aggregate);
  - the transfer point at the bucket elevator;
  - the transfer point at the overhead storage bin;
  - the transfer point at the mixer; and
  - the transfer point at the pneumatic conveyor (for cement transfer).
- **Hardstand Areas/Road Haulage** – The hardstand areas at the Project Site include the site entry, and the areas designated for the temporary overflow storage bins (aggregate and sand) and plant machinery. The movement of trucks and other equipment on these surfaces has the potential to give rise to particulate emissions. The area within the Project Site is proposed to be sealed which will minimise the generation of particulate emissions, however to be conservative, these emissions have been included in this assessment.

2.4.2 Proposed Emission Controls

The following emission control measures have been considered in this assessment:

- **Trucks Dumping Aggregates** – The trucks will dump the raw aggregate at the drive-over storage bins. It is anticipated that the raw aggregate brought to the site will contain inherent moisture; however it is difficult to quantify the expected moisture content of the raw aggregates. Therefore, to be conservative, even though the inherent moisture content is likely to offer some control over the particulate emissions, it has not been considered in this assessment.
- **Material Handling using FELs** – It is proposed that the aggregate from the temporary overflow storage bins and reclaimer will be handled and transferred to the loading hopper bins using one FEL. The aggregate handled will be in moist condition as both the aggregate storage bins and weigh hoppers will have sprinkler systems fitted, hence there will be reduced particulate emissions during the handling and transferring procedure. However, to be conservative, the estimation of emissions from the action of the FEL on the aggregates has been performed without any emissions control assumed.
- **Mixer Loading** – The mixer loading is proposed to occur in a dual enclosure. Loading of raw materials (cement, aggregate and sand) will be conducted inside the inner enclosure with a suitably specified fabric filter. All inlet points, including the fabric filter, will be contained within a second outer enclosure. Dust control is therefore offered by:
  - The addition of water to the mix.
  - A primary enclosure, including enclosed material conveyors.
  - An extractive system to minimise fugitive emissions.
  - A fabric filter to offer effective air pollution control of the particulates in the extracted air.
  - A secondary enclosure to house all of the above infrastructure.
- **Miscellaneous Transfer Points (Including Conveying)** – The miscellaneous transfer points proposed at the Project Site along with corresponding control measures and control efficiencies assumed are shown in **Table 2**.

Table 2 Proposed Control Measures for Miscellaneous Transfers at the Project Site

Transfer Point	Modelled Controls	Modelled Control Efficiency
Transfer points (for sand and aggregate)	Enclosure	99%
Transfer of cement from cement trucks to cement silo (Pneumatic conveying)	Enclosure	Controlled emission factor used

Source: EA 1999

- **Hardstand Areas/Road Haulage** – As noted in **Section 2.4.1**, the entire working surface of the Project Site will be sealed, with the remainder either landscaped or grassed, minimising the potential for dust generation from wind erosion on the site. The yard area near the loading and slumping points will usually be wetted down. In addition to this, staff will maintain a good standard of housekeeping by regularly hosing down the yard to remove the daily spillage of aggregates from the yard surface.

The *Emission Estimation Technique Manual for Concrete Batching* published by Environment Australia (EA 1999) states that watering (to eliminate dust) reduces fugitive particulate emissions from *unpaved* roads by 75%. The control technologies on *paved* roads can be a combination of preventative and mitigative controls. For example, covering load in trucks is an example of preventative measure, and vacuum sweeping, water flushing & broom sweeping are examples of mitigative measures. The actual control efficiencies of these controls when used on paved roads can be highly variable and there are no published control factors available for any of the control measures mentioned above.

In light of the preventative and mitigative measures noted in the Dust Management Plan (WA Premix 20011a) and the absence of any published control factors, a combined control factor of 50% for watering has been used, which is considered appropriate and conservative.

- **Temporary Overflow Storage Bins** – The proposed design of the aggregate storage bins (see **Figure 3**) will provide a wind break for particulate emissions due to wind erosion. In addition to the wind breaks, it is proposed that the aggregates will arrive in a dampened state from the quarry and will be maintained in a damp state at all times using a sprinkler system mounted on the inside of the aggregate storage bins. The proposed combination of control measures (enclosure on 2 or 3 walls in conjunction with water sprays) has been assumed to control the particulate emissions by up to 95% (DSEWPC, 2012)[2].

2.4.3 Summary of Emission Sources and Control Measures

Based on the information presented above, a summary of the emissions sources and the associated emission controls evaluated in this assessment is shown in **Table 3**. The methodology used to estimate these emissions and the subsequent emissions inventory are discussed in detail in **Section 7**.

[2] The combined control efficiency is multiplicative. For example, if water sprays (50%) are used in conjunction with enclosure (90%), the resultant emissions will be (1-0.5) x (1-0.9) = 0.05 of the uncontrolled emissions (95% efficiency).

Table 3 Summary of Identified Emission Sources and Assumed Emission Controls

Emission Source	Emission Type	Pollutants Modelled	Modelled Control Efficiency
Aggregate			
Trucks dumping aggregates (drive-over bins)	Material handling	TSP, PM_{10}	Covered on 3 sides + water sprays (95%)
Transfer of aggregates – drive over bins to overhead storage bins (bucket elevator)	Material handling	TSP, PM_{10}	Enclosure (99%)
Transfer of aggregates – overhead storage bins to conveyor	Material handling	TSP, PM_{10}	Enclosure with filtered dust extraction (99%)
Transfer of aggregates – conveyor to mixer	Material handling	TSP, PM_{10}	Enclosure (99%)
Road haulage (trucks)	Wheel generated dust	TSP, PM_{10}	Watering and street sweeper (50%)
Trucks dumping aggregates (temporary overflow storage bins)	Material handling	TSP, PM_{10}	Covered on 3 sides + water sprays (95%)
FEL on aggregates – temporary overflow storage bins to loading hopper	Material handling	TSP, PM_{10}	No control
FEL on aggregates – reclaimed aggregates from reclaimer to loading hopper[1]	Material handling	TSP, PM_{10}	No control
Road haulage (FEL)	Wheel generated dust	TSP, PM_{10}	Watering and street sweeper (50%)
Transfer of aggregates – loading hopper to overhead storage bins	Material handling	TSP, PM_{10}	Enclosure (99%)
Temporary overflow storage bins – wind erosion	Wind erosion	TSP, PM_{10}	Covered on 3 sides + water sprays (95%)
Cement			
Transfer of cement from cement trucks to cement silo (pneumatic conveying)	Material handling	TSP, PM_{10}	Controlled emission factor was used
Road haulage (trucks)	Wheel generated dust	TSP, PM_{10}	Watering and street sweeper (50%)
Product			
Mixer loading	Material handling	TSP, PM_{10}	Controlled emission factor was used
Road haulage	Wheel generated dust	TSP, PM_{10}	Watering and street sweeper (50%)

[1] Reclaimed aggregate are usually consist of very coarse material (diameter > 0.25 mm) and unlikely to give rise in TSP or PM_{10} emission. However this activity was included as a dust source as a conservative approach to include the potential of dust emissions with breaking down of coarse particles to finer particulates with the FEL operation.

2.5 Activity Rates

The plant is proposed to operate with an average production rate of 135 m³ per day.

Based on the production data at one of the region's busiest concrete batching plants at Bibra Lake which is owned by the Proponent, the maximum production rate from the proposed plant could be up to 500 m³ per day, however it is anticipated that this maximum production rate may only occur for one or two days in a year.

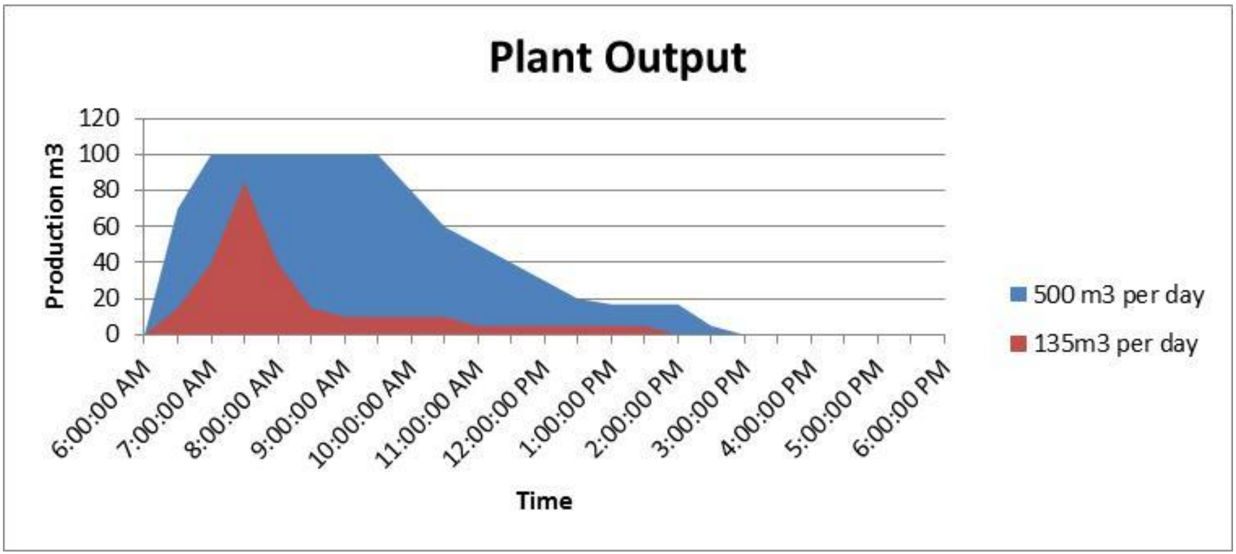
Based on the above information, for the purpose of this assessment, the following two operating scenarios have been assessed in this report.

- **Scenario 1** – Maximum Production (500 m³/day) – likely to occur 1-2 times per year; and
- **Scenario 2** – Average Production (135 m³/day) – likely to occur most of the time of the year.

It should be noted that for Scenario 1, it has been assumed that the plant will operate at this maximum capacity at every day of the year. Therefore care should be taken in interpreting the results for Scenario 1 as the plant is likely to operate at the maximum production rate for only 1-2 days of the year. The two scenarios are discussed in detail in **Section 7.1**.

A realistic daily schedule for the proposed CBP output is shown **Figure 4**. The plant production will peak in the early morning, gradually reducing and finishing between 2 pm to 3 pm. This is to accommodate for the 'on-demand' production of concrete.

Figure 4 Representative Daily Schedules for Maximum and Average Production Scenarios



Source: WA Premix 2011

2.6 Hours of Operation

Based on the information supplied by the Proponent, a summary of the hours of operation for each source within each scenario are presented in **Table 4**. It is noted that a number of the predicted activity rates have been altered from the original AQIA. Reference should be made to **Section 7** for the justification for these changes.

Table 4 Hours of Operation

Process	Scenario 1 (500 m^3/day)	Scenario 2 (135 m^3/day)	Number of days (per year)
Trucks dumping aggregates (drive over bins)	1.4	0.4	300
Transfer of aggregates – drive over bins to overhead storage bins (bucket elevator)	3.5	0.9	300
Transfer of aggregates – overhead storage bins to primary conveyor	4.5	1.2	300
Transfer of aggregates – primary conveyor to mixer	4.5	1.2	300
Road Haulage (aggregate trucks)	0.4	0.1	300
Trucks dumping aggregates (temporary overflow storage bins)	0.007	0.007	300
FEL on aggregates – temporary overflow storage bins to loading hopper	0.007	0.007	300
FEL on aggregates – reclaimed aggregates from reclaimer to loading hopper	0.3	0.1	300
Temporary overflow storage bins – wind erosion	24	24	365
Transfer of cement from cement tanker to silo (pneumatic conveying)	2.6	0.75	300
Transfer of cement from cement silo to cement hopper	5	1.4	300
Road haulage (cement tanker) (330 m per delivery @ 15 km/h)	0.4	0.1	300
Road haulage (agitator truck)	1.2	0.5	300

Notes: 1 The total number of days per year is estimated based on 25 days per month in a year.
2 For temporary overflow storage bins, it is assumed that the wind erosion will be occurring all the time.
3 Concurrent deliveries are possible and may occur on a high production day.

2.7 Raw Material Density

The raw material and product density data provided for the Project is shown in **Table 5**.

It is noted that a silt percentage (percentage <75 µm) for aggregate of 14% was adopted for the estimation of particulate emissions due to wind erosion, sourced from the aggregate test report for ‘dust’.

Table 5 Assumed Material Densities

Constituent	Density (g/cm^3)
Aggregate	2.75
Cement	3.15
Sand	2.6
Dust (<4 mm Aggregate)	1.2
Product (dry)	2.28

Source: WA Limestone

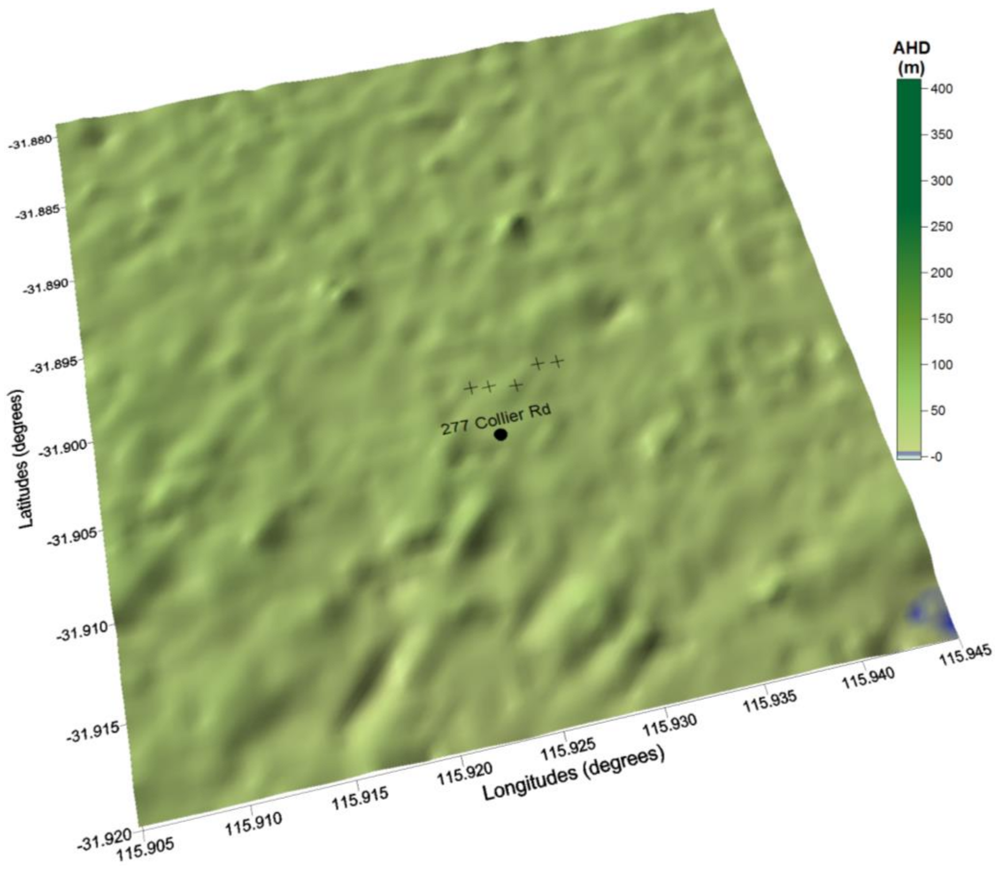
3 DESCRIPTION OF THE STUDY AREA

3.1 Local Topography

Figure 5 shows a topographical map of the region surrounding the Project Site compiled using data sourced from the United States Geological Service's Shuttle Radar Topography Mission database that has recorded topography across Australia with a 3 arc second (~90 m) spacing.

As shown in **Figure 5**, the land surrounding the site and the land between the site and sensitive receptors is dominated by flat terrain. It is therefore concluded that the topography of the region will have minimal effect on the dispersion of pollutants, and terrain effects have not been considered in the dispersion modelling (i.e. the modelling was performed assuming flat terrain).

Figure 5 Topographical Map of the Area Surrounding the Project Site



Note: Sensitive receptors represented by '+' sign.

3.2 Existing Project Site Condition

The land at the Project Site is currently covered by bush in the northern half of the plot, while the southern half (towards Collier Road) of the plot has a compacted limestone ground surface. The condition of the plot on 16 May 2012 is shown in **Figure 6**.

It has been advised that land at the Project Site was previously used as a bulk fuel depot. The fuel tanks and infrastructure have since been removed and there are understood to be no relevant legacy issues associated with the removed or existing infrastructure.

Figure 6 Picture Illustrating the Existing Site Condition (16 May 2012)

Note: This photo was taken from the northern end of the plot, looking towards Collier Road.

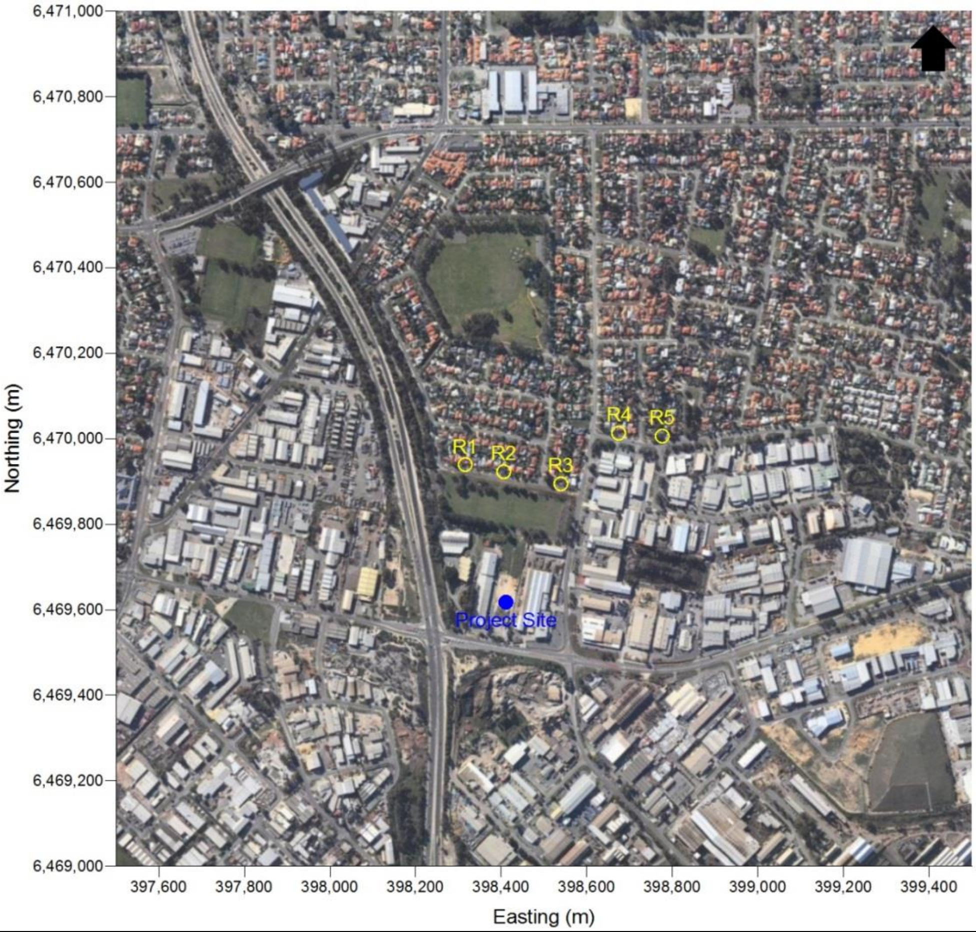
3.3 Sensitive Receptors

Sensitive receptors identified in the vicinity of the Project Site are shown in **Figure 7**, with the corresponding locations shown in **Table 6**. The Council of City of Bayswater has recommended a 300 metre (m) separation distance as a minimum buffer distance from all plant structures. It is noted that receptors R1, R2 and R3 are within the recommended 300 m separation distance from the Project Site. A full layout of the receptors showing the separation distances is provided in **Appendix B**.

Table 6 Locations of Identified Sensitive Receptors

Receptor	UTM Coordinates (m)		Elevation (m)
	Easting	Northing	
R1	398,315.8	6,469,938.7	27.2
R2	398,405.6	6,469,922.1	27.7
R3	398,538.8	6,469,894.8	27.5
R4	398,675.1	6,470,012.4	27.0
R5	398,775.5	6,470,005.5	25.9

Figure 7 Locations of Identified Sensitive Receptors



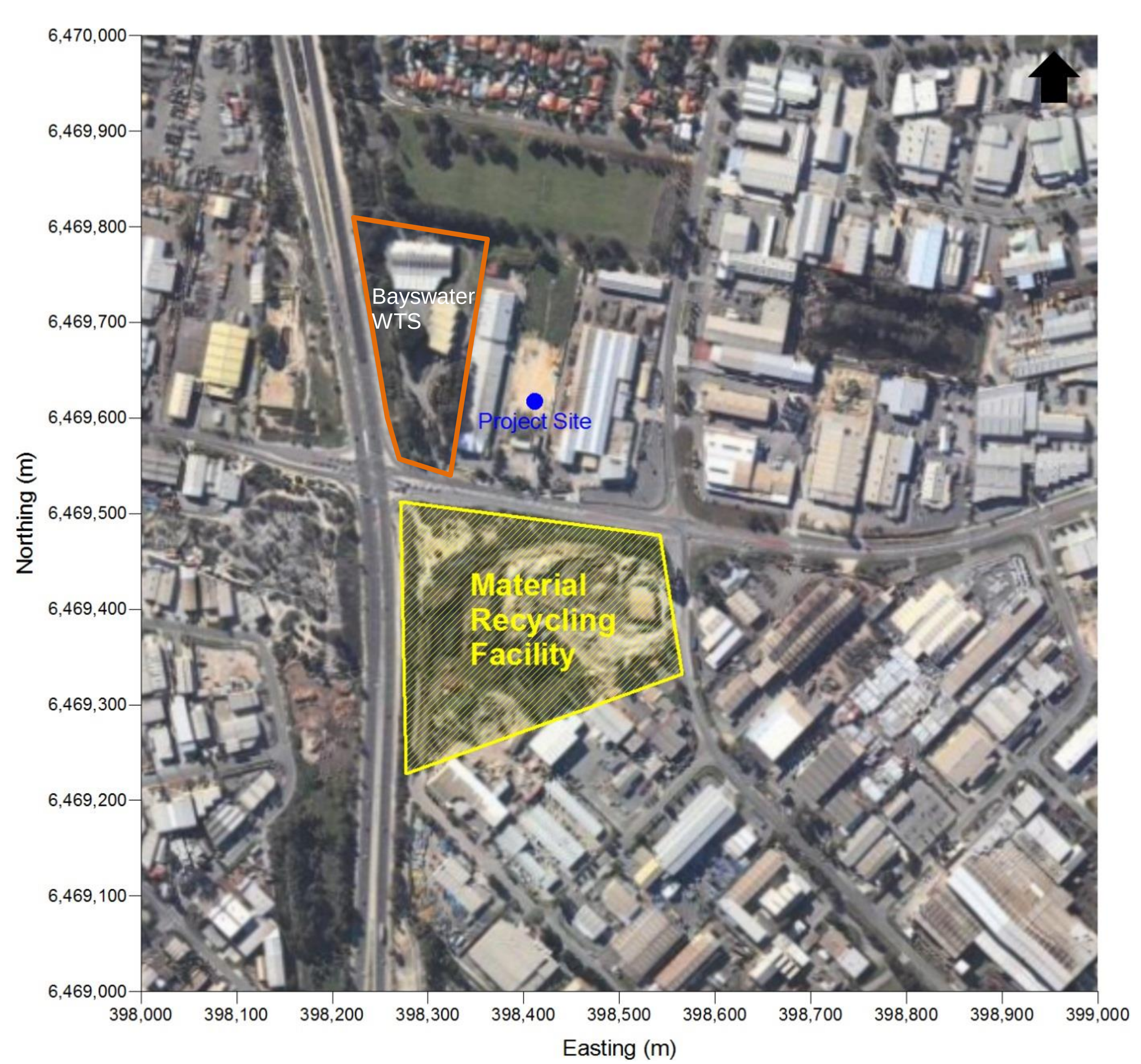
3.4 Background Sources of Particulate Matter

3.4.1 Local Sources

The Project Site is located in an industrial area where other industries are currently operational, and a number of the existing industrial sources will also emit the pollutants of interest identified for this assessment. Within the wider region of the Project Site and its surrounds, there are two existing concrete batching plants, located approximately 600 m southwest of the Project Site. Within the immediate neighbourhood, a waste transfer station (WTS) is located on the western side (corner of Tonkin Highway and Collier Road) of the Project Site and a building material recycling facility is located across Collier Road, to the south of the Project Site (shown as shaded area in **Figure 8**).

In order to capture the impact of particulate emissions from the other sites (particularly the ones identified in **Figure 8**) on air quality at the proposed Project Site and nearby sensitive receptors, a particulate monitoring campaign was conducted by SLR Consulting during the period April to July 2012 (SLR 2012). The results of this monitoring program have been used to ensure that the impacts of the identified background emission sources are considered within the background data used for this assessment. Further information is provided in **Section 6**.

Figure 8 Location of Existing Industries for Cumulative Assessment



3.4.2 Regional Sources

Concentrations of particulates can be elevated under certain naturally occurring conditions, such as bushfires or dust storms. Although these events are generally unusual, they do occur and in some instances can result in elevated ambient particulate concentrations for several days. These events can be identified through the use of a regional network of air quality monitors.

4 AIR QUALITY ASSESSMENT CRITERIA

4.1 Regulatory Framework

The Western Australian Department of Environment Regulation (DER) routinely adopts ambient air quality goals in the assessment of new proposals, and in the management of both local and regional ambient air quality.

The only legislated criteria for particulate matter in Western Australia are those contained in the *Kwinana Environmental Protection Policy* (Kwinana EPP) (WA EPA, 1999). The original Kwinana EPP was formed in 1992 to maintain acceptable air quality. The Kwinana EPP was formally reviewed in 1999 and re-issued unchanged.

It is noted that the proposed Project Site is not in the region covered by the Kwinana EPP.

With the exception of the region covered by the Kwinana EPP, as a matter of general policy, the DER has adopted the goals set out in the *National Environment Protection Measure for Ambient Air Quality*. Adopting the Ambient Air NEPM goals is an interim approach while the DEC, in conjunction with the Department of Health, develops ambient air quality guidelines for WA. In the absence of an Ambient Air NEPM standard, the WA DER will adopt the World Health Organisation (WHO) Guidelines for Air Quality (2000) which was updated in 2005. In the absence of a NEPM standard or a WHO guideline, the DEC will adopt goals from another jurisdiction (once it has been assessed and determined to be applicable to the WA context).

4.1.1 National Environment Protection Measure for Ambient Air Quality

The National Environment Protection Council (NEPC) is a national ministerial body which makes national environment protection measures to ensure that Australians have equivalent protection from air, water, soil and noise pollution. National Environment Protection Measures (NEPMs) are broad framework-setting statutory instruments defined in the National Environment Protection Council (NEPC) legislation. They outline agreed national objectives for protecting or managing particular aspects of the environment.

In June 1998, the National Environment Protection Council (NEPC) of Environment Ministers agreed to set uniform standards and goals for ambient levels of “criteria pollutants” to apply to all States and Territories. These standards and goals are contained in the NEPM for Ambient Air Quality (hereafter referred to as the “Ambient Air NEPM”). The Ambient Air NEPM standards were developed by the NEPC with a goal that they were to be achieved within 10 years of commencement (i.e. 2008).

The relevant Ambient Air NEPM standards and goals applicable to this assessment are presented in **Table 7**.

Table 7 Ambient Air NEPM Standards and Goals for Relevant Pollutants

Pollutant	Averaging Period	Maximum Concentration	Maximum Allowable Exceedances
Particles as PM_{10}	24 hours	50 µg/m^3	5 days a year

On 31 July 2014, an Impact Statement for a Draft Variation to the Ambient Air NEPM, which evaluates the environmental, social and economic costs and benefits of meeting proposed standards for airborne particles, and a draft varied Ambient Air NEPM was released for public consultation. The changes to the PM_{10} and $PM_{2.5}$ standards proposed for consideration are summarised as follows:

- Based on the latest health findings, it is proposed to include an annual average standard for PM_{10} of 20 µg/m^3 in the Ambient Air NEPM.

- A review of current PM_{10} monitoring data and an economic analysis indicated that a tightening of the 24-hour standard for PM_{10} (currently 50 µg/m^3) could encourage future improvements in air quality. A change to a standard of 40 µg/m^3 was concluded to be possible, particularly in urban areas. However, as moving to the lower value could present some difficulties in certain jurisdictions, an alternative intermediate option of 45 µg/m^3 is also being considered. It is noted that the Impact Statement on the draft variation to the Ambient Air NEPM states that from a health and economic perspective it is advisable to place more emphasis on the annual mean standard than on the 24-hour standard.

In addition to the above changes, development of an exposure index based on monitoring to track population exposure within urban areas is also proposed.

As the draft Varied Ambient Air NEPM is still undergoing public consultation, the proposed new standard for PM_{10} has not been adopted for this assessment.

4.1.2 World Health Organisation Guidelines for Air Quality

The World Health Organisation (WHO) has published Air Quality Guidelines for Europe which address the effect of air pollution on human health and set an international standard for health based air quality guidelines. The WHO air quality guidelines are also being used as a starting point for the derivation of legally binding limit values in the European Union Air Quality Framework Directive and subsequent Daughter Directives, which have been amalgamated into Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe ("CAFE").

The WHO maximum 24-average goal for PM_{10} is 50 µg/m^3.

4.1.3 National Health and Medical Research Council

At their 92nd session in October 1981, the National Health and Medical Research Council (NHMRC), recommended an annual goal for Total Suspended Particulate Matter (or TSP) of 90 µg/m^3.

4.1.4 NSW Environment Protection Authority

The WA DEC does not specify recommended levels for dust deposition. In New South Wales, the Environment Protection Authority (EPA) sets dust deposition limits in the *Approved Methods for the Modelling and Assessment of Air Pollutants* (DEC, 2005). In Victoria, the Protocol for Environmental Management for Mining and Extractive Industry lists assessment criteria for nuisance dust (VIC EPA, 2007).

Table 8 presents the NSW EPA and VIC EPA impact assessment goals for nuisance dust, showing the allowable increase in dust deposition levels over the ambient (background) level which would be acceptable so that dust nuisance can be avoided.

Table 8 NSW EPA and VIC EPA Goals for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

Note: Assessed as insoluble solids as per AS 3580.1.1:2007

4.2 Criteria Adopted for Use in this Assessment

The air quality criteria adopted for use in this assessment are summarised below in **Table 9**.

Table 9 Criteria Adopted for this Assessment

Pollutant	Averaging Period	Criteria	Source
Particulate matter (as PM_{10})	24-hour	50 µg/m^3	Ambient Air NEPM[1]
Dust deposition [2,3]	Annual	2 g/m^2/month 4 g/m^2/month	NSW EPA
Total suspended particulates (TSP)	24-hour	150 µg/m^3	Kwinana EPP Area C[4]
	Annual	90 µg/m^3	NHMRC

Note (1) Ambient Air NEPM - maximum of 5 exceedances per year is permitted.
(2) Dust is assessed as insoluble solids as defined by AS 3580.10.1-1991.
(3) Note that 2 g/m^2/month relates to an incremental contribution to dust deposition (i.e. due to the proposed development). Cumulative levels are not to exceed 4 g/m^2/month.
(4) In absence of any available criteria in other jurisdictions, a 24-hour average TSP criterion of 150 µg/m³ from the Kwinana EPP Area C (Residential) was selected following the recommendation from Environmental Alliances (Environmental Alliances 2013).

4.3 Performance Criteria Imposed through Conditions

The matter DR 242 of 2011 contains a number of conditions relating to plant operation. Condition 6 states:

> *6 Activities associated with the use of Lot2 (Nos. 277-279) Collier Road, Bayswater (**Land**) shall not cause the concentration of particulate matter as PM_{10} at the location referred to in Condition 7(i), first dot point, to exceed:*
>
> *(a) 12.4 µg/m^3 as a 24-hour average on any day when the ambient concentration (inclusive of the contribution from emissions from the Land) exceeds 50 µg/m^3 of particulate matter as PM_{10} as a 24-hour average; or*
>
> *(b) 500 µg/m^3 as a 15-minute average.*

The purpose of this Condition is to enable the monitoring at the on-site monitoring stations to be used to control impacts in the neighbouring community.

Regarding Condition 6(a), the incremental PM_{10} concentration of 12.4 µg/m^3 (as a 24-hour average process-contribution concentration measureable at the on-site monitoring stations) was established in the SAT conferencing as a suitable proxy value that could be related to impacts at off-site receptor locations. This was established by the determination of the statistical relationship between:

1 the predicted maximum off-site incremental PM_{10} concentration (i.e. the location of the nearest sensitive receptor); and

2 the corresponding contemporaneous incremental PM_{10} concentration predicted at the on-site air quality monitoring stations.

Once this relationship between the predicted PM_{10} concentrations at those two locations was established, the corresponding factor could be applied to the maximum predicted off-site incremental impact of 4.6 µg/m^3 (SLR 2013a) to derive a corresponding value that would be applied to measurements at the on-site air quality monitoring stations on days when the total measured concentration exceeded 50 µg/m^3.

Regarding Condition 6(b), the value of 500 µg/m^3 (as a 15-minute average concentration measureable at the on-site air quality monitoring stations) was established to offer a control on short-term emissions that may lead to unacceptable plume visibility and nuisance complaints, and to enable a reactive control on emissions.

5 PREVAILING DISPERSION METEOROLOGY

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component.

The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness.

The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Oke, 2003; Sturman and Tapper, 2006).

Spatial variations and diurnal and seasonal changes in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales. Atmospheric processes at macro- and meso-scales need therefore be taken into account in order to accurately parameterise the atmospheric dispersion potential of a particular area.

Hourly meteorological data covering the period April 2012 to March 2013 were sourced from the nearby Caversham automatic weather station operated by the DEC (Department of Environment and Conservation). This observational dataset was used to generate a 1-year, hourly, site-representative meteorological file suitable for use in the AUSPLUME model. The modelling period of April 2012 to March 2013 was selected for the dispersion modelling study in order to be consistent with the available background pollutant data, and as agreed with Council

An analysis of the meteorological data used in this assessment is presented in the following sections.

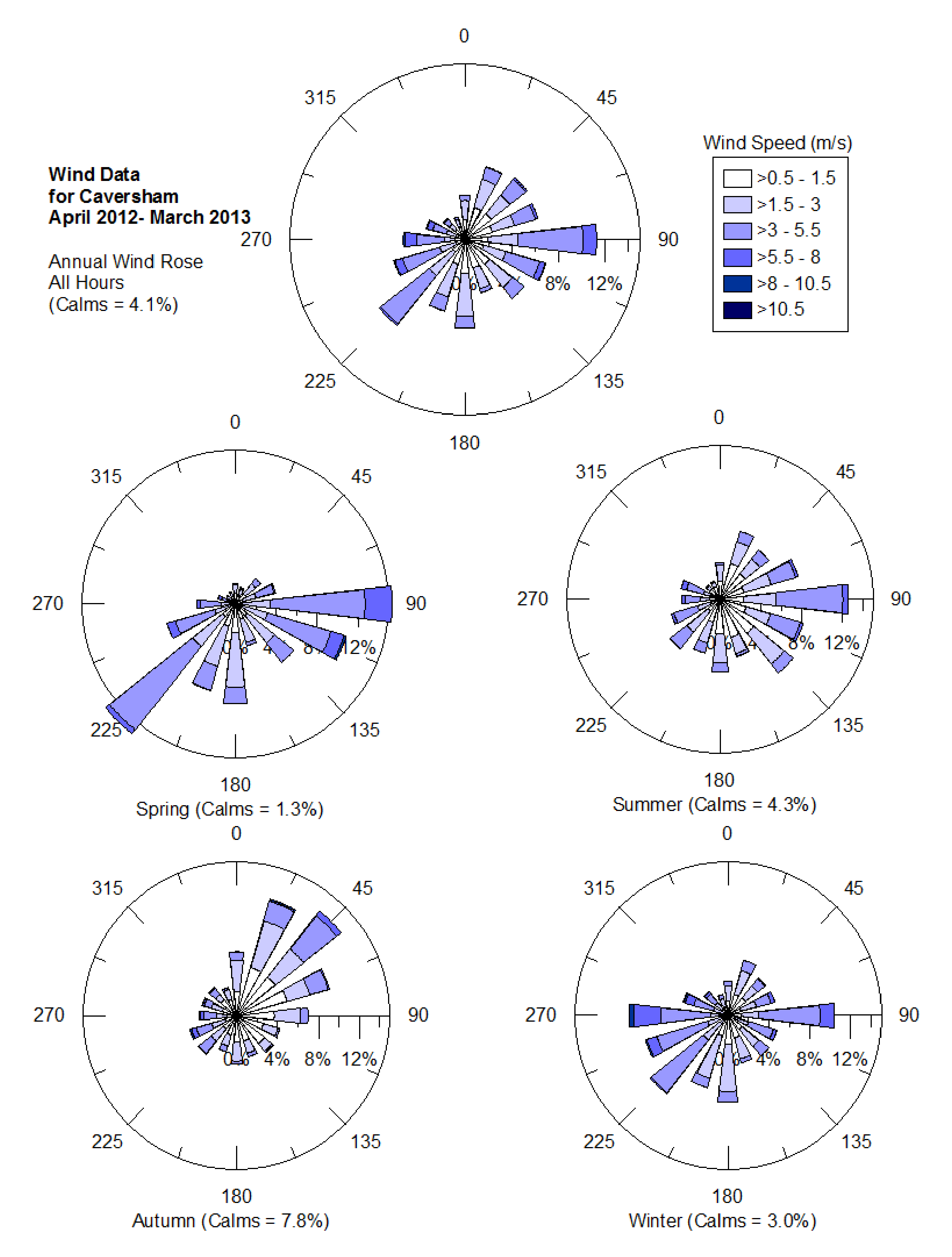
5.1 Wind Speed and Wind Direction

A summary of the annual wind behaviour is presented as wind roses in **Figure 9**. **Figure 9** indicates that winds experienced at the Project Site are predominantly light to moderate (between 1.5 m/s and 8 m/s) and from the eastern and southwestern quadrants. Calm wind conditions (wind speed less than 0.5 m/s) were recorded as occurring 4% of the time.

The seasonal wind roses indicate that typically:

- In summer, winds are light to moderate predominantly from the eastern quadrant (approximately 13%)
- In autumn, winds are light to moderate predominantly from the north-eastern quadrant (approximately 13%).
- In winter, winds are light to moderate and are experienced predominantly from the west - southwest quadrant (approximately 12% combined) with approximately 10% time of winds from the eastern quadrant.
- In spring, winds are light to moderate predominantly from eastern quadrant (approximately 16%) combined) with 17% of time from southwest quadrant.

Figure 9 Wind Roses for the Project Site



5.2 Atmospheric Stability

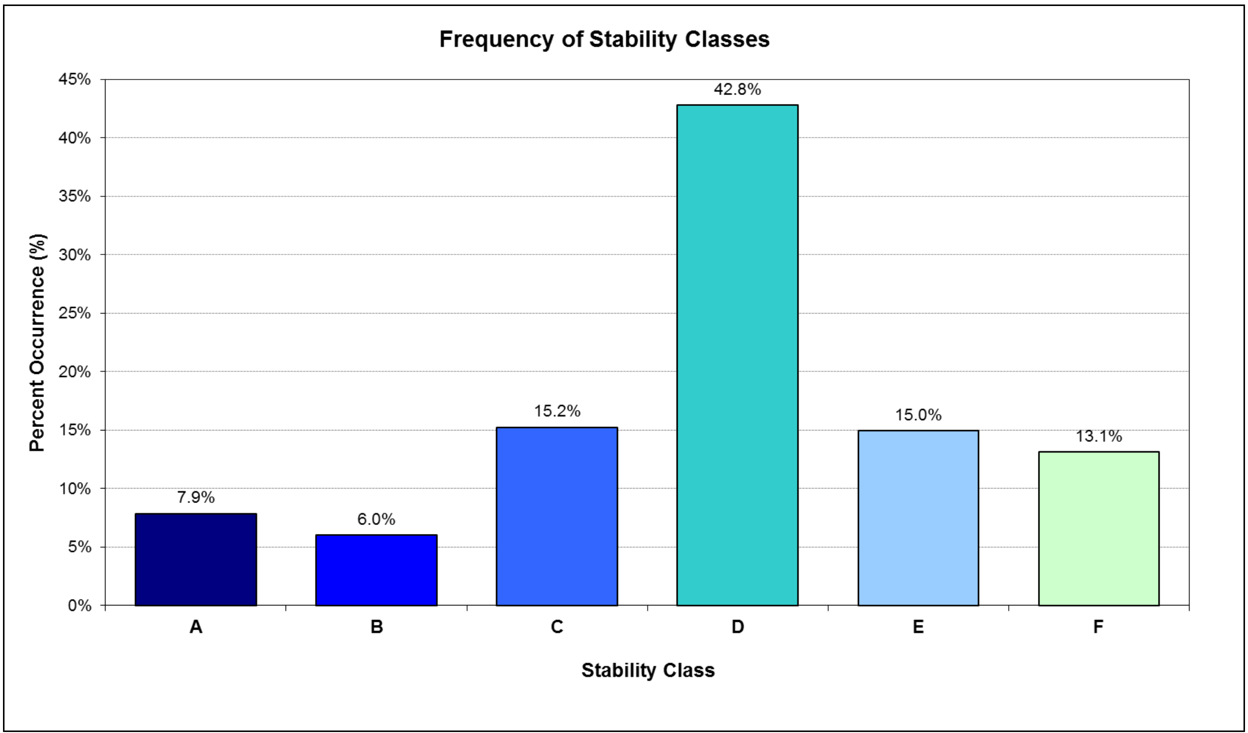
Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability. These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models. A description of the atmospheric stability classes is shown in **Table 10**.

The frequency of each stability class for each hour was calculated following the USEPA turbulence based method (σ_A method of USEPA, 2000) and using measured 5 minute average sigma theta data recorded at Caversham and a surface roughness of 0.5 m. The distribution of stability class is shown in **Figure 10**. The results indicate a high frequency of conditions typical to Stability Class D.

Table 10 Description of Atmospheric Stability Classes

Atmospheric Stability Class	Category Description
A	Very unstable Low wind, clear skies, hot daytime conditions
B	Unstable Clear skies, daytime conditions
C	Moderately unstable Moderate wind, slightly overcast daytime conditions
D	Neutral High winds or cloudy days and nights
E	Stable Moderate wind, slightly overcast night-time conditions
F	Very stable Low winds, clear skies, cold night-time conditions

Figure 10 Stability Class Distribution



6 EXISTING AIR ENVIRONMENT

The existing air quality at the Project Site was quantified using data gathered from a baseline ambient air quality monitoring program conducted by SLR.

6.1 Baseline Air Quality Monitoring Program

As outlined in **Section 3.4.1**, a baseline monitoring program was implemented by SLR Consulting over the period April 2012 to April 2012 (SLR 2012).

SLR Consulting was commissioned by WA Limestone to install and maintain an Air Quality Monitoring Station (AQMS) equipped with a Tapered Element Oscillating Microbalance (TEOM), a High Volume Air Sampler (HVAS) and an on-site weather station. The AQMS was located within the boundary of the Project Site, at the northern end of the site and operated for a one year period. In addition, four dust deposition gauges (DDGs) were installed along the boundary of the Project Site and operated for a four month period.

The locations of the AQMS and the dust gauges are shown in **Figure 11**.

Figure 11 Locations of the AQMS and Dust Deposition Gauges

Source: Google Earth

6.1.1 Dust Deposition Levels

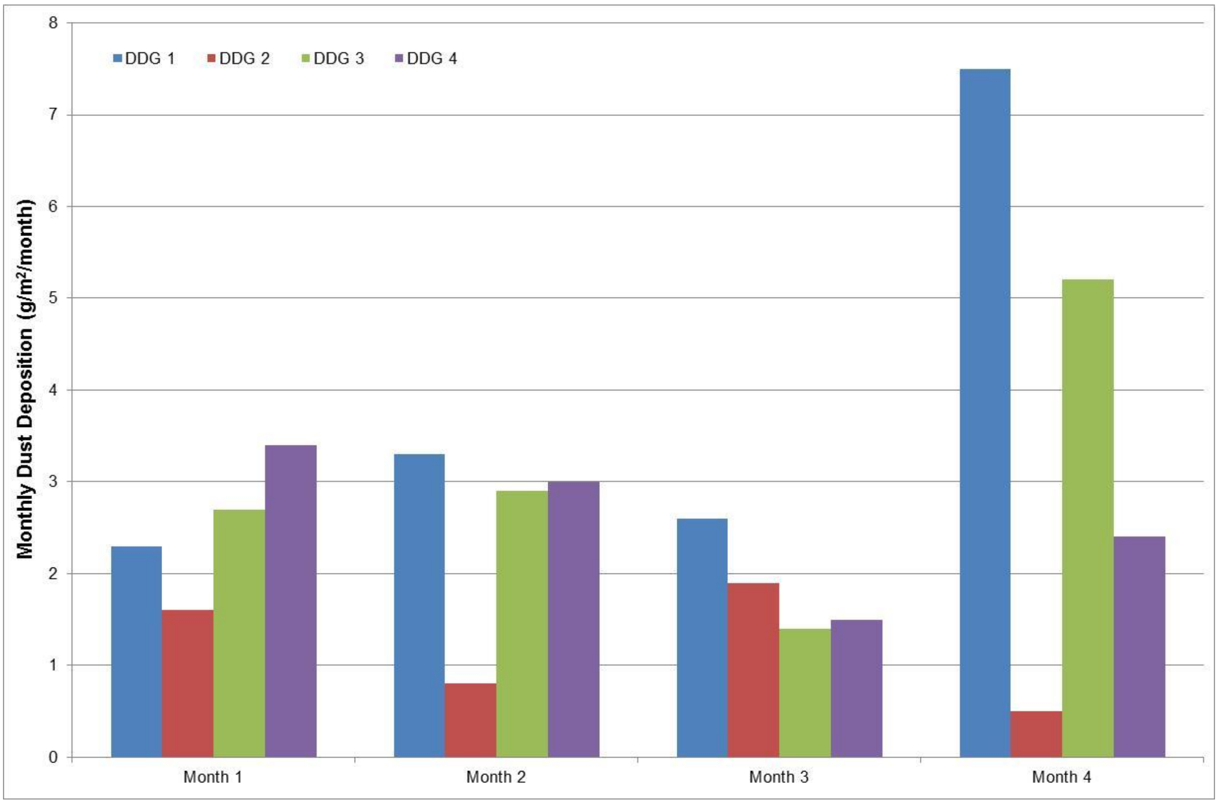
A summary of the dust deposition monitoring results are listed in **Table 11** and shown in **Figure 12**. The overall average dust deposition rate for the Project Site was measured to be 2.7 g/m^2/month.

The average background dust deposition rate should be determined from annual average dust deposition results. In the absence of any other data, however, the average across all four DDGs recorded during the four-month monitoring campaign (2.7 g/m^2/month) has been adopted as the background dust deposition for the purposes of assessing potential cumulative impacts.

Table 11 Summary of Dust Deposition Monitoring Results – 14 March to 6 July 2012

Monitoring Period	Number of Days	Total Insoluble Solids (g/m^2/month)			
		DDG 1	DDG 2	DDG 3	DDG 4
14 March 2012 to 12 April 2012 (Month 1)	29	2.3	1.6	2.7	3.4
12 April 2012 to 09 May 2012 (Month 2)	28	3.3	0.8	2.9	3.0
09 May 2012 to 06 June 2012 (Month 3)	28	2.6	1.9	1.4	1.5
06 June 2012 to 06 July 2012 (Month 4)	30	7.5	0.5	5.2	2.4
Average	--	3.9	1.2	3.0	2.6

Figure 12 Summary of Dust Deposition Monitoring Results – 14 March to 6 July 2012



6.1.2 Air Quality Monitoring Station (AQMS)

The AQMS was equipped with:

- a TEOM for the measurement of background 24-hour average PM_{10} concentrations; and
- a HVAS for the measurement of background 24-hour average TSP concentrations (1-in-6 day cycle).

A summary of the AQMS monitoring results recorded over the year ending 6 April 2013 is provided in **Table 12**. The measured 24-hour average ambient PM_{10} and TSP concentrations are presented in **Figure 13** and **Figure 14**

Figure 13 On-Site PM_{10} Ambient Monitoring Data (TEOM) for Year Ending April 2013

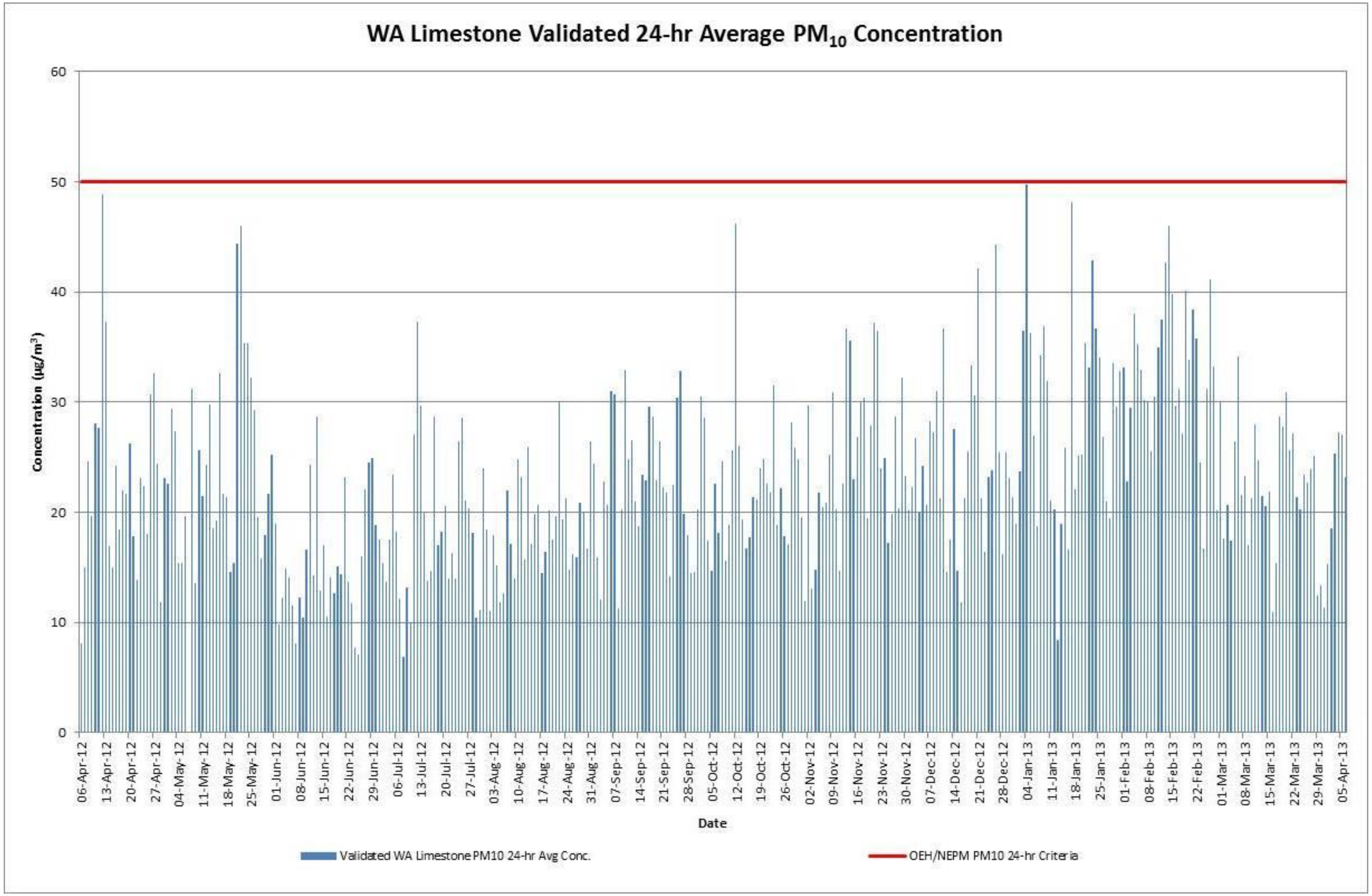


Figure 14 On-Site TSP Ambient Monitoring Data (HVAS) for Year Ending April 2013

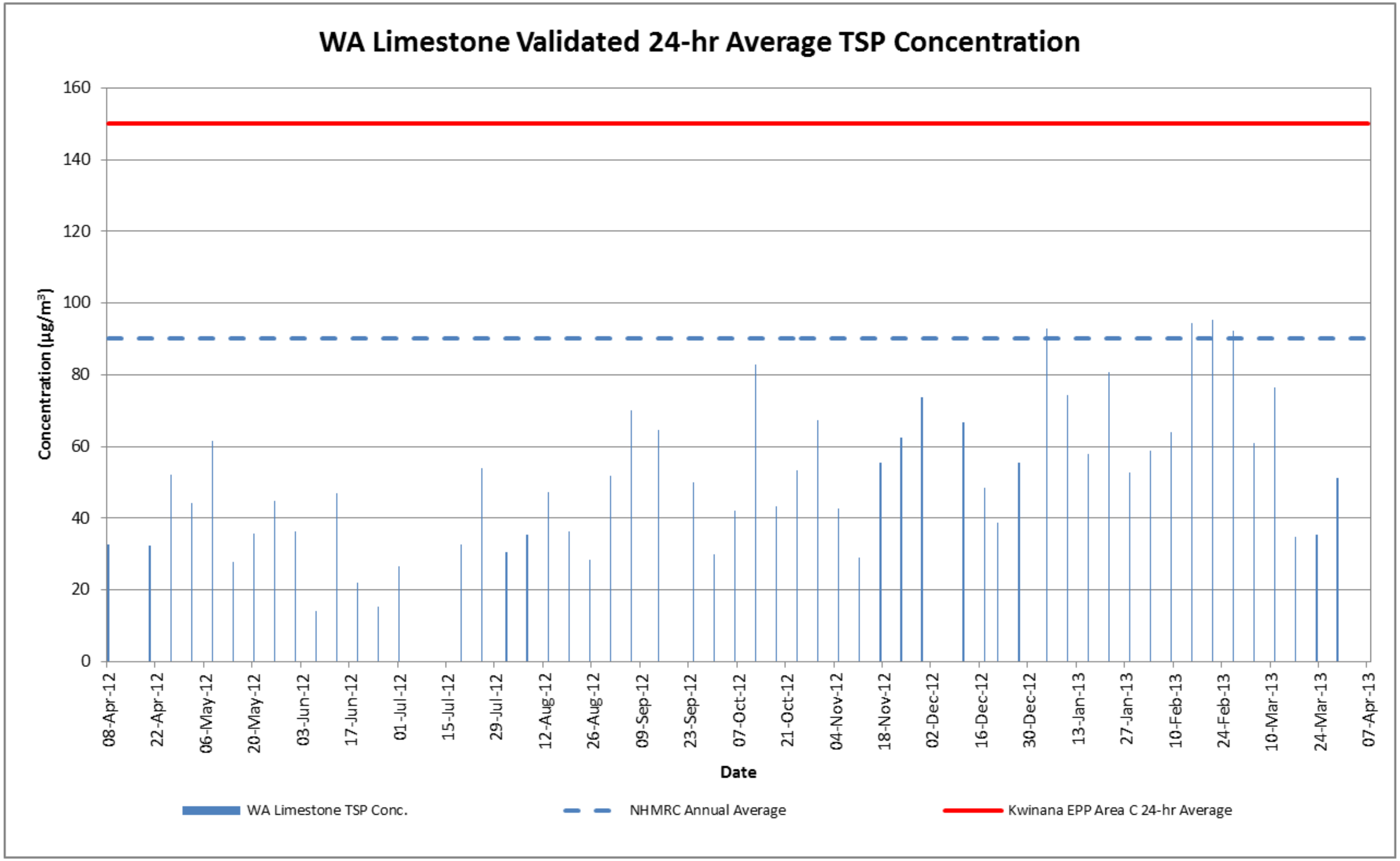


Table 12 Summary of the AQMS Monitoring Results – Year Ending 6 April 2013

Pollutant	Monitoring Method	Concentration (µg/m³)	
		Maximum 24-Hour Average	Annual Average
PM_{10}	Continuous with TEOM	49.7	23.1
TSP	1-in-6 day cycle with HVAS	95.2	51.0

6.1.3 Daily Varying TSP Concentration for Cumulative Assessment

As discussed in **Section 6.1.2**, ambient TSP concentrations were recorded by the AQMS on a 1 in 6 day cycle using a HVAS. However, daily varying background TSP concentration data are required to assess the potential cumulative 24-hour average TSP concentrations. To estimate daily varying ambient TSP concentrations for the study area, the following relationship was developed based on the available measured ambient PM_{10} and TSP concentration data, as presented in **Figure 15**.

$$Conc_{TSP} = 1.9761 \times Conc_{PM10} + 2.5854$$

A comparison of the calculated background TSP concentration using the above relationship and available measured background TSP concentration data is presented in **Figure 16**.

Figure 15 Scatter plot of the 24-hour Average PM_{10} and TSP Monitoring Data

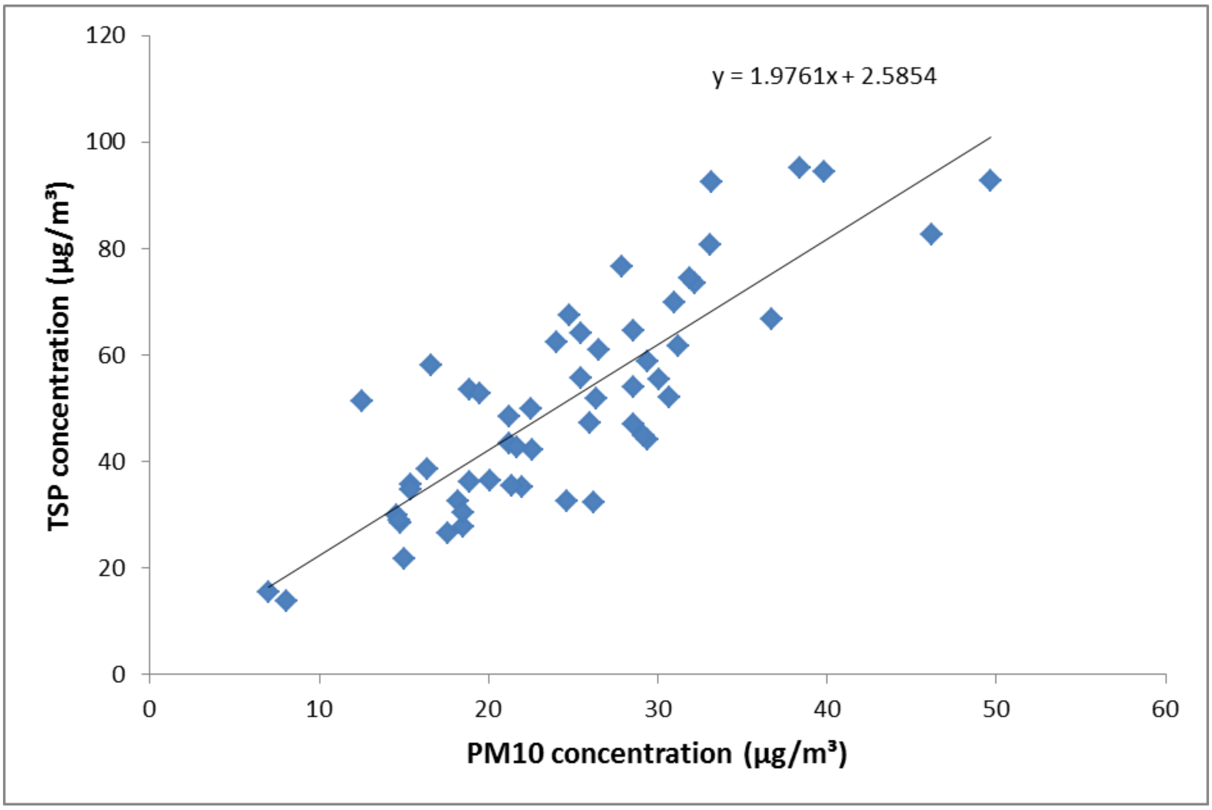
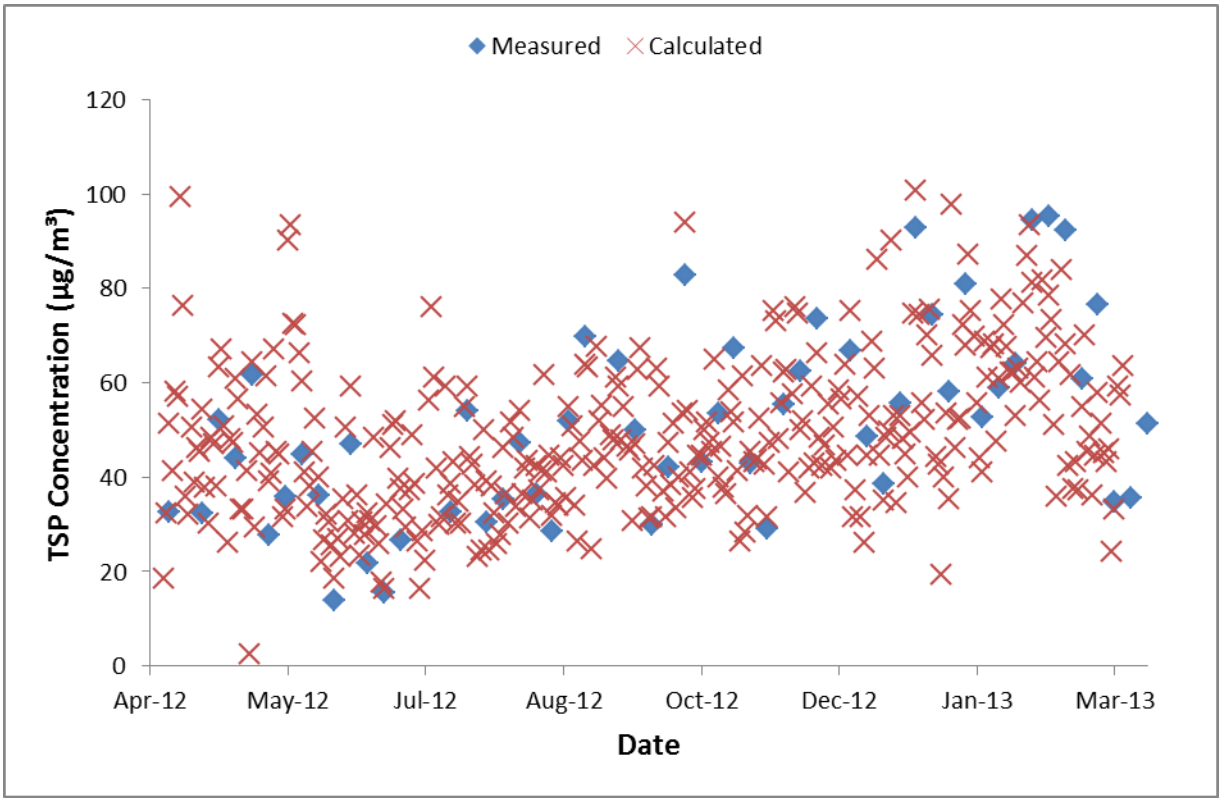


Figure 16 Comparison of Calculated and Available Measured Ambient TSP Concentration



6.2 Background Air Quality Used for Assessment Purposes

For the purposes of this assessment, background air quality concentrations/levels have been adopted as presented in **Table 13**.

Table 13 Background Air Quality used for Assessment Purposes

Air Quality Parameter	Concentration/Level	Notes	Data Source
Dust Deposition	2.7 g/m^2/month (4-month average)	As measured	Site-specific data
TSP	Daily varying (24-hour average)	Calculated[1]	Site-specific data
	51.0 µg/m^3 (annual average)	As measured	Site-specific data
PM_{10}	Daily varying (24-hour average)	As measured	Site-specific data

[1]Daily varying TSP concentrations were calculated based on the PM_{10} and TSP relationship derived from the monitoring data as presented in **Section 6.1.3**.

7 ESTIMATION OF EMISSIONS

Particulate emissions from the proposed CBP have been calculated using default emission factors for the relevant emission sources. Emission factors were sourced from the US EPA AP-42 Emission Factor Handbook (US EPA, 2006), supplemented with relevant control efficiencies from the National Pollutant Inventory *EETM for Concrete Batching* (EA 1999).

7.1 Scenarios Assessed

As discussed in **Section 2.5**, to effectively assess the impacts due to proposed operations of the Project, the proposed activities have been assessed using two operational scenarios:

- Scenario 1 – worst case impacts reflecting the maximum production; and
- Scenario 2 – worst case impacts reflecting the average production.

7.2 Emission Estimation Techniques (EETs)

A list of the emission sources included in the operational scenarios is provided in **Table 3**. The emission factors used for the estimation of TSP and PM_{10} emissions from each source type are presented in **Table 14**.

7.3 Site Activity Data

Operational phase air quality impacts associated with the proposed operation of the Project Site are anticipated to be dominated by the emissions of particulate matter (which might be experienced as TSP and PM_{10}). Those emissions will potentially be associated with the following activities:

- Activities associated with the aggregate handling:
  - Trucks dumping aggregate;
  - FEL on aggregate at overflow storage bins and reclaimer;
  - Transfer points at loading hopper, mixer, bucket elevator and overhead storage bins;
  - Road haulage within the site (paved roads); and
  - Wind erosion.
- Activities associated with cement handling:
  - Transfer point for incoming cement (pneumatic conveyor);
  - Transfer point below cement silo;
  - Transfer point at the mixer; and
  - Road haulage within the site (paved roads).
- Activities associated with product dispatch:
  - Road haulage within the site (paved roads).

Table 15 lists the activity data used to estimate the particulate emissions from material handling activities during proposed operations at the Project site.

Table 14 Summary of Emission Factors Used to Estimate Emissions

Activity	Emission Factor Equation	Units	Source	Variables	Controls Applied
Aggregate					
Trucks dumping aggregate	$EF_{TSP} = 0.0035$ $EF_{PM10} = 0.0017$	kg/t	USEPA 2006	-	Water Sprays - (50%)
FEL on aggregate	$EF_{TSP} = 0.0035$ $EF_{PM10} = 0.0017$	kg/t	USEPA 2006	-	No Controls
Transfer points	$EF_{TSP} = 0.0035$ $EF_{PM10} = 0.0017$	kg/t	USEPA 2006	-	Enclosed – 99% (EA 1999)
Road haulage within the site (paved roads)	$EF_{TSP} = 3.23 \times sL^{0.91} \times W^{1.02}$ $EF_{PM10} = 0.62 \times sL^{0.91} \times W^{1.02}$	kg/VKT	USEPA 2006	sL = road surface silt loading (12 g/m^2) W = average weight of vehicles travelling on the road (25.9 t)	Watering (50%)
Wind erosion[1]	$EF_{TSP} = 1.9 \times \left(\frac{s}{1.5}\right) \times 365 \times \left(\frac{365-p}{235}\right) \times \left(\frac{f}{15}\right)$ $EF_{PM10} = 0.5 \times EF_{TSP}$	kg/ha/day	USEPA 2006	s = silt content (14 %) p = number of rain days (>0.25mm) f= percentage of time when wind speed >5.4m/s	Enclosure (3 walls) in conjunction with Water Sprays - (95%) (EA 1999)
Cement					
Transfer point for incoming cement (pneumatic conveyor)	$EF_{TSP} = 0.00050$ $EF_{PM10} = 0.00017$	kg/t	USEPA 2006	-	Controlled emission factor used
Road haulage within the site (paved roads)	$EF_{TSP} = 3.23 \times sL^{0.91} \times W^{1.02}$ $EF_{TSP} = 0.62 \times sL^{0.91} \times W^{1.02}$	kg/VKT	USEPA 2006	sL = road surface silt loading (12 g/m^2) W = average weight of vehicles travelling on the road (25.9 t)	Watering (50%)
Product					
Mixer Loading (Central Mix)	$EF_{TSP} = 0.0092$ $EF_{PM10} = 0.0028$	kg/t	USEPA 2006	-	Controlled emission factor used
Road haulage within the site (paved roads)	$EF_{TSP} = 3.23 \times sL^{0.91} \times W^{1.02}$ $EF_{TSP} = 0.62 \times sL^{0.91} \times W^{1.02}$	kg/VKT	USEPA 2006	sL = road surface silt loading (12 g/m^2) W = average weight of vehicles travelling on the road (14.5 t)	Watering (50%)

[1]Silt percentage for aggregate was adopted for the estimation of particulate emissions due to wind erosion. A silt percentage of 14% was used, sourced from the aggregate test report for 'Dust', issued by Mining & Civil Geotest Pty Ltd – Aggregate test report, number 60003-P08/1950.

Table 15 Site Activity Data

Parameter	Scenario 1 (500 m^3/day)	Scenario 2 (135 m^3/day)	Units
General			
Number of days of operation	300[1]	300[1]	days/year
Total product throughput	500	135	m^3/day
Aggregate			
Aggregate transfer throughput – Truck tipping into drive over bins	600	600	tonnes/hour
Aggregate transfer throughput - Drive over underground bins → overhead storage bins (bucket elevator)	274	274	tonnes/hour
Aggregate transfer throughput – Overhead storage bins → conveyor	205	205	tonnes/hour
Aggregate transfer throughput – Conveyor → Mixer	205	205	tonnes/hour
Aggregate transfer throughput – FEL overflow storage bins → loading hopper	274	274	tonnes/hour
Aggregate transfer throughput – FEL reclaimed aggregates from reclaimer → loading hopper → overhead storage bins	195	195	tonnes/hour
Number of truckloads of aggregate needed	16.6	4.5	movements/day
Quantity of reclaimed aggregates produced	35.2	9.5	tonnes/day
Distance travelled within site – aggregate delivery	330	330	metres/load
Quantity of aggregates tipped into overflow storage bins	27.5	27.5	tonnes/day
Number of FEL movements - emptying overflow storage bins	4	4	movements/day
Distance travelled within site – FEL emptying overflow storage bins	30	30	metres/load
Number of FEL movements - transfer reclaimed aggregates from reclaimer → loading hopper	14.7	4	movements/day
Distance travelled within site – FEL transferring reclaimed aggregates → loading hopper	80	80	metres/load
Drive over underground transfer bin capacity	72	72	m^3
Overhead storage bin capacity	1150	1150	m^3
Total overflow storage bin capacity	80	80	m^3
Weighted mean of aggregate delivery fleet weight	55.9	55.9	tonnes
Cement			
Cement transfer throughput – tanker → silo	60	60	tonnes/hour
Cement transfer throughput – silo (via screw auger) → mixer	90	90	tonnes/hour
Number of truckloads of cement needed	2.8	0.8	movements/day
Distance travelled within site – cement delivery	330	330	m/delivery
Weighted mean of cement delivery truck weight	49	49	tonnes
Product			
Number of agitator truckloads	100	31	movements/day
Distance travelled within site – Agitator truck (per load)	165	165	m/load
Weighted mean of agitator trucks	14.5	14.5	tonnes

7.4 Emissions Inventory

The particulate emission inventory for all expected operations at the Project Site during Scenario 1 (highly conservative maximum throughput of 500 m^3/day) is shown in **Table 16** and **Figure 17**.

The particulate emission inventory for all expected operations at the Project Site during Scenario 2 (anticipated throughput of 135 m^3/day) is shown in **Table 17** and **Figure 18**.

A detailed emissions inventory is provided in **Appendix C**.

Table 16 Emissions Inventory for the Proposed Operations – Scenario 1 (500 m^3/day)

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)
Aggregate		
Truck dumping aggregates - drive over bins	44.1	21.4
Transfer of aggregates - drive over bins to overhead storage bins	10.1	4.9
Transfer of aggregates - overhead storage bins to conveyor	9.7	4.7
Transfer of aggregates - conveyor to mixer	9.7	4.7
Trucks dumping aggregates - temporary overflow storage bins	1.4	0.7
FEL on aggregates - temporary overflow storage bins to loading hopper	28.9	14.0
FEL on aggregates - from reclaimer to loading hopper	61.4	29.8
Transfer of aggregates - loading hopper to overhead storage bins	10.1	4.9
Road haulage - trucks	440.8	84.6
Road haulage - FEL emptying overflow storage bins	12.9	0.5
Road haulage - FEL transferring reclaimed aggregates	83.6	16.1
Temporary overflow storage bins - wind erosion	3.4	1.7
Subtotal (aggregate)	***716.1***	***188.0***
Cement		
Transfer point for incoming cement (pneumatic conveyor)	23.4	8.0
Road haulage within the site (paved roads)	65.7	12.6
Subtotal (cement)	***89.1***	***20.6***
Product		
Product mixing (Central Mix)	3,146.4	957.6
Road haulage within the site (paved roads)	1,173.4	225.2
Subtotal (product)	***4,319.8***	***1,182.8***
TOTAL	***5,125.0***	***1,391.4***

Table 17 Emissions Inventory for the Proposed Operations – Scenario 2 (135 m^3/day)

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)
Aggregate		
Truck dumping aggregates - drive over bins	12.6	6.1
Transfer of aggregates - drive over bins to overhead storage bins	2.6	1.3
Transfer of aggregates - overhead storage bins to conveyor	2.6	1.3
Transfer of aggregates - conveyor to mixer	2.6	1.3
Trucks dumping aggregates - temporary overflow storage bins	1.4	0.7

Emission Source	TSP Emissions (kg/year)	PM_{10} Emissions (kg/year)
FEL on aggregates - temporary overflow storage bins to loading hopper	28.9	14.0
FEL on aggregates - from reclaimer to loading hopper	20.5	9.9
Transfer of aggregates - loading hopper to overhead storage bins	2.6	1.3
Road haulage - trucks	104.6	20.1
Road haulage - FEL emptying overflow storage bins	12.9	0.5
Road haulage - FEL transferring reclaimed aggregates	22.8	4.4
Temporary overflow storage bins - wind erosion	3.4	1.7
Subtotal (aggregate)	***217.5***	***62.6***
Cement		
Transfer point for incoming cement (pneumatic conveyor)	6.8	2.3
Road haulage within the site (paved roads)	18.8	3.6
Subtotal (cement)	***25.6***	***5.9***
Product		
Product mixing (Central Mix)	229.5	69.9
Road haulage within the site (paved roads)	363.7	69.8
Subtotal (product)	***593.2***	***139.7***
TOTAL	***836.2***	***208.0***

Figure 17 Source Contribution Analysis for Proposed Operations – Scenario 1 (500 m^3/day)

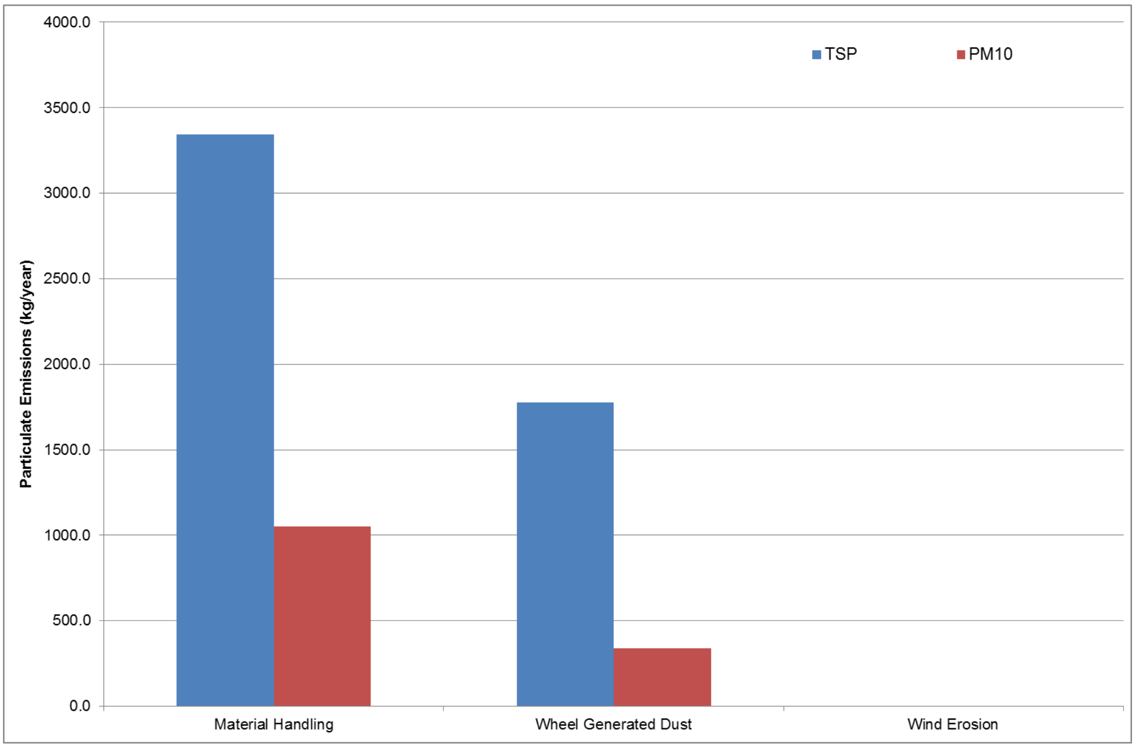
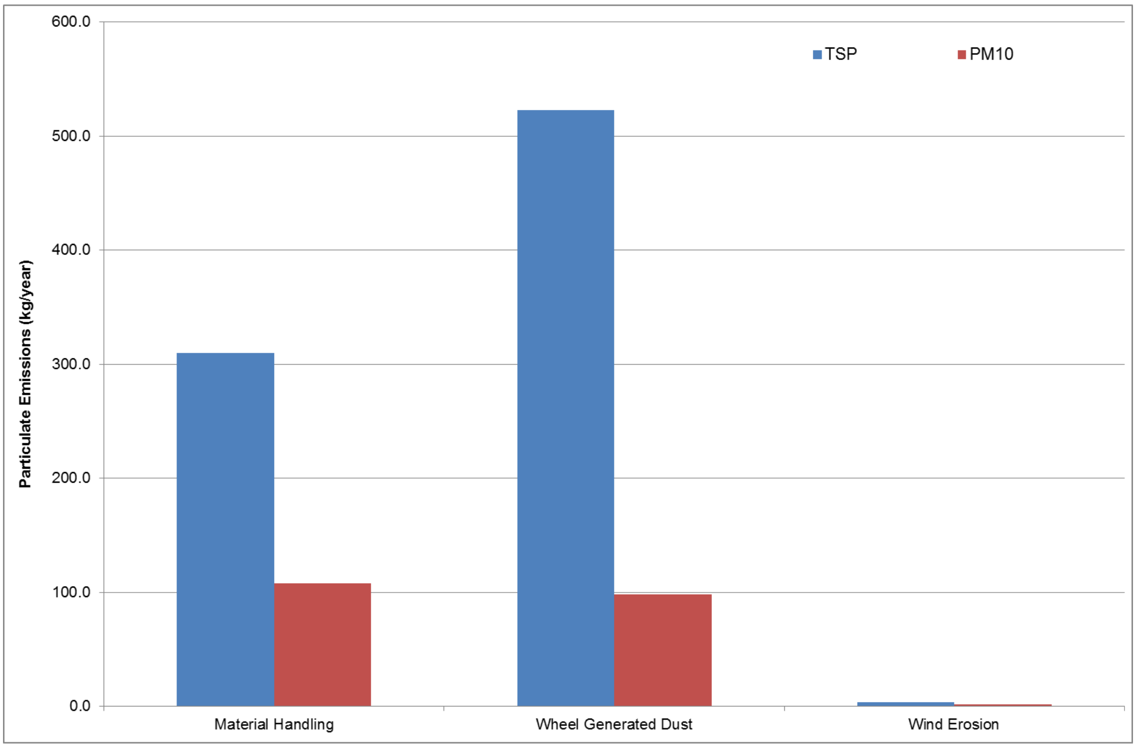


Figure 18 Source Contribution Analysis for Proposed Operations – Scenario 2 (135 m^3/day)



7.5 Modelling Parameters

Dispersion modelling parameters used in the AUSPLUME model are summarised in **Table 18**.

Table 18 Dispersion Modelling Parameters and Assumptions

Parameter	Modelled
Number of operating hours	10 hours/day
Number of days of operation	Every day of the modelling period
Particle Density	1 g/cm³
Surface roughness	0.4
Topography	Flat
Particle fraction	49% > 10 µm (avg dia 17.3 µm) 17% 6-10 µm (avg dia 8 µm) 19% 2.5 - 6 µm (avg dia 4.25 µm) 15% 2.5 µm (avg dia 1 µm)
Other parameters	Default options in AUSPLUME

8 ATMOSPHERIC DISPERSION MODELLING RESULTS AND DISCUSSION

8.1 Dust Deposition

Table 19 shows the results of the dispersion modelling for dust deposition from the Project Site at each of the identified receptors using the emission rates calculated in **Section 7**. Contour plots of the incremental increase in dust deposition are also presented in **Appendix D** for Scenario 1 and Scenario 2.

Table 19 Predicted Annual Average Dust Deposition Rates

Receptor ID	Annual Average Dust Deposition Rate (g/m²/month)				
	Background	Scenario 1 (500 m³/day)		Scenario 2 (135 m³/day)	
		Increment	Cumulative	Increment	Cumulative
R1	2.7	<0.1	<2.8	<0.1	<2.8
R2	2.7	<0.1	<2.8	<0.1	<2.8
R3	2.7	<0.1	<2.8	<0.1	<2.8
R4	2.7	<0.1	<2.8	<0.1	<2.8
R5	2.7	<0.1	<2.8	<0.1	<2.8
Criteria		**2.0**	**4.0**	**2.0**	**4.0**

The results indicate that incremental and cumulative annual average dust deposition rates at all nominated residences/properties surrounding the Project Site are predicted to be well below the criterion of 2 g/m^2/month (incremental increase in dust deposition) and below 4 g/m^2/month (cumulative dust deposition) during Scenario 1 and Scenario 2. As the nominated residences/properties were chosen as being indicative of all surrounding residences/properties, it can be concluded that cumulative dust deposition levels at residences/properties surrounding those modelled would also be below the relevant criterion of 4 g/m^2/month for the two scenarios.

8.2 Particulate Matter (as TSP)

8.2.1 24-Hour Averages

Table 20 and **Table 21** present summaries of the maximum 24-hour average TSP concentrations predicted at each of the identified receptors by the modelling of the proposed CBP operations, using the emission rates calculated in **Section 7**. Calculated background TSP concentrations presented in **Section 6** were used to assess the cumulative 24-hour average TSP impact at the representative sensitive receptor locations. Contour plots of the incremental increase in maximum 24-hour average TSP concentrations are also presented in **Appendix D** for Scenario 1 and Scenario 2

Table 20 presents the following information for each scenario

- Date: Day of occurrence of maximum incremental (contribution from the project only) 24-hour average TSP concentration
- Maximum Increment: Maximum incremental 24-hour average TSP concentration
- Background: Measured ambient monitoring concentration on the day of predicted maximum incremental 24-hour average TSP concentration
- Cumulative: Calculated cumulative (background + contribution from the project) 24-hour average TSP concentration

Table 21 presents the following information for each scenario

- Date: Day of occurrence of maximum cumulative (background + contribution from the project) 24-hour average TSP concentration
- Increment: Incremental (contribution from the project only) 24-hour average PM_{10} concentration on the day of predicted maximum cumulative 24-hour average TSP concentration
- Background: Measured ambient monitoring concentration on the day of predicted maximum cumulative 24-hour average TSP concentration
- Maximum Cumulative: Calculated maximum cumulative (background + Increment from the project) 24-hour average TSP concentration

Table 20 Predicted Maximum Incremental 24-hour Average TSP Concentrations at Nearest Sensitive Receptors

Receptor ID	Scenario 1 (500 m³/day)				Scenario 2 (135 m³/day)			
	Date	Maximum Increment	Background	Cumulative	Date	Maximum Increment	Background	Cumulative
R1	23-06-2012	23.6	25.9	49.5	23/06/12	4.6	25.9	30.5
R2	01-06-2012	18.7	39.9	58.6	17/07/12	3.9	59.3	63.2
R3	18-07-2012	18.3	36.2	54.5	18/07/12	3.8	36.2	39.9
R4	18-06-2012	6.4	27.7	34.1	18/06/12	1.2	27.7	28.9
R5	21-06-2012	6.8	48.4	55.2	21/06/12	1.3	48.4	49.7
Criterion				**150.0**				**150.0**

Table 21 Predicted Maximum Cumulative 24-hour Average TSP Concentrations at Nearest Sensitive Receptors

Receptor ID	Scenario 1 (500 m³/day)				Scenario 2 (135 m³/day)			
	Date	Increment	Background	Maximum Cumulative	Date	Increment	Background	Maximum Cumulative
R1	04/01/13	0.1	100.8	100.9	04/01/13	0.0	100.8	100.8
R2	04/01/13	0.7	100.8	101.5	04/01/13	0.2	100.8	101.0
R3	12/04/12	6.6	99.2	105.8	04/01/13	0.4	100.8	101.2
R4	12/04/12	3.1	99.2	102.3	04/01/13	0.1	100.8	100.9
R5	04/01/13	0.4	100.8	101.2	04/01/13	0.1	100.8	100.9
Criterion				**150.0**				**150.0**

For Scenario 1 and Scenario 2, the maximum predicted 24-hour average TSP concentrations are significantly below the relevant ambient air quality criterion at all identified sensitive receptor locations. As the nominated residences/properties were chosen as indicative sensitive receptor locations typifying the local surrounding communities, it is unlikely that the 24-hour average TSP concentrations at other properties will exceed the relevant ambient air quality criterion.

8.2.2 Annual Average

Table 22 presents the annual average TSP concentrations predicted by the dispersion modelling at each of the nominated residences/properties using the emission rates calculated in **Section 7** for Scenario 1 and Scenario 2 operations. Contour plots of the incremental increase in annual average TSP concentrations are also presented in **Appendix D** for Scenario 1 and Scenario 2.

Table 22 Predicted Annual Average TSP Concentrations

Receptor ID	Annual Average TSP (µg/m^3)				
	Background	Scenario 1 (500 m^3/day)		Scenario 2 (135 m^3/day)	
		Increment	Cumulative	Increment	Cumulative
R1	51.0	1.0	52.0	0.2	51.2
R2	51.0	1.1	52.1	0.2	51.2
R3	51.0	0.8	51.8	0.2	51.2
R4	51.0	0.3	51.3	0.1	51.1
R5	51.0	0.2	51.2	<0.1	<51.1
Criterion			**90.0**		**90.0**

During Scenario 1 and Scenario 2 annual average TSP concentrations are predicted to be significantly below the relevant ambient air quality criterion at all identified sensitive receptor locations. As the nominated residences/properties were chosen as indicative sensitive receptor locations typifying the local surrounding communities, it is unlikely that the annual average TSP concentrations at other properties will exceed the relevant ambient air quality criterion.

8.3 Particulate Matter (as PM_{10})

Table 23 and **Table 24** show the results of the dispersion modelling for 24-hour average PM_{10} concentrations from the Project Site, using the emission rates calculated in **Section 7** at each of the identified receptors.

Table 23 presents the following information for each scenario

- Date: Day of occurrence of maximum incremental (contribution from the project only) 24-hour average PM_{10} concentration
- Maximum Increment: Maximum incremental 24-hour average PM_{10} concentration
- Background: Measured ambient monitoring concentration on the day of predicted maximum incremental 24-hour average PM_{10} concentration
- Cumulative: Calculated cumulative (background + contribution from the project) 24-hour average PM_{10} concentration

Table 24 presents the following information for each scenario

- Date: Day of occurrence of maximum cumulative (background + contribution from the project) 24-hour average PM_{10} concentration
- Increment: Incremental (contribution from the project only) 24-hour average PM_{10} concentration on the day of predicted maximum cumulative 24-hour average PM_{10} concentration
- Background: Measured ambient monitoring concentration on the day of predicted maximum cumulative 24-hour average PM_{10} concentration
- Maximum Cumulative: Calculated maximum cumulative (background + increment from the project) 24-hour average PM_{10} concentration

Table 25 shows the predicted number of days of exceedences of 24-hour average PM_{10} criteria at each representative receptor.

Table 23 Predicted Maximum Incremental 24-hour Average PM_{10} Concentrations at Nearest Sensitive Receptors

Receptor ID	Scenario 1 (500 m³/day)				Scenario 2 (135 m³/day)			
	Date	Maximum Increment	Background	Cumulative	Date	Maximum Increment	Background	Cumulative
R1	23/06/12	8.4	11.8	20.2	23/06/12	1.6	11.8	13.4
R2	01/06/12	6.7	18.9	25.6	17/07/12	1.2	28.7	29.9
R3	18/06/12	6.6	12.7	19.3	18/06/12	1.3	12.7	14.0
R4	18/06/12	2.7	12.7	15.4	18/06/12	0.5	12.7	13.2
R5	21/06/12	2.7	23.2	25.9	27/07/12	0.5	20.3	20.8
Criterion [1]				**50.0**				**50.0**

[1] Not to be exceeded more than 5 times per year.

Table 24 Predicted Maximum Cumulative 24-hour Average PM_{10} Concentrations at Nearest Sensitive Receptors

Receptor ID	Scenario 1 (500 m³/day)				Scenario 2 (135 m³/day)			
	Date	Increment	Background	Maximum Cumulative	Date	Increment	Background	Maximum Cumulative
R1	04/01/13	<0.1	49.7	<49.8	04/01/13	<0.1	49.7	<49.8
R2	04/01/13	0.3	49.7	50.0	04/01/13	0.1	49.7	49.8
R3	12/04/12	2.0	48.9	50.9	04/01/13	0.2	49.7	49.9
R4	12/04/12	1.0	48.9	49.9	04/01/13	<0.1	49.7	<49.8
R5	04/01/13	0.1	49.7	49.8	04/01/13	<0.1	49.7	<49.8
Criterion [1]				**50.0**				**50.0**

Note: 1 Not to be exceeded more than 5 times per year.

Table 25 Number of Days Predicted to Exceed the 24-Hour Average PM_{10} Criterion

Receptor	Scenario 1 (500 m³/day)	Scenario 2 (135 m³/day)
R1	0	0
R2	0	0
R3	2 (50.5, 50.9)	0
R4	0	0
R5	0	0

Note: Project criterion – 50 µg/m³ not to be exceeded more than 5 times per year.

As shown in **Table 24**, the maximum cumulative 24-hour average concentrations are predicted to exceed the criterion of 50 µg/m³ at R3 for Scenario 1 (maximum throughput of 500 m³/day). An investigation of the days predicted to give rise to exceedences showed that the cumulative 24-hour average PM_{10} concentrations on these days are dominated by the assumed background concentration, and that the predicted contribution from the proposed CBP is relatively low (<4% of the criteria). The results presented in **Table 24** show that the predicted cumulative 24-hour average PM_{10} concentrations are well below the relevant criteria on all days when the maximum incremental impacts from the proposed project are predicted to occur. For Scenario 2, no exceedences of the 24-hour average PM_{10} criterion of 50 µg/m³ were predicted by the model.

Table 25 shows the predicted number of days of exceedences of 24-hour average PM_{10} concentrations at representative sensitive receptors. The results show that up to two days of exceedences may occur at any surrounding sensitive receptors for Scenario 1. The adopted Ambient Air NEPM criterion presented in **Table 9** allows up to five days of exceedences in a year. It should be noted that the proposed operation is anticipated to only operate 1-2 days of the year at the maximum throughput of 500 m^3/day (Scenario 1). Therefore the predicted exceedances would only potentially occur if the maximum background level occurs on the same day as the plant operates at the maximum throughput, which is highly unlikely.

Based on the modelling results it is therefore concluded the proposed operation will comply with the relevant ambient air quality criterion for 24-hour average PM_{10} concentrations.

8.4 Comparison with Previous Modelling Results

Table 26 presents a summary of the maximum 24-hour PM_{10} concentrations predicted in the revised modelling study compared to the 2013 modelling results. This table shows that proposed changes to the CBP design and operation have resulted in lower concentrations and fewer exceedances of the Ambient Air NEPM standard for PM_{10} being predicted compared to the previous study.

Table 26 Comparison of 24-Hour PM_{10} Model Predictions with Previous Results

Receptor	Number of Days Predicted to Exceed the 24-Hour Average PM_{10} Criterion			
	2013 Modelling Study		Revised Project Design	
	Scenario 1 (500 m^3/day)	Scenario 2 (135 m^3/day)	Scenario 1 (500 m^3/day)	Scenario 2 (135 m^3/day)
R1	1 (51.1)	0	0	0
R2	1 (51.5)	0	0	0
R3	2 (52.0, 54.2)	2 (50.5, 50.9)	2 (50.5, 50.9)	0
R4	1 (51.6)	0	0	0
R5	0	0	0	0

9 SUMMARY AND CONCLUSION

9.1 Background

WA Limestone proposes to construct a wetmix concrete batching facility on Lot 2 Collier Road, Bayswater. Lot 2 is located on industrial zoned land, adjoining the northern edge of the Bayswater Industrial Area is the Bayswater Urban Area.

Lot 2 is separated from the Bayswater Urban Area by Shalford Reserve parkland.

9.2 SLR Brief

SLR was engaged by WA Limestone to conduct an Air Quality Impact Assessment (AQIA) for the proposed operations at 277 Collier Road, Bayswater WA. The AQIA study was conducted with a conservative approach using two scenarios (average and maximum production) to determine any factors that may potentially impact on dwellings to the north of the proposed batching plant.

Any potential impacts were quantified using the worst case scenarios, modelled and assessed against the relevant ambient air quality guidelines.

The particulate emissions from the Project Site were estimated using emission estimation techniques listed by USEPA AP-42.

USEPA AP-42 emission factors were used as the proposed plant is a wetmix plant that utilises the latest technology and design, and provides the ability to minimise potential dust emissions by using enclosed plant for the mixing of dry materials. The parallel Australian emission factors as presented in the NPI Emission Estimation Technique Manuals do not account for the newer technology and design, being based on the older and less efficient dry mixing technology.

9.3 Conservative Assumptions Used in the Report

This report is based upon a number of assumptions, which are necessary when performing air quality impact assessment work through predictive modelling, due to the uncertainty associated with plant and/or processes not yet operating.

In all cases, the predictive modelling has been based upon assumptions that may be reasonably assumed to be representative of actual (or anticipated) operational activities and/or conditions.

To provide a level of confidence in the assessment a number of conservative assumptions have been adopted in this report, which are briefly summarised below:

- **Production Rates:** Two operational scenarios have been assessed as introduced in **Section 2.5**, namely:
  - **Scenario 1** — potential worst case impacts resulting a maximum daily concrete production of 500 m^3/day which may occur infrequently each year (nominally only one to two days per year). It is noted that results presented in this report for Scenario 1 are based on the assumptions that the plant will operate at maximum production rate throughout the entire modelling period.
  - **Scenario 2** — potential worst case impacts resulting the anticipated daily concrete production of 135 m^3/day throughout the entire modelling period.

- **Background data:** the background concentrations measured at site for 12 months through 2012 – 2013 include an unquantifiable contribution from the currently unsealed and undeveloped site, however it is considered that this contribution will not be insignificant. It is noted that bare sand and unswept pavement are currently present on site which will constitute particulate emission sources that will contribute to the particulate concentrations measured during the background monitoring campaign. Upon the development of the site, this contribution to background will be minimised, through sealing of all production and transport areas and revegetation of bare ground thereby helping to reduce potential dust generation and resultant impacts. Due to this, it is considered reasonable that the measured background particulate concentrations will be higher during the monitoring period than would be experienced during site operation, and that constitutes a level of conservatism in the assessment.
- **Site hard standing:** As discussed in **Section 2.4.1**, all haulage routes on-site and hard standing areas will be sealed with a high level of site housekeeping, including regular sweeping and/or damping down and washing as appropriate. Dust emissions from on-site traffic movements are likely to be minimal, however for the purposes of this assessment all haulage was assumed to be a source of wheel generated dust which is considered to be a conservative assumption in this assessment.
- **Watering control of hard standing areas:** As discussed in **Section 2.4.2, a** conservative control factor of 50% has been applied to account for the effect of dust control by wetting down. The *Emission Estimation Technique Manual for Concrete Batching* published by Environment Australia states that watering (to eliminate dust) reduces fugitive particulate emissions on unsealed roads by 75%. It is likely that this report significantly under-estimates the dust control offered by watering.
- **Moisture content of aggregates:** As discussed in **Section 2.4.2,** the inherent material moisture content will introduce some dust control, however for the purposes of this assessment this has not been considered due to the potential variability in the moisture content over time. This approach will tend to overestimate the particulate emissions from all materials handling on-site, and also from the contribution of the front-end loader loading the hopper bins.
- **Estimated Emission for Mixer Loading Operation:** Particulate emissions from mixer loading operation were estimated using the controlled emission factors from USEPA AP-42 (USEPA 2006). This emission factor is generally used for estimating particulate emissions from mixer loading operations under enclosed conditions where the fabric filter (cement loading) is exposed to the ambient wind. However the proposed facility is designed to have a dual enclosure where the fabric filter (cement loading) will also be operated under enclosed conditions. Therefore, the emission from the proposed operation and hence the predicted impact at receptors are likely to be significantly lower compared to that presented in this report. The following relationship between the potential particulate emission rate and site specific data (wind speed and moisture content) was developed by USEPA.

$$E = k(0.0032)\left[\frac{U^a}{M^b}\right] + c \qquad \text{(Equation 1)}$$

Where:

E = *Emission factor in lbs/ton of cement and cement supplement*

k = *Particle size multiplier (0.13 for PM_{10} for Central Mix Operation)*

U = *Wind speed at the material drop point, miles per hour (mph)*

M = *Minimum moisture (% by weight) of cement and cement supplement*

a, b = *Exponents (0.45,0.9 for PM_{10} for Central Mix Operation)*

c = *constant (0.0010 for PM_{10} for Central Mix Operation)*

To convert the units of lbs/ton to units of kg/Mg, the emissions calculated by Equation 1 should be divided by 2.0, as specified in AP-42.

As the material drop point (including fabric filter) of the proposed facility will be operated under enclosed conditions, it may be conservatively assumed that wind speed at the material drop point will be less than 1 mph (0.45 m/s). This assumption is derived from the default AP42 wind speed data where a truck is obstructing the meteorological station (USEPA 2006). In absence of the site specific moisture content data for cement for the proposed facility, average moisture content data (USEPA 2006) for cement (0.44%) may be used to estimate the potential particulate emissions. The default AP42 control emission factor for PM_{10} and calculated PM_{10} emission factor based on Equation 1 and above assumptions are presented in **Table 27**.

Table 27 AP42 Default and Calculated PM_{10} Emission Factors for Mixer Loading Operation

Default Controlled Emission Factor (kg/Mg)	Calculated Emission Factor(kg/Mg)
0.0028	0.000935

Based on the comparison presented in **Table 27** and assuming that average moisture content data from AP42 are representative for the proposed facility, it can be observed that use of default AP42 controlled emission factor is likely to significantly overestimate the potential PM_{10} emissions from this source, possibly by a factor of 3.

- **Improvements in Management of Adjoining Industries:** It is anticipated that emission levels from adjoining and nearby industries should improve in future as awareness, technology and regulation improves. For example a fence and associated sprinklers has been approved by the City of Bayswater for the open air material recycling facility (**Figure 9**), adjoining to the south across Collier Road, which should assist in reducing potential dust emissions from that site, reducing both background concentrations and the predicted impacts at the residential areas to the north.

9.4 Potential Improvement with the Proposed New Design

The proposed new design incorporates a number of mitigation measures including reduction in FEL operation and shorter haul road compared to that assessed in the previous report (SLR 2014) to minimise the potential dust emissions from the site. A comparison of estimated emissions reported in the previous assessment (SLR 2014) and estimated emissions from the proposed new design are presented in **Table 28** and **Table 29**. It can be observed from **Table 28** and **Table 29** that significant reduction in potential TSP and PM_{10} emissions have been achieved for the proposed CBP with the new design. The key improvements associated with the dust generating activities include significant reduction in FEL operation (loading and hauling activities), reduction in onsite VKT for Aggregate, Cement and Product transport vehicles compared to that in the previous design (SLR 2014).

Table 28 Comparison of Estimated Emissions – Scenario 1 (500 m^3/day)

Activity	SLR (2014)		Proposed New Design		Key Improvements
	TSP	PM_{10}	TSP	PM_{10}	
Aggregate handling and transport	3286	959	716	188	Reduction in FEL operation Shorter haul road for Aggregate transport at onsite Reduction in wind erosion areas (bins)
Cement handling and transport	148	33	89	21	Reduction in haul road
Mixer loading	3146	958	3146	958	No change
Product transport	1280	246	1173	225	Shorter haul road

Table 29 Comparison of Estimated Emissions – Scenario 2 (135 m^3/day

Activity	SLR (2014)		Proposed New Design		Key Improvements
	TSP	PM_{10}	TSP	PM_{10}	
Aggregate handling and transport	550	135	217	62	Reduction in FEL operation Shorter haul road for Aggregate transport at onsite Reduction in wind erosion areas (bins)
Cement handling and transport	41	8	26	6	Reduction in haul road
Mixer loading	230	70	230	70	No change
Product transport	397	76	364	70	Shorter haul road

9.5 Summary

The particulate emissions from the Project Site were estimated using emission estimation techniques listed by USEPA AP42. Site-specific air quality modelling was conducted for TSP, PM_{10}, and dust deposition for use in the dispersion modelling. The modelling predicted the anticipated ground level particulate concentrations at five identified representative sensitive receptors.

The following provides a summary of the conclusions derived from the predictive modelling:

- **Dust deposition:** Annual average dust deposition rates at all nominated residences surrounding the Project Site are predicted be to below the relevant designated compliance criterion of 4 g/m^2/month (cumulative dust deposition) when using a background dust deposition rate of 2.7 g/m^2/month. The incremental contribution from the proposed facility is predicted to be minimal (< 0.1 g/m^2/month).
- **TSP:** 24-hour and annual average TSP concentrations are predicted to be well below the relevant ambient air quality guidelines at all modelled residences. The predicted cumulative 24-hour and annual average TSP concentrations at representative receptors are below 106 µg/m^3 and 53 µg/m^3 respectively. The maximum incremental contribution to the adopted 24-hour and annual average TSP criteria are predicted to be 23.6 µg/m^3 and 0.8 µg/m^3 respectively.
- **PM_{10}:** Based on the ambient monitoring data collected at Lot 2 in the industrial area, the maximum 24-hour average PM_{10} concentrations will comply with the adopted criteria of 50 µg/m^3 that allows up to five exceedences in a year.

  Maximum 24-hour average PM_{10} concentrations are predicted to exceed the adopted criteria of 50 µg/m^3 at R3 for Scenario 1 (maximum 500 m^3/day throughput) but at less than 5 times per year. The predicted impact results shows that the exceedences are driven by high background PM_{10} concentrations. No exceedences were predicted for Scenario 2.

  Further investigation revealed that the predicted exceedences of the PM_{10} criterion were dominated by the background contributions, and the predicted increments from the project on the days of exceedences are low, relative to those background concentrations. Based upon the model input (which includes a number of conservative assumptions) the model predictions indicate that exceedences may occur on up to two days per year at any surrounding sensitive receptors for Scenario 1. To account for the potential for regional air quality events to result in elevated background concentrations, the Ambient Air NEPM guideline allows up to five days of exceedences. It should be noted that the proposed operation is anticipated to only operate 1-2 days of the year at the maximum throughput of 500 m^3/day (Scenario 1). Therefore the predicted exceedances would only potentially occur if the maximum background level occurs on the same day as the plant operates at the maximum throughput, which is highly unlikely.

  Therefore, based on the modelling results, it can be concluded that the project will comply with the Ambient Air NEPM goal.

The above conclusions are drawn without consideration of the level of conservatism summarised in **Section 9.3**, which should provide further assurance of compliance. Briefly, the conservative assumptions include:

- Prediction of impacts using two levels of assumed production, including the maximum predicted daily throughput of 500 m^3/day. In reality, this production rate is anticipated to occur only 1-2 days per year.
- Conservative background air quality data compared to the conditions when operating due to site improvements.
- Inclusion of wheel generated dust emissions from site hard standing, even though this will be minimal.
- A conservative control factor applied to watering controls.
- Over-estimation of particulate emissions due to no consideration of moisture content.
- Over estimation of emissions from the Mixer Loading Operation, afforded through dual enclosure of those processes (a primary enclosure with bag house and secondary enclosure).
- Improvements in management of adjoining industries will reduce background emissions over time.

9.6 Conclusions

Based on the modelling results, it is concluded that the proposed operation will comply with the relevant ambient air quality criteria.

The air quality criteria applied to this study are discussed in **Section 4.2** and presented in **Table 9**.

The predicted maximum cumulative 24-hour average impacts are driven by high background concentrations, which it is acknowledged will be reduced during operation due to site improvements, and is comprised of contributions from neighbouring operations that should reduce over time due to improvements in management and regulatory controls.

The predicted incremental contributions from the proposed facility during normal operation (average production rate) is minimal (<4% of the criteria) on the days with high background concentration. Although the predicted 24-hour average increment for the maximum production rate scenario is relatively high compared to that of normal operation (average production rate) scenario, the proposed operation is unlikely to cause any adverse impact at the local area as the proposed operation is likely to operate occasionally (couple of days per year) with maximum production rate.

It is additionally noted that effective environmental improvement is enforced through the application of Best Available Technology (BAT) and effective controls imposed through adherence to reasonable Council conditions and a suitable Dust Management Plan, rather than the results of a predictive modelling study.

Through the modelling study, the WA Limestone has demonstrated that the site is suitable for use for this development, and that predicted impacts at the surrounding sensitive receptors will demonstrate compliance with all relevant air quality criteria applicable to the location.

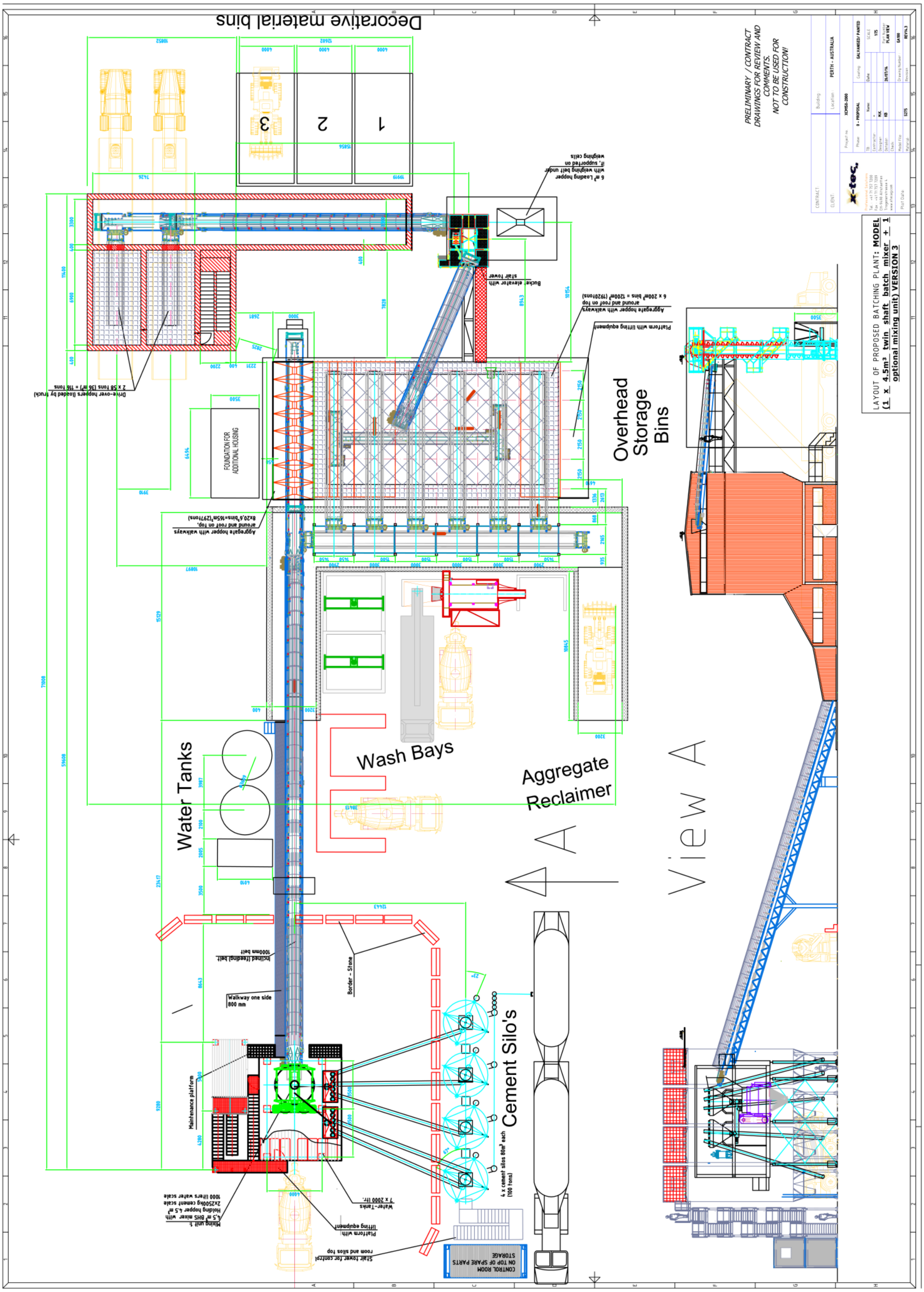
WA Limestone is proposing to construct and operate a wetmix concrete batching plant with significant performance improvements on other plants operating in Perth. The plant is designed to comply with the adopted BAT criteria for the industry and will operate within the confines of a Dust Management Plan within the Operational Environmental Management Plan.

These commitments will also include a campaign of compliance monitoring which will be significantly more rigorous than that operated by other industries in the area, and will be designed to allow Council to operate with confidence that the impacts are being monitored to strict QA/QC controls (through NATA endorsed monitoring) and allow WA Limestone to operate with pro-active dust management procedures to ensure the community is not adversely affected by operations.

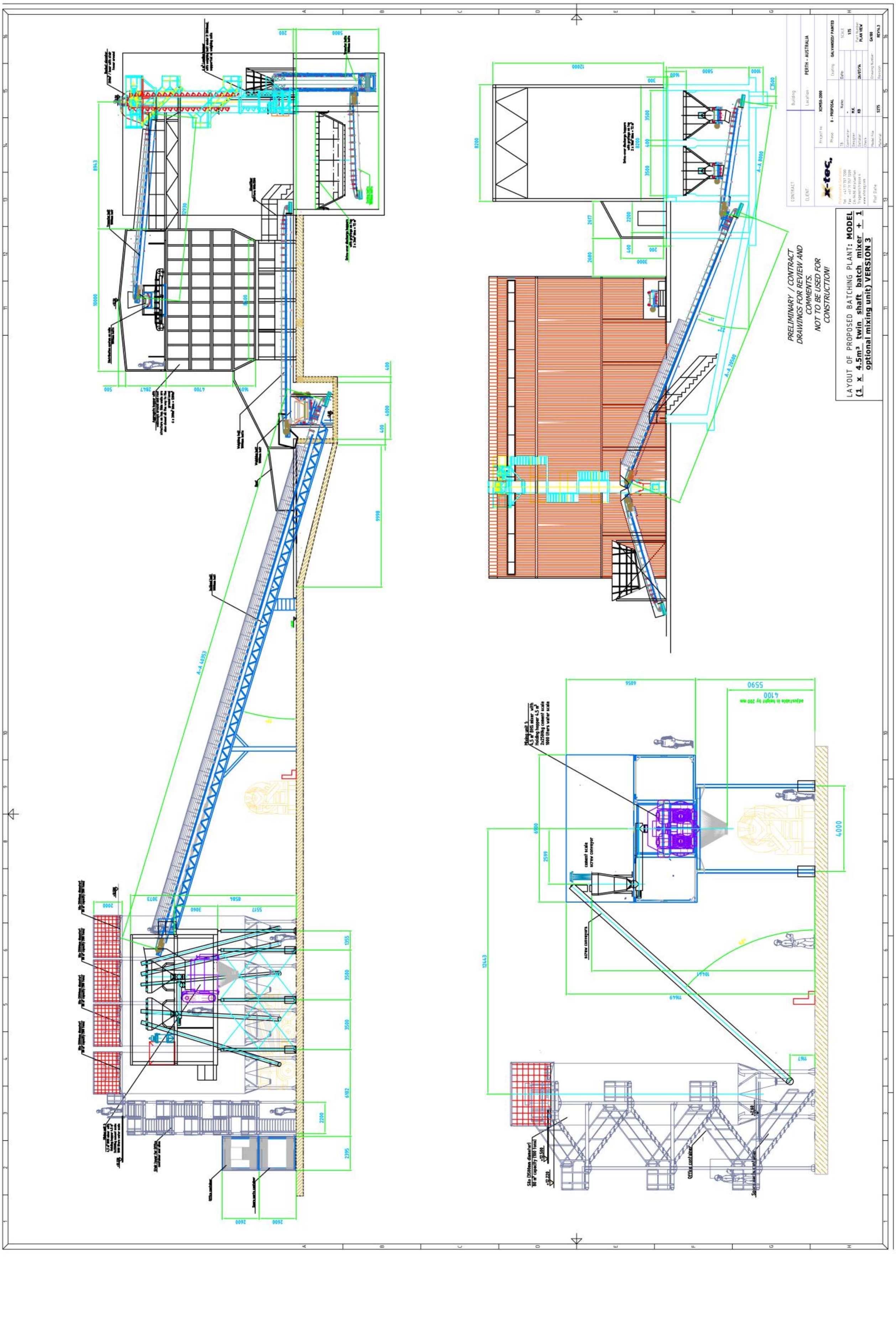
10 REFERENCES

- DEC 2005, NSW Department of Environment and Conservation, *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, 26 August 2005.
- EA 1999, *National Pollutant Inventory Emission Estimation Technique Manual for Concrete Batching and Concrete Product Manufacturing*, Environment Australia, February 1999.
- Environmental Alliances (2013) *Response to SLR Report "Bayswater Concrete Batching Plant – Baseline Monitoring Report"* dated 19 April 2013.
- MRI 2006, *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors*, prepared by: Midwest Research Institute, prepared for: Western Governors Association – Western Regional Air Partnership (WRAP), MRI Project number 110397, dated: 1 November 2006.
- SLR 2012, *Bayswater Concrete Batching Plant, Baseline Monitoring Report*, 277 Collier Road, Bayswater WA, report number 675.10267-R1, dated 6 July 2012.
- SLR 2013a, *Bayswater Concrete Batching Plant Air Quality Impact Assessment*, report number 675.10267-R4, Revision 1, June 2013.
- SLR 2013b, *Bayswater Concrete Batching Plant, Baseline Monitoring Report (Revision 4)*, 277 Collier Road, Bayswater WA, report number 675.10267-R1R4, dated 19 April 2013.
- USEPA 2005, *40 CFR Part 51 Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule,* Environmental Protection Agency, November 9, 2005, http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf.
- USEPA 2011, United States Environmental Protection Authority (2011) *Compilation of Air Pollutant Emission Factors AP-42 - Chapter 13.2.1 Paved Roads*.
- USEPA 2006, United States Environmental Protection Authority, *Compilation of Air Pollutant Emission Factors AP-42 - Chapter 11.12 Concrete Batching*.
- USEPA 2000 United States Environmental Protection Authority, *Meteorological Monitoring Guidance for Regulatory Modeling Applications*.
- VIC EPA 2007, *Protocol for Environmental Management, State Environment Protection Policy (Air Quality Management), Mining and Extractive Industries*, Publication 1191, December 2007.
- WA EPA 1999, *Government Gazette – Environmental Protection Act 1986 – Environmental Protection (Kwinana) (Atmospheric Wastes) Policy Approval Order 1999*, 21 December 1999.
- WA Premix 2011, *Proposal Summary & Operational Overview*, Walter Lukic, Ransberg Pty Ltd trading as WA Premix, 5 October 2011.
- WA DEC 2012, *2011 Western Australia Air Monitoring Report*, Department of Environment and Conservation, July 2012.

Site Layout

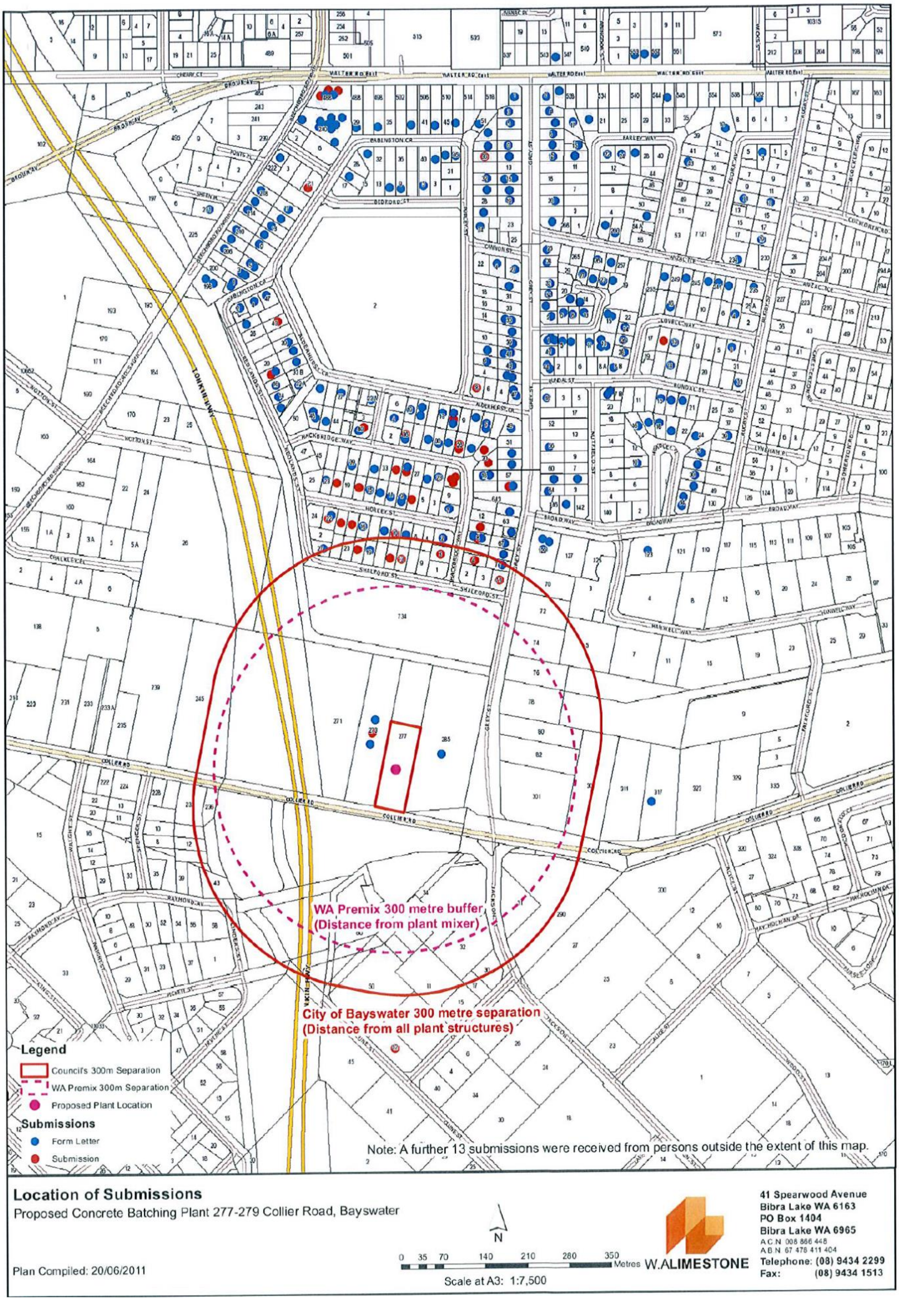

Decorative material bins
Overhead Storage Bins
Water Tanks
Wash Bays
Aggregate Reclaimer
Cement Silo's
View A

Site Layout



PRELIMINARY / CONTRACT DRAWINGS FOR REVIEW AND COMMENTS. NOT TO BE USED FOR CONSTRUCTION!
LAYOUT OF PROPOSED BATCHING PLANT: MODEL (1 x 4.5m³ twin shaft batch mixer + 1 optional mixing unit) VERSION 3
PERTH - AUSTRALIA

Locations of Sensitive Receptors



Detailed Emission Inventories

DETAILED EMISSION INVENTORY – SCENARIO 1

Emission Source	Emission Factor			Area	Road Length	VKT/hr	Hours per day	Days per year	Throughput	
	TSP	PM_{10}	Units	(m²)	(m)				Value	Unit
Aggregate										
Truck dumping aggregates - drive over bins	0.0035	0.0017	kg/t				1.4	300	600	t/hr
Transfer of aggregates - drive over bins to overhead storage bins	0.0035	0.0017	kg/t				3.5	300	274	t/hr
Transfer of aggregates - overhead storage bins to conveyor	0.0035	0.0017	kg/t				4.5	300	205	t/hr
Transfer of aggregates - conveyor to mixer	0.0035	0.0017	kg/t				4.5	300	205	t/hr
Trucks dumping aggregates - temporary overflow storage bins	0.0035	0.0017	kg/t				1	300	27.5	t/day
FEL - temp overflow storage bins to loading hopper	0.0035	0.0017	kg/t				1	300	27.5	t/hr
FEL - reclaimed aggregates from reclaimer to loading hopper	0.0035	0.0017	kg/t				0.3	300	195	t/hr
Transfer of aggregates - loading hopper to overhead storage bins	0.0035	0.0017	kg/t				3.5	300	274	t/hr
Road haulage - trucks	1.9	0.4	kg/VKT		330	3.9	0.4	300		
Road haulage - FEL emptying overflow storage bins	0.5	0.1	kg/VKT		30	0.12	1	300		
Road haulage - FEL transferring reclaimed aggregates	0.5	0.1	kg/VKT		80	3.9	0.3	300		
Temporary overflow storage bins - wind erosion	variable	variable		152			24	365		
Cement										
Transfer of cement from cement tanker to silo	0.0005	0.00017	kg/t				2.6	300	60	t/hr
Road haulage	0.5	0.1	kg/VKT		330	2.31	0.4	300		
Mixer										
Mixer loading	0.0092	0.0028	kg/t				5.0	300	228	t/hr
Road haulage	0.5	0.1	kg/VKT		165	13.75	1.2	300		

DETAILED EMISSION INVENTORY – SCENARIO 1 (CONTINUED)

Emission Source	Control Applied	Control Factor	Emission Rate						Modelled As
			TSP (kg/day)	PM_{10} (kg/day)	TSP (kg/hr)	PM_{10} (kg/hr)	TSP (kg/annum)	PM_{10} (kg/annum)	
Aggregate									
Truck dumping aggregates - drive over bins	Covered on 3 sides, water sprays	95%	0.147	0.071	0.015	0.007	44.1	21.4	constant
Transfer of aggregates - drive over bins to overhead storage bins	Enclosure	99%	0.034	0.016	0.003	0.002	10.1	4.9	constant
Transfer of aggregates - overhead storage bins to conveyor	Enclosure, filtered dust extraction	99%	0.032	0.016	0.003	0.002	9.7	4.7	constant
Transfer of aggregates - conveyor to mixer	Enclosure	99%	0.032	0.016	0.003	0.002	9.7	4.7	constant
Trucks dumping aggregates - temporary overflow storage bins	Covered on 3 sides, water sprays	95%	4.8×10^{-3}	2.3×10^{-3}	4.8×10^{-4}	2.3×10^{-4}	1.4	0.7	constant
FEL - temp overflow storage bins to loading hopper	No control	0%	0.096	0.047	0.010	0.005	28.9	14.0	constant
FEL - reclaimed aggregates from reclaimer to loading hopper	No control	0%	0.205	0.099	0.020	0.010	61.4	29.8	constant
Transfer of aggregates - loading hopper to overhead storage bins	Enclosure	99%	0.034	0.016	0.003	0.002	10.1	4.9	constant
Road haulage - trucks	Watering, street sweeper	50%	1.469	0.282	0.147	0.028	440.8	84.6	constant
Road haulage - FEL emptying overflow storage bins	Watering, street sweeper	50%	0.028	0.005	0.003	5.5E-04	12.9	0.5	constant
Road haulage - FEL transferring reclaimed aggregates	Watering, street sweeper	50%	0.279	0.054	0.028	5.4E-03	83.6	16.1	constant
Temporary overflow storage bins - wind erosion	Covered on 3 sides, water sprays	95%	varying	varying	varying	varying	3.4	1.7	varying
Cement									
Transfer of cement from cement tanker to silo	Controlled emission factor		0.078	0.027	0.008	0.003	23.4	8.0	constant
Road haulage	Watering, street sweeper	50%	0.219	0.042	0.022	4.2×10^{-3}	65.7	12.6	constant
Mixer									
Mixer loading	Controlled emission factor		10.488	3.192	1.049	0.319	3146.4	957.6	constant
Road haulage	Watering, street sweeper	50%	3.911	0.751	0.391	0.075	1173.4	225.2	constant
							5,125.0	**1,391.4**	

DETAILED EMISSION INVENTORY – SCENARIO 2

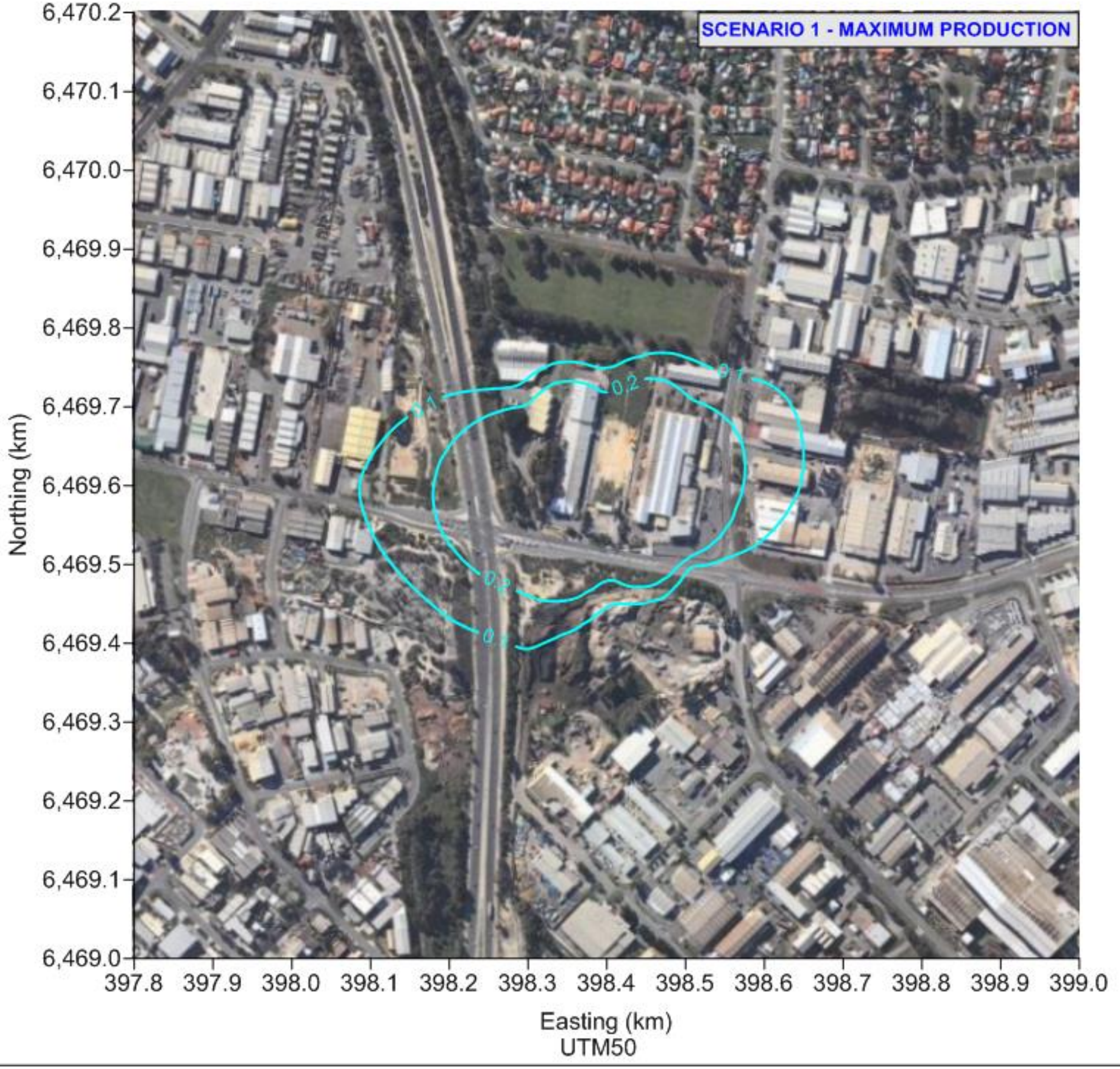
Emission Source	Emission Factor			Area	Road Length	VKT/hr	Hours per day	Days per year	Throughput	
	TSP	PM_{10}	Units	(m²)	(m)				Value	Unit
Aggregate										
Truck dumping aggregates - drive over bins	0.0035	0.0017	kg/t				0.4	300	600	t/hr
Transfer of aggregates - drive over bins to overhead storage bins	0.0035	0.0017	kg/t				0.9	300	274	t/hr
Transfer of aggregates - overhead storage bins to conveyor	0.0035	0.0017	kg/t				1.2	300	205	t/hr
Transfer of aggregates - conveyor to mixer	0.0035	0.0017	kg/t				1.2	300	205	t/hr
Trucks dumping aggregates - temporary overflow storage bins	0.0035	0.0017	kg/t				1	300	27.5	t/day
FEL - temp overflow storage bins to loading hopper	0.0035	0.0017	kg/t				1	300	27.5	t/hr
FEL - reclaimed aggregates from reclaimer to loading hopper	0.0035	0.0017	kg/t				0.1	300	195	t/hr
Transfer of aggregates - loading hopper to overhead storage bins	0.0035	0.0017	kg/t				0.9	300	274	t/hr
Road haulage - trucks	1.9	0.4	kg/VKT		330	3.7	0.1	300		
Road haulage - FEL emptying overflow storage bins	0.5	0.1	kg/VKT		30	0.12	1	300		
Road haulage - FEL transferring reclaimed aggregates	0.5	0.1	kg/VKT		80	3.2	0.1	300		
Temporary overflow storage bins - wind erosion	variable	variable		152			24	365		
Cement										
Transfer of cement from cement tanker to silo	0.0005	0.00017	kg/t				0.75	300	60	t/hr
Road haulage	0.5	0.1	kg/VKT		330	2.64	0.1	300		
Mixer										
Mixer loading	0.0092	0.0028	kg/t				1.4	300	61.6	t/hr
Road haulage	0.5	0.1	kg/VKT		165	10.23	0.5	300		

DETAILED EMISSION INVENTORY – SCENARIO 2 (CONTINUED)

Emission Source	Control Applied	Control Factor	Emission Rate						Modelled As
			TSP (kg/day)	PM_{10} (kg/day)	TSP (kg/hr)	PM_{10} (kg/hr)	TSP (kg/annum)	PM_{10} (kg/annum)	
Aggregate									
Truck dumping aggregates - drive over bins	Covered on 3 sides, water sprays	95%	0.042	0.020	0.005	0.003	12.6	6.1	constant
Transfer of aggregates - drive over bins to overhead storage bins	Enclosure	99%	0.009	0.004	0.001	0.001	2.6	1.3	constant
Transfer of aggregates - overhead storage bins to conveyor	Enclosure, filtered dust extraction	99%	0.009	0.004	0.001	0.001	2.6	1.3	constant
Transfer of aggregates - conveyor to mixer	Enclosure	99%	0.009	0.004	0.001	0.001	2.6	1.3	constant
Trucks dumping aggregates - temporary overflow storage bins	Covered on 3 sides, water sprays	95%	4.8×10^{-3}	2.34×10^{-3}	6.0×10^{-4}	2.9×10^{-4}	1.4	0.7	constant
FEL - temp overflow storage bins to loading hopper	No control	0%	0.096	0.047	0.012	0.006	28.9	14.0	constant
FEL - reclaimed aggregates from reclaimer to loading hopper	No control	0%	0.068	0.033	0.009	0.004	20.5	9.9	constant
Transfer of aggregates - loading hopper to overhead storage bins	Enclosure	99%	0.009	0.004	0.001	0.001	2.6	1.3	constant
Road haulage - trucks	Watering, street sweeper	50%	0.349	0.067	0.044	0.008	104.6	20.1	constant
Road haulage - FEL emptying overflow storage bins	Watering, street sweeper	50%	0.028	0.005	0.004	6.8E-04	12.9	0.5	constant
Road haulage - FEL transferring reclaimed aggregates	Watering, street sweeper	50%	0.076	0.015	0.009	1.8E-03	22.8	4.4	constant
Temporary overflow storage bins - wind erosion	Covered on 3 sides, water sprays	95%	varying	varying	varying	varying	3.4	1.7	varying
Cement									
Transfer of cement from cement tanker to silo	Controlled emission factor		0.023	0.008	0.003	0.001	6.8	2.3	constant
Road haulage	Watering, street sweeper	50%	0.063	0.012	0.008	1.5×10^{-3}	18.8	3.6	constant
Mixer									
Mixer loading	Controlled emission factor		0.765	0.233	0.096	0.029	229.5	69.9	constant
Road haulage	Watering, street sweeper	50%	1.212	0.233	0.152	0.029	363.7	69.8	constant
							836.2	**208.0**	

Contour Plots

Contour Plots



Predicted Annual Average Dust Deposition Rate (g/m²/month)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR

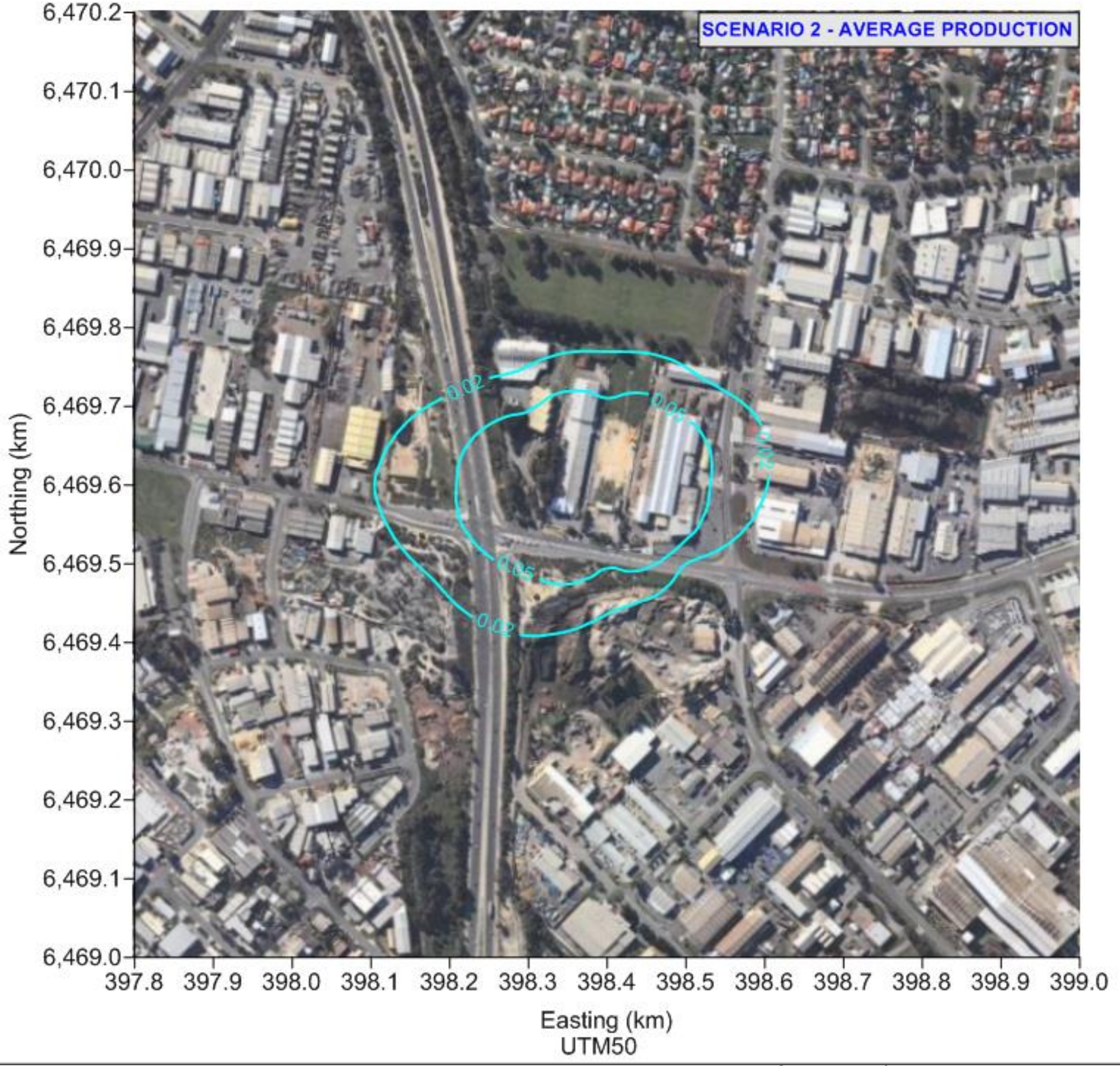
240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

WA Limestone Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 1 - INCREMENT

Project No.	Date
675.10817	03/11/2014



Predicted Annual Average Dust Deposition Rate (g/m²/month)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR

240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

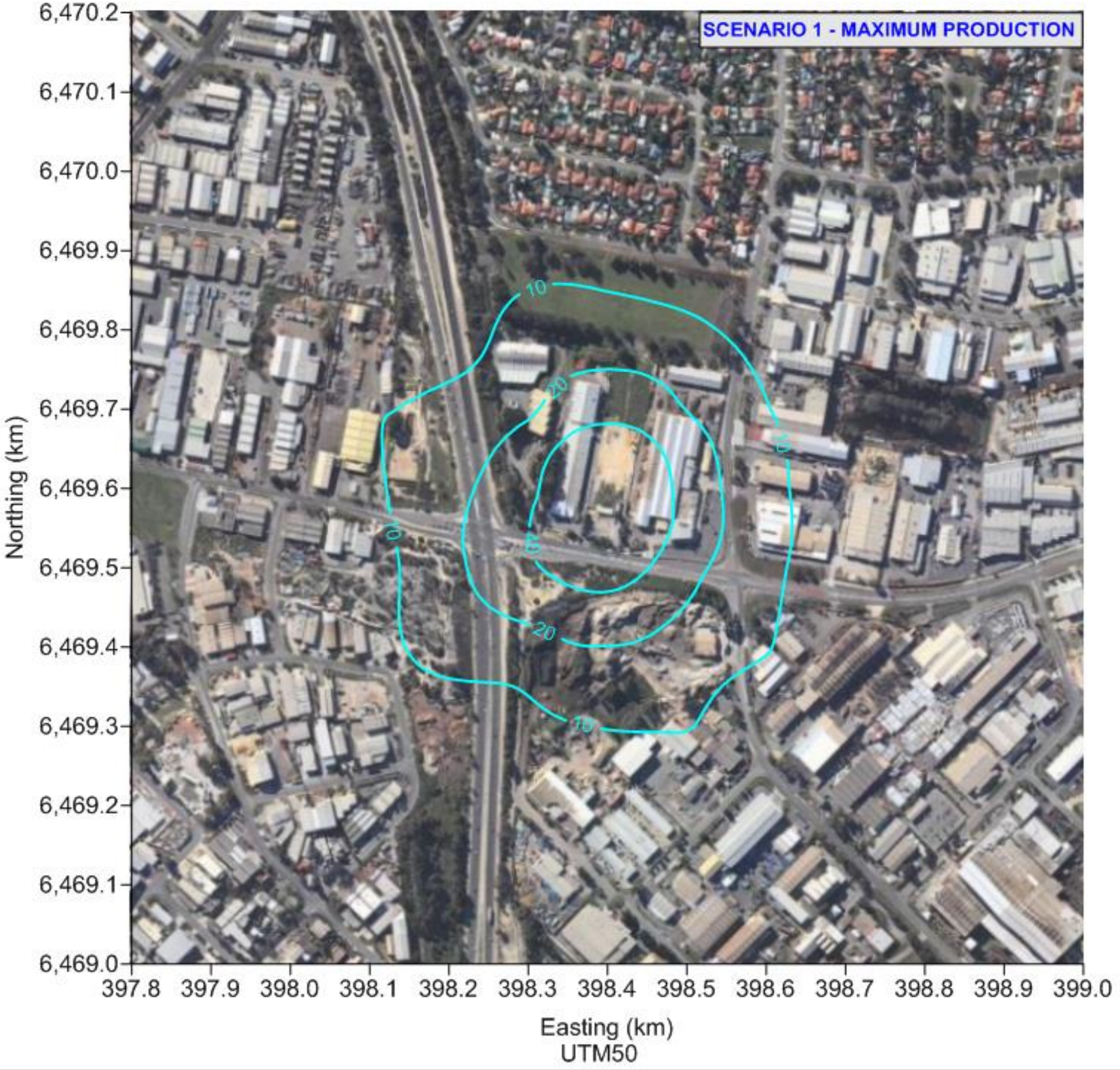
WA Limestone
Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 2 - INCREMENT

Project No. 675.10817	Date 03/11/2014

Contour Plots



Maximum Predicted 24-Hour Average PM10 Concentrations (µg/m³)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR

240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

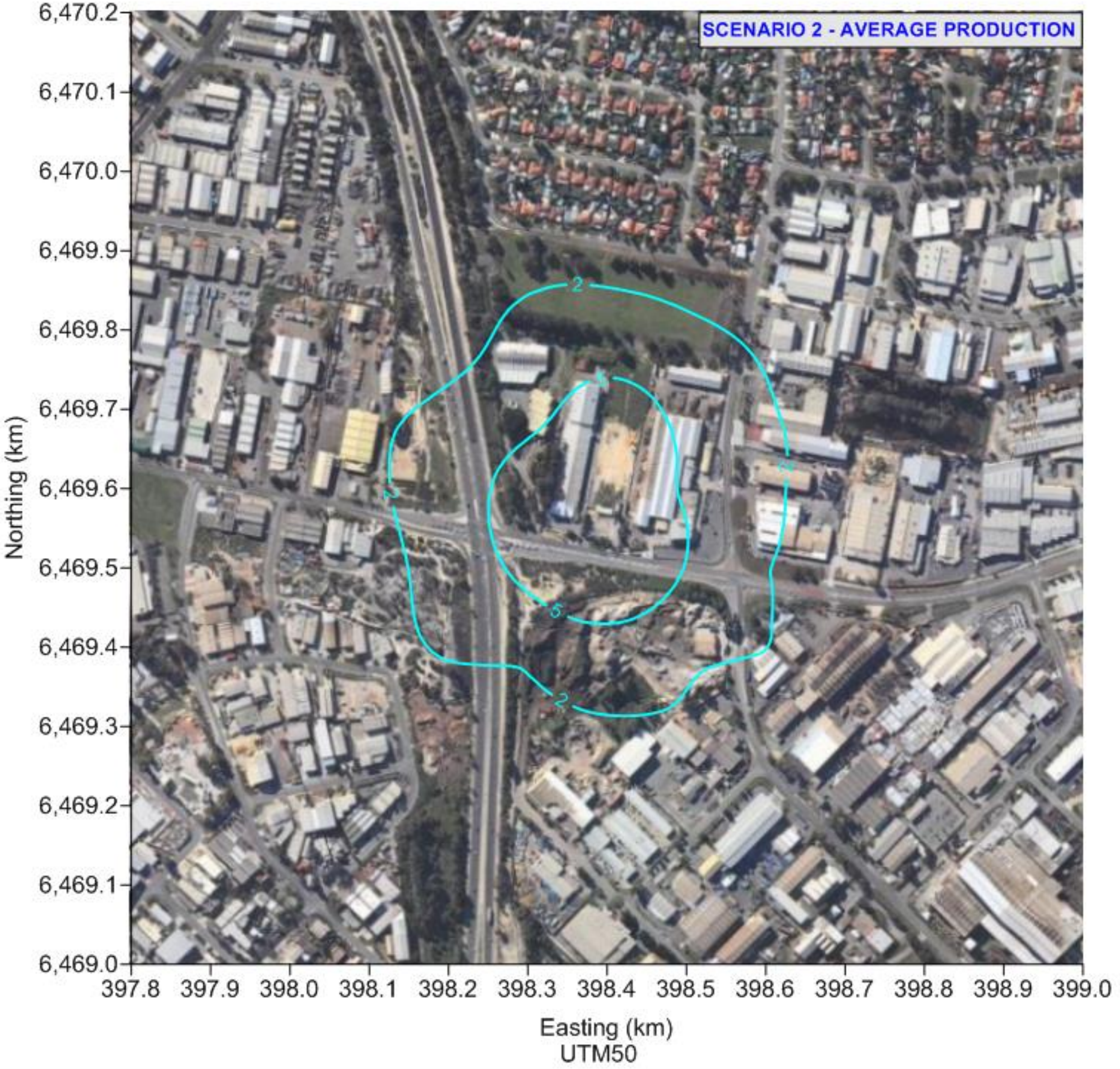
WA Limestone Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 1 - INCREMENT

Project No. 675.10817

Date 03/11/2014



Maximum Predicted 24-Hour Average PM10 Concentrations (µg/m³)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR

240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

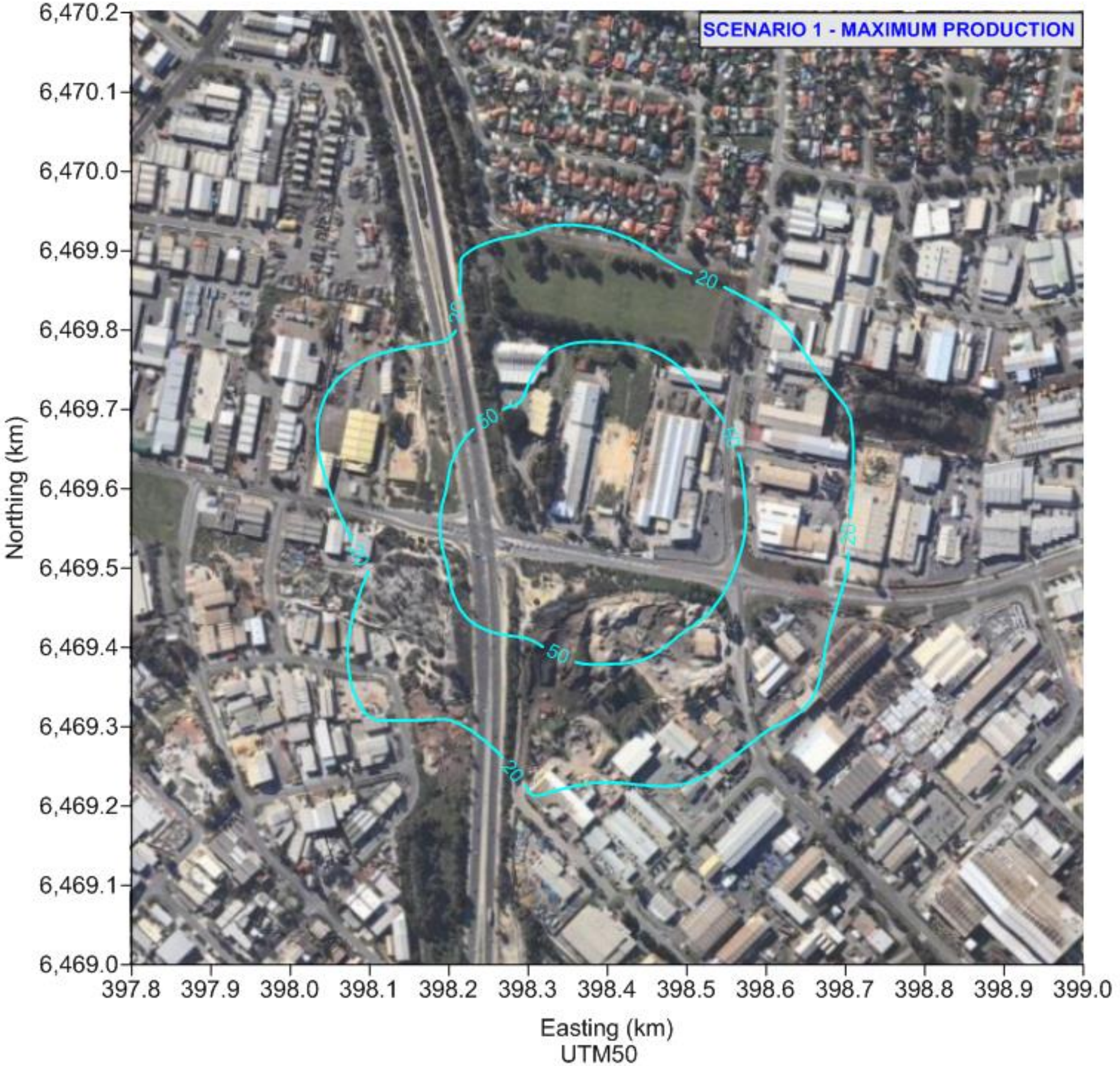
WA Limestone Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 2 - INCREMENT

Project No. 675.10817

Date 03/11/2014



Maximum Predicted 24-Hour Average TSP Concentrations (µg/m³)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR

240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

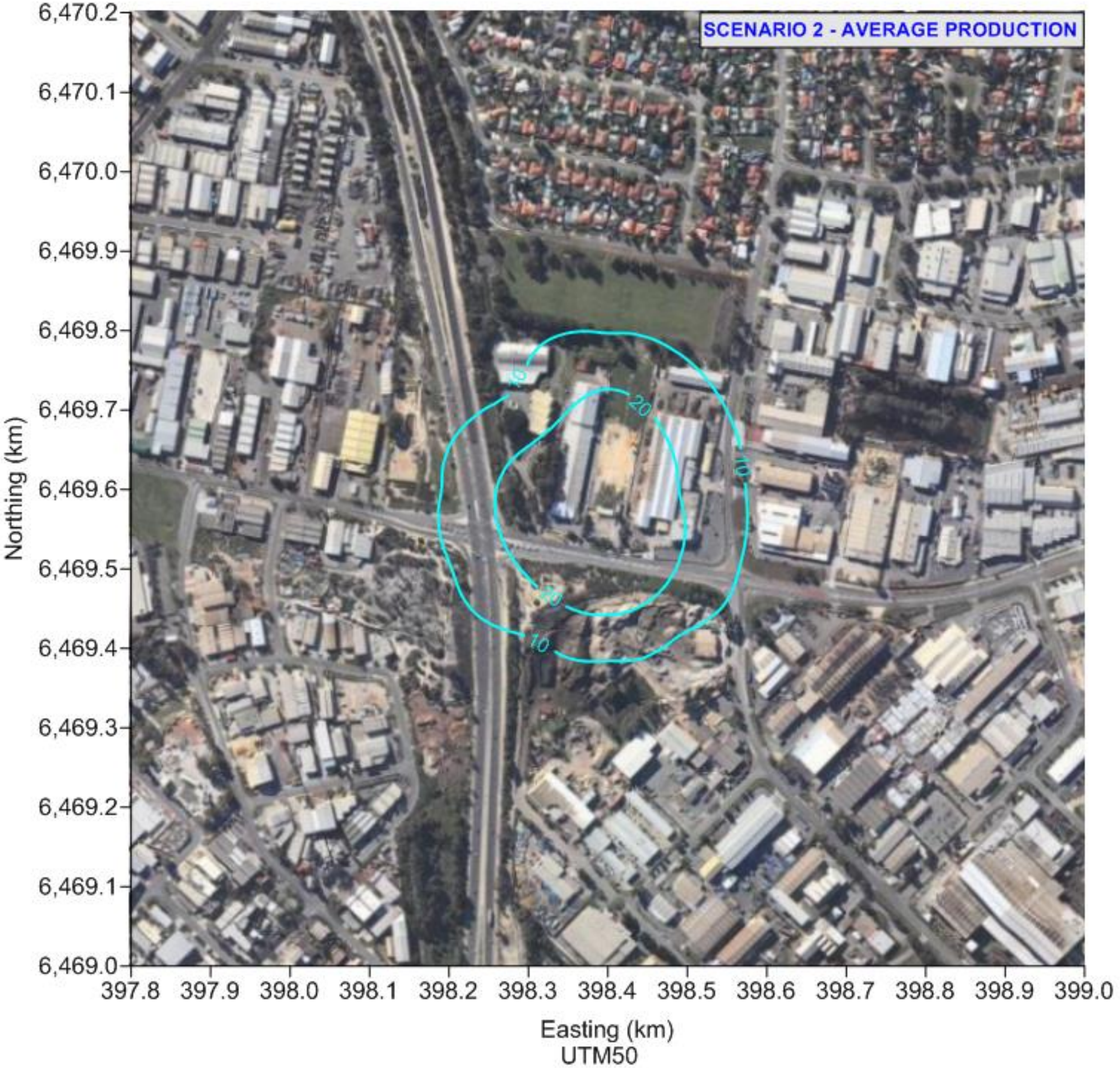
WA Limestone Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 1 - INCREMENT

Project No. 675.10817	Date 03/11/2014

Contour Plots



Maximum Predicted 24-Hour Average TSP Concentrations (µg/m³)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR

240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

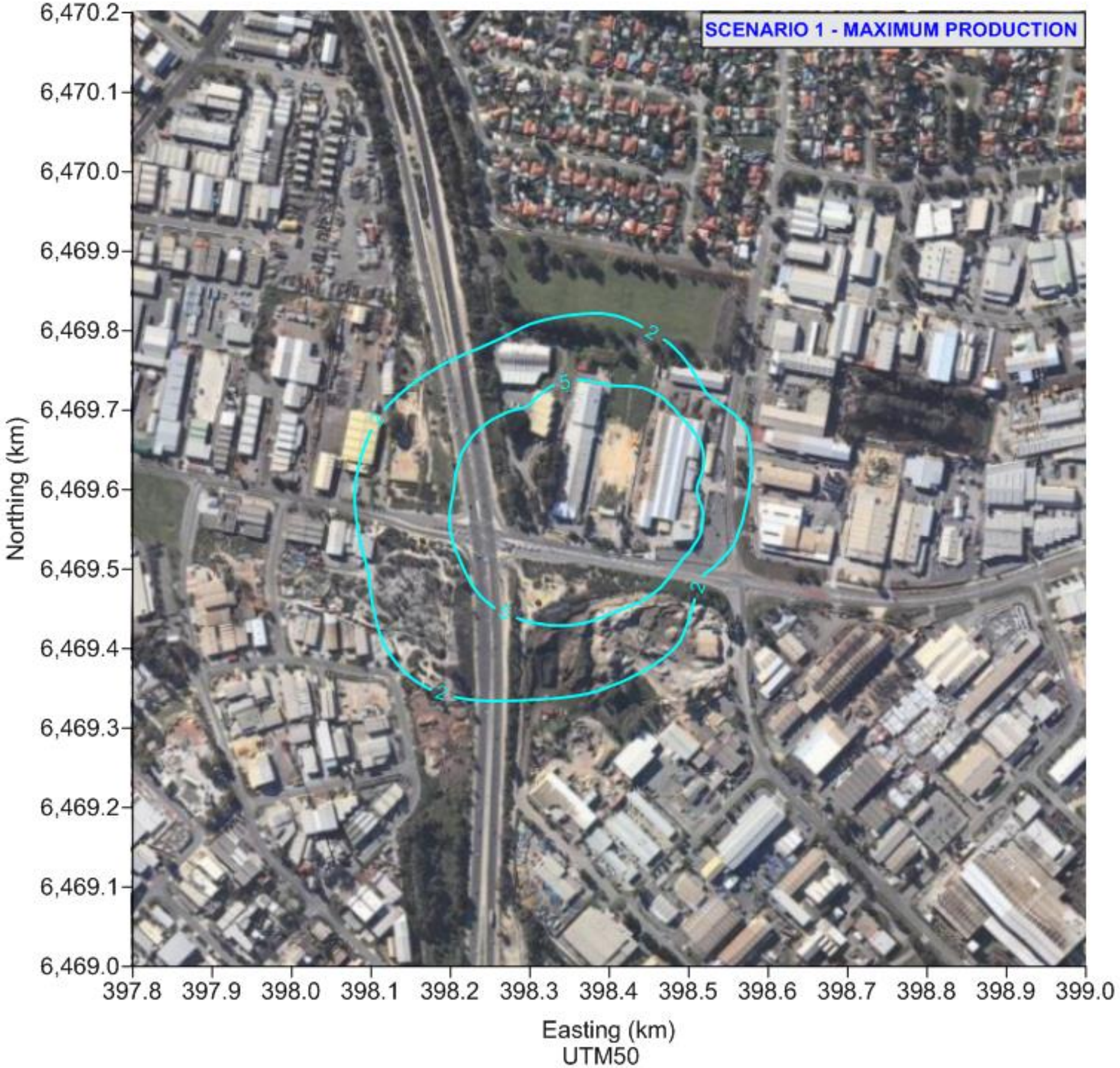
WA Limestone Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 2 - INCREMENT

Project No.	Date
675.10817	03/11/2014

Contour Plots



Predicted Annual Average TSP Concentrations (µg/m³)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR
240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

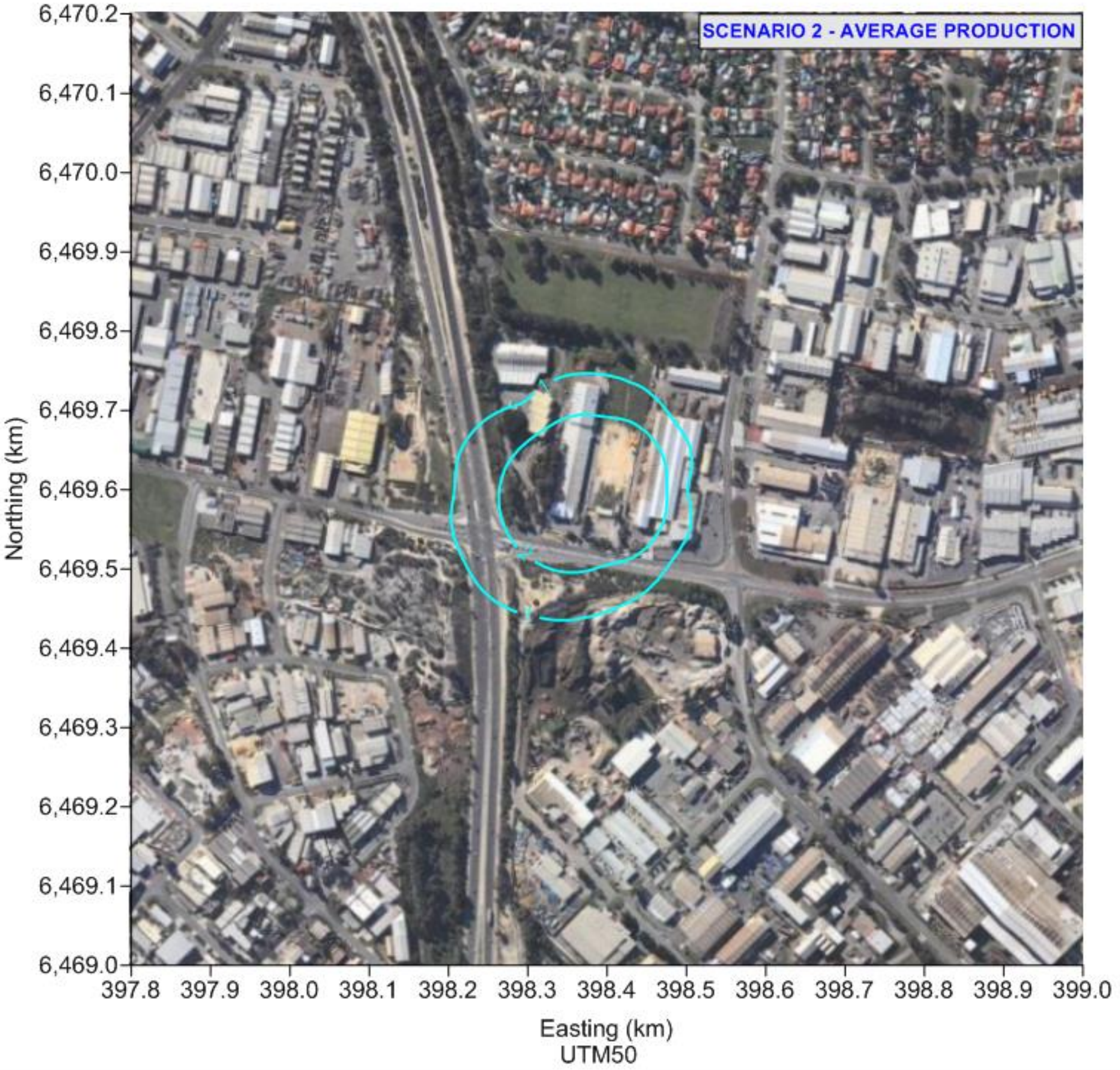
WA Limestone Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 1 - INCREMENT

Project No. 675.10817 | Date 03/11/2014

Contour Plots



Predicted Annual Average TSP Concentrations (µg/m³)

LEGEND

NOTES

Dispersion Model: Ausplume

Modeller: FR

N

SLR
240 Waterworks Road
Ashgrove
QLD 4060
T: +61 7 3858 4800
F: +61 7 3858 4801
www.slrconsulting.com

WA Limestone
Concrete Batching Plant Project

AIR DISPERSION MODELLING STUDY FOR WA LIMESTONE PROJECT

SCENARIO 2 - INCREMENT

Project No. 675.10817 | Date 03/11/2014