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Cement Australia

Proposed Port of Melbourne Mill

Air Quality Assessment

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Executive Summary

Cement Australia is proposing to build a Granulated Blast Furnace Slag (GBFS) grinding station in Port Melbourne, Victoria, Australia. Vipac Engineers & Scientists (Vipac) have been engaged to provide an air quality assessment for the proposed development.

The impact assessment has been carried out for the assessment of the proposed grinding station emissions as follows:

- An emissions inventory of PM10, PM2.5, NO_2 and SO_2 for the proposed Project was compiled using manufacturer specification data including a range of pollution control measures for the operation of the Project. A Mill Stack height of 52m was assessed in the modelling.
- The emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of measured meteorological data from the closest BoM Station, The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the AERMOD dispersion model with reference to the requirements of the EPA Publication 1551 – Guidance notes for using the regulatory air pollution model AERMOD in Victoria.
- The atmospheric dispersion modelling results were assessed by comparison with the assessment criteria described in Guideline for Assessing and Minimising Air Pollution in Victoria and the National Environment Protection Measure.

Table ES-1 provides the maximum model predictions at the most affected sensitive receptor for the grinding station emissions in isolation and including a conservative estimation of background (i.e. cumulative) at 52m and compares them with the assessment criteria. While a conservative approach has been adopted for the assessment, the modelled concentrations at all sensitive receptors are predicted to be well below the criteria.

The emissions from the operation of the proposed Project are not predicted to adversely impact upon the sensitive receptors.

Table ES-1: Maximum Predicted Concentrations for a 52m Mill Stack Height

Pollutant	Averaging Period	Criteria ($\mu g/m^3$)	Maximum Prediction at Any Receptor -In Isolation ($\mu g/m^3$)	Cumulative Maximum Prediction at Any Receptor – Cumulative ($\mu g/m^3$)	Compliant
PM_{10}	24-hour	50	0.52	20.72	✓
	Annual	25	0.06	14.16	✓
$PM_{2.5}$	24-hour	25	0.52	8.92	✓
	Annual	8	0.06	6.96	✓
NO_2	1 Hour	160	18.88	72.27	✓
	Annual	30	0.31	20.85	✓
SO_2	1 Hour	290	5.01	32.69	✓
	24 Hour	57	0.72	7.64	✓

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1 INTRODUCTION

Vipac Engineers & Scientists (Vipac) have been engaged by Cement Australia to provide an air quality assessment for a proposed Granulated Blast Furnace Slag (GBFS) grinding station in Port Melbourne, Victoria, Australia.

1.1 PROJECT BACKGROUND

1.1.1 OVERVIEW

Cement Australia is proposing to build a Granulated Blast Furnace Slag (GBFS) grinding station in Port Melbourne, Victoria, Australia.

The facility will receive GBFS from ships docked at berth 33 (Figure 1-1). The GBFS will be transferred from the ship to hoppers and then transferred via a series of conveyor belts to a GBFS storage shed. The GBFS will be reclaimed from the shed, ground through a vertical roller mill producing Ground Granulated Blast Furnace Slag (GGBFS) and then stored in a silo ready to be dispatched into either single or B-Double tankers over two weighbridges.

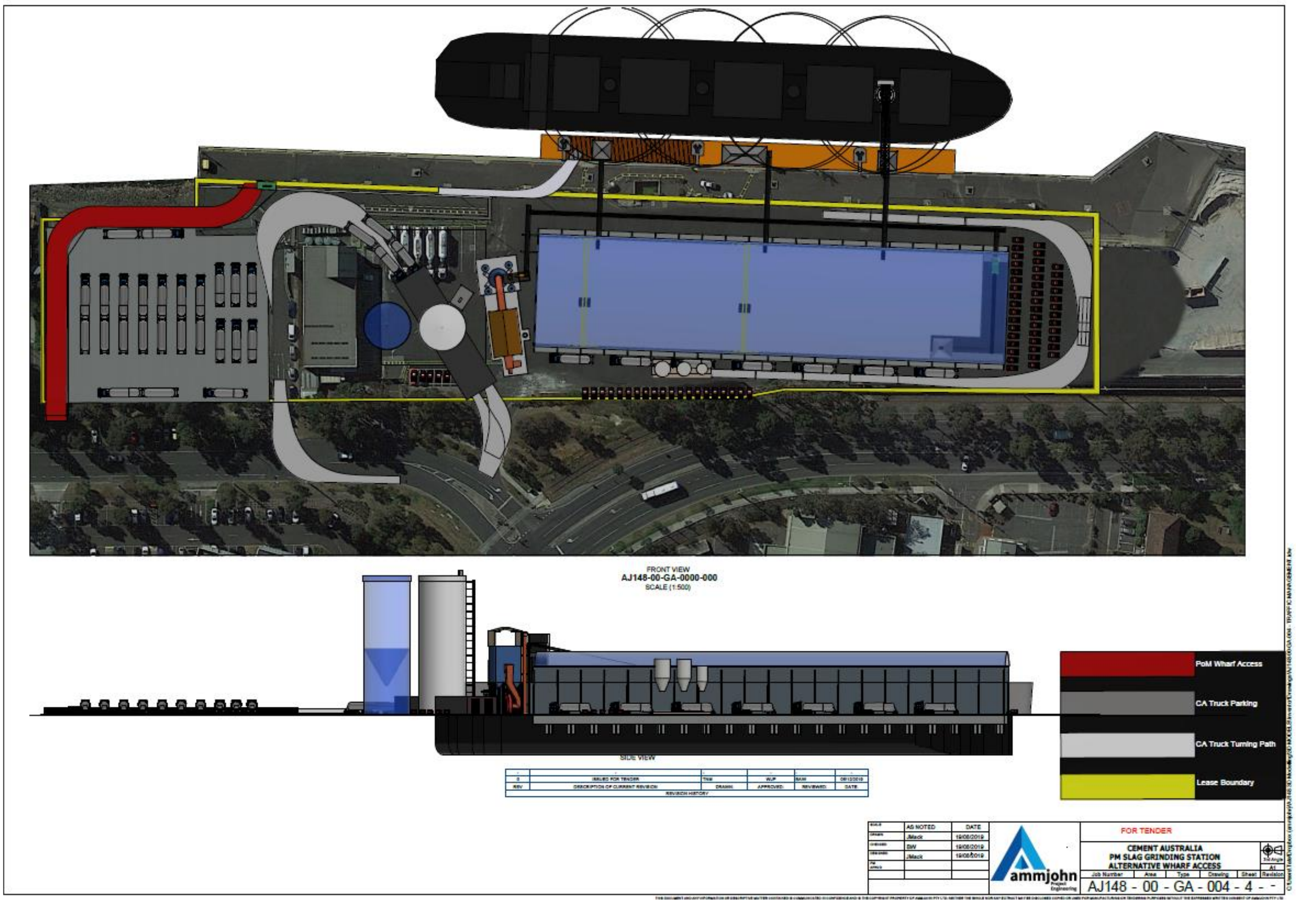


Figure 1-1: Proposed Site Layout

1.2 SITE LOCATION

Figure 1-2 shows the approximate subject site and surrounding area. The site is located at 465 Lorimer St, Port Melbourne, and occupies Berths 32, 33 and 34 South Wharf. The site is located within the local government of Melbourne City Council, and within the Port of Melbourne jurisdiction. The surrounding land use is either industrial or port zoned with the closest residential zone approximately 1.7km to the south.

1.2.1 SENSITIVE RECEPTORS

Seven sensitive receptors were adopted for the modelling scenario. Six of these receptors (R2 to R7) were selected as representative of the residential zone closest to the proposed site and the remaining receptor as the PoM Training Centre that neighbours the site. While this receptor is not considered as a sensitive location such as a school, hospital or residence, it is included for conservatism.

Table 1-1 outlines the locations of the modelled sensitive receptors.

Table 1-1: Sensitive Receptor Locations

Receptor ID	**Name**	**Location (UTM)**	
		Easting (m)	**Northing (m)**
R1	PoM Training Centre	315962	5811789
R2	Yarraville 1	314788	5811832
R3	Yarraville 2	314827	5812132
R4	Yarraville 3	314865	5814231
R5	Yarraville 4	314893	5812703
R6	Garden City 1	316659	5810240
R7	Garden City 2	317159	5810369

Figure 1-2: Location of the Site and Surrounding Area

1.3 PROJECT DESCRIPTION

1.3.1 PRODUCT RECEIVING

Standard Open-hold ships will be berthed at Berth 33SW and will unload Granulated Blast Furnace Slag (GBFS) into three separate fixed hoppers located on the berth utilizing the ships cranes and stevedore supplied grabs. The ships grabs shall be operator controlled (radio) for opening/closing actuation. Dust collection/mitigation systems are not intended for the hoppers as the moisture content of the GBFS is between 6 and 12%.

The hoppers shall distribute material to a belt conveyor system that will transfer the GBFS to the storage shed.

1.3.2 STORAGE SHED

A storage shed capable of storing 37,000T (37kT) of GBFS shall be constructed on the site. The shed itself shall be fully enclosed and shall be fitted with internal gantry cranes that shall reclaim and redistribute the material within the shed. Material will be reclaimed within the shed and deposited to a reclaim hopper that transports material to the milling circuit.

The shed itself will be non-habitable, with no operator interaction required beyond infrequent maintenance activities.

1.3.3 MILLING CIRCUIT

The milling circuit, in broad terms, is comprised of the following:

- Vertical Roller Mill: When the product reaches the mill, it falls onto a rotating steel table. The centrifugal force of this rotation shifts the materials to the grinding rollers where product is ground to an appropriate fineness (blaine).
- Hot Gas Generator: Fired by natural gas, the Hot Gas Generator is required to dry the GBFS which contains between 6 – 12% moisture.
- Process Fan: A large Process Fan is integrated into the mill circuit which maintains a negative pressure within the Vertical Roller Mill, provides air circulation for drying and the energy required to convey the ground product to the Separator and into the Main Process Bag Filter for collection.
- Separator: A Separator separates the product leaving the mill circuit directing oversize product back to the grinding table for further processing with the balance (being the finished product) going to the Process Bag filter.
- Process Bag Filter: The Process Bag Filter separates the product from the process air. The cleaned process air is partially recirculated back to the mill and the remainder exhausted through the exhaust stack. The product clinging to the bags on the Process Bag Filter is released by "pulse jets" of air and the finished product is captured at the bottom of the baghouse for transfer to the silo.

1.3.4 FINISHED PRODUCT TRANSFER AND STORAGE

The finished product is transferred via sealed conveyors and bucket elevators from the Mill Circuit Process Bag Filter to a single 3,500T steel silo. The silo and the transfer systems are fitted with dust collection systems to mitigate fugitive dust emissions.

1.3.5 PRODUCT DISPATCH

Product dispatch will be via the loading of pneumatic road tankers from the storage silo. The driver of the vehicle attaches a "load spout" to the vehicle to allow the product to be deposited into the vehicle.

Weighbridges are located beneath the silo to gauge the weight of the product being dispatched to ensure that the vehicle does not exceed its gross vehicle mass (GVM) and to determine the supply to the customer. The loading of the trucks is via an automated control system which requires the driver to be engaged in the process throughout the filling of the vehicle. The data which is entered provides a record of the product that is loaded, the quantity obtained and identifies the purchaser.

Air displaced from the pneumatic trucks during the loading of the tankers is ducted back through the truck loading spout and collected by its corresponding dedusting system to ensure there are no fugitive dust emissions.

Should trucks be inadvertently filled beyond their GVM, provision will be made on site to "pump" back the excess product. This is uncommon as the control system is programmed with each truck's GVM to prevent overloading.

1.3.6 PRODUCT TRANSFERS AND FUGITIVE DUST

All potential emissions will be controlled. GBFS has relatively high moisture content and is transported in covered conveyors, and consequently does not generate dust.

The GBFS storage shed will be fully enclosed to further mitigate the opportunity for fugitive dust emission from the storage shed.

Dust collectors will be utilised throughout the transportation of the final product to ensure there are no fugitive dust emissions.

The mill will be supported by a baghouse to collect product manufactured in the grinding process. The product that is located in the baghouse will either be transferred to the silo pending dispatch or returned to the mill for further grinding. If any failures are detected, operations are suspended automatically until the matter is resolved. Furthermore, all 'dust' constitutes 'finished product' and represent an economic return for Cement Australia which provides additional impetus for its collection.

The only potential visible emissions to occur will be water vapour when water is converted to steam during the heating process associated with the manufacture of product.

Any air displaced from pneumatic road tankers is processed through the truck loading dust extractors to ensure there is no loss of product and that there are no fugitive dust emissions.

1.3.7 ELECTRICAL SUBSTATIONS

Electrical substations shall be constructed as required throughout the facility to provide power and controls to the Grinding Facility. It is envisaged that power will be brought to the site at 11kV and stepped down to various voltages dependent on vendor equipment selection – nominally, 3.3kV, 690V and 400V systems.

1.3.8 PLANT ROOMS

A plant Room will be constructed adjacent the mill to house the following:

- Hydraulic Tensioning Systems for grinding
- Lubrication Systems for the Mill, and
- Compressed Air Systems for process.

1.3.9 OFFICE, LABORATORY, WORKSHOP AND AMENITIES

At this stage it is envisaged that the existing Office and Workshop complex will remain. Notwithstanding that, the following additional works are envisaged:

- Modifications to existing Office Complex
- Installation of Ablutions/Amenities connected to the main sewer, and
- Construction of a small laboratory for final product testing.

1.3.10 TRUCK AND VEHICLE PARKING

Currently Cement Australia uses the available sealed areas for parking cement tankers when not in use and for employee parking within the "old" 33 South Wharf Lease.

In conjunction with the Grinding Facility construction, the site now comprising part of 32 SW, all of 33 SW and part of 34 SW, will be configured so available space throughout the facility may be used for Truck and Vehicle parking. Further, the area comprising 34SW will be set up exclusively for truck parking as shown in the reference drawings contained in the appendices.

1.3.11 MATERIAL PROPERTIES

1.3.11.1 GRANULATED BLAST FURNACE SLAG (GBFS)

GBFS is a by-product of the steel industry. During iron production slag is produced. This slag rises and accumulates on the surface of the iron. The slag accumulating on the surface is in turn tapped' where it is passed through water to cool. The cooled slag (GBFS) has the following properties:

- A chemical composition similar to clinker and consequently can be used as a cementitious product,
- A moisture content of approximately 6-12%, and
- Is chemically inert, and has no known hazardous reactions or decomposition products.

1.3.11.2 GROUND GRANULATED BLAST FURNACE SLAG (GGBFS)

GGBFS is the ground finished product and is comprised of 100% GBFS. The process of producing GGBFS requires the removal of the moisture from the GBFS and this is achieved by the addition of hot air.

The GGBFS is inert in nature and chemically stable. It is slightly soluble in water, and produces an alkaline solution with a pH between 10 to 12. GGBFS should be kept free of moisture.

2 LEGISLATIVE REQUIREMENTS

2.1 NATIONAL ENVIRONMENTAL PROTECTION MEASURE

Australia's first national ambient air quality standards were outlined in 1998 as part of the National Environment Protection Measure for Ambient Air Quality.

The Ambient Air Measure sets national standards for the key air pollutants; carbon monoxide, ozone, sulphur dioxide, nitrogen dioxide, lead and particles (PM10 and PM2.5). The Air NEPM requires the state governments to monitor air quality and to identify potential air quality problems.

2.2 GUIDELINE FOR ASSESSING AND MINIMISING AIR POLLUTION IN VICTORIA

The Guideline for Assessing and Minimising Air Pollution in Victoria provides a framework to assess and control risks associated with air pollution. It is a technical guideline for air quality practitioners and specialists with a role managing pollution discharges to air.

In Victoria, The Environment Protection Act, 2017 (the EP Act) provides the main legislative instrument for the protection of the environment within the State of Victoria. Under the EP Act all risks to human health and environment from pollution and waste must be minimised so far as reasonably practicable.

The contents of this guideline constitute guidance under this Act. This guideline provides duty holders with an approach to minimising risks in a proportionate way. The guideline aims to achieve this objective by providing:

- A clear framework for air pollution assessment and management that protects the environmental values of air (as defined in the Environment reference standards (ERS)) to ensure risks of harm to human health and the environment are minimised so far as reasonably practicable.
- Guidance on methods for assessing risk of harm from air pollution to human health and the environment. This includes a broad risk-based assessment framework, site-specific risk assessment methods, and risk-based air quality assessment criteria (AQACs).
- A conceptual framework for identifying and selecting risk management techniques and technologies to ensure that risks are minimised so far as reasonably practicable.
- Clarity on EPA’s expectations for the minimum reporting standards related to the assessment and management of air pollution in Victoria.

2.2.1 AIR QUALITY ASSESSMENT CRITERIA

AQACs are concentrations of pollutants in air that provide a benchmark to understand potential risks to human health or the environment. They are risk-based concentrations that can help identify when or if an activity is likely to pose an unacceptable risk to the receiving environment.

AQACs are not intended to be concentrations one can ‘pollute up to’. They are also not concentrations below which no action is required. This is because under the GED, anyone engaging in an activity that may give rise to risks of harm to human health or the environment due to discharges to air is required to minimise those risks so far as reasonably practicable.

For criteria pollutants, the relevant objectives specified in the proposed final Environment Reference Standards 14 December 2020 (ERS) should always be adopted as AQACs. Should the ERS be updated at any point in time (for example to implement a variation to the Air NEPM), then this updated ERS objective will apply as the AQAC objective.

2.3 APPLICABLE CRITERIA

The applicable criteria for this assessment are presented in Table 2-1.

Table 2-1: Project Air Quality Goals

Pollutant	Basis	Criteria (μg/m³)¹	Source	Averaging Time
PM_{10}	Human Health	50	ERS	24-hour
	Human Health	25	ERS	Annual
$PM_{2.5}$	Human Health	25	ERS	24-hour
	Human Health	8	ERS	Annual
Nitrogen Dioxide	Human Health	160	ERS	1-hour
	Human Health	30	ERS	Annual
Sulphur Dioxide	Human Health	290	ERS	1-hour
	Human Health	57	ERS	1-day

1. gas concentrations at 0^0C and 1 atmos.

3 EXISTING ENVIRONMENT

3.1 LOCAL SETTING

The development is located at 465 Lorimer St, Port Melbourne, Victoria. The surrounding land use is either industrial or port zoned with the closest residential zone approximately 1.7km to the south.

3.2 TERRAIN

The terrain surrounding the development is predominantly flat with AHD of approximately 3m. The terrain data captured from NASA's Shuttle Radar Topography Mission (SRTM) at approximately 90m resolution (3-arc seconds).

3.3 DISPERSION METEOROLOGY

3.3.1 REGIONAL METEOROLOGY

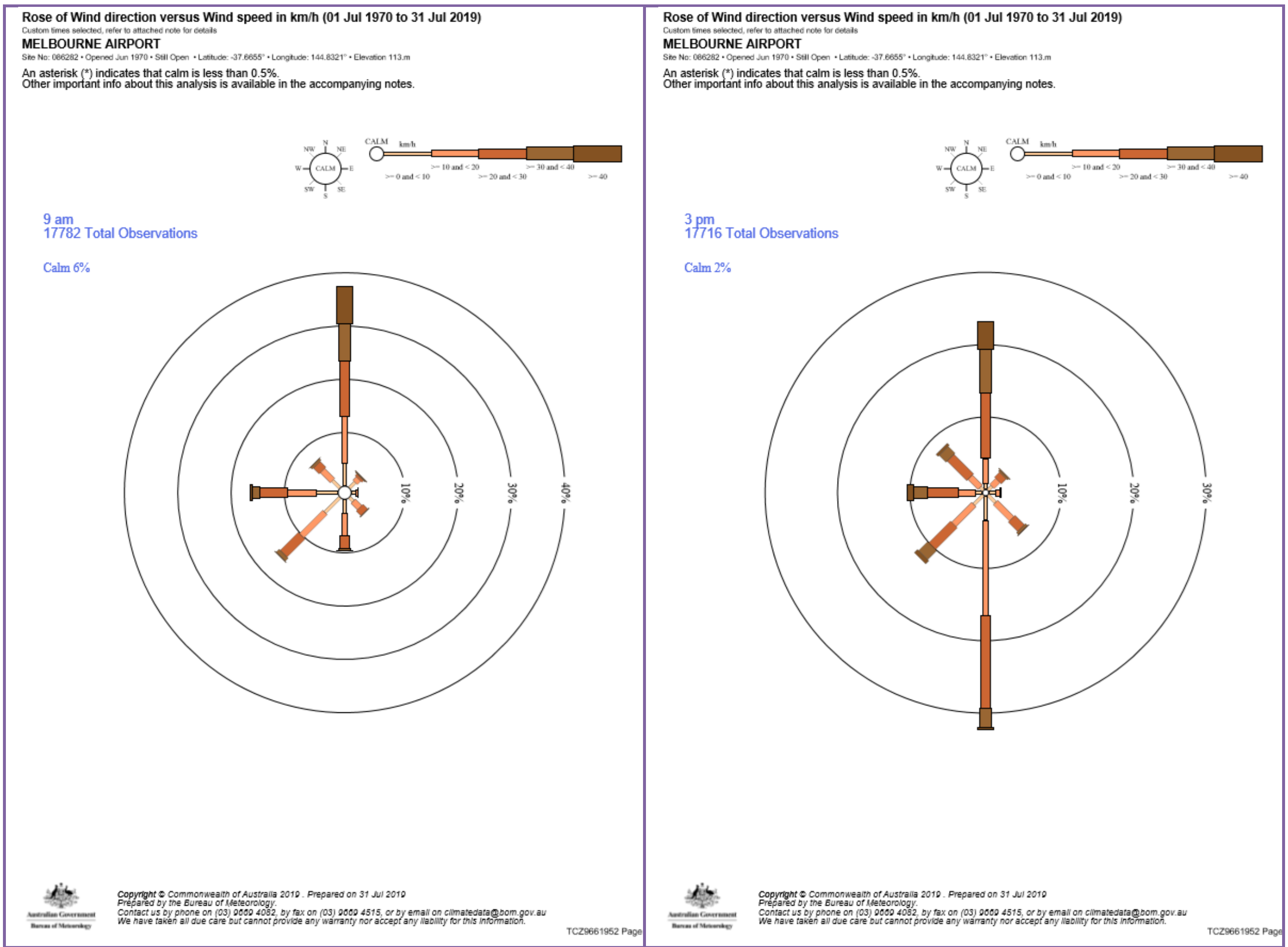
Data recorded by the nearest Bureau of Meteorology (BoM) long term weather stations for which data was available at Melbourne Airport (located approximately 13km north of the site) were reviewed to describe the meteorological and climatic influences in the region. Long term weather data obtained from the BOM weather station at Melbourne Airport is presented in Table 3-1).

The mean temperature range is between 5.2°C and 26.6°C with the coldest month being July and the hottest, January and February. The rainfall in the region is variable, with most rainfall in the warmer months. On average, most of the annual rainfall is received between October and December. The mean annual rainfall is approximately 535 mm.

The long term wind roses recorded daily at the Melbourne Airport station at 9am and 3pm are provided in Figure 3-1. Winds are shown to be primarily from the north at 9am and from the south and north at 3pm. Stronger winds (>40km/hr or >11.1m/s) occur infrequently mostly from the north at 3pm.

Table 3-1: Mean Long-term Weather Data for Melbourne Airport

Month	Mean Temperature (1970-2020)		Mean Rainfall (1970-2020) (mm)	9 am Conditions			3 pm Conditions		
	Max (°C)	Min (°C)		Temp (1970-2010) (°C)	RH (1970-2010) (%)	Wind Speed (1970-2010) (km/h)	Temp (1970-2010) (°C)	Mean RH (1970-2010) (%)	Wind Speed (1970-2010) (km/h)
Jan	26.6	13.8	42.5	18.1	65	18.5	24.3	44	22.3
Feb	26.6	14.2	41.5	18	69	17	24.8	44	21.2
Mar	24.2	12.8	37.2	16.6	70	16.9	22.5	47	20.6
Apr	20.4	10.2	44.8	14.2	72	16.7	19	52	19.9
May	16.7	8.3	40	11.3	79	17.2	15.6	60	19.7
Jun	13.7	6.2	40.3	8.7	83	18.3	12.6	67	20.8
Jul	13.2	5.5	35.2	8	81	20.2	12	65	22.7
Aug	14.4	5.9	44.3	9.1	77	21.6	13.2	59	23.9
Sep	16.8	7.1	46.1	11.3	72	22.1	15.2	56	24.4
Oct	19.5	8.5	52.8	13.6	66	21.8	17.6	52	23.5
Nov	22.2	10.4	61.4	15	67	19	20.2	49	22.4
Dec	24.7	12.1	50.6	16.8	64	18.7	22.4	45	22.7
Annual	19.9	9.6	534.9	13.4	72	19	18.3	53	22



Location: **Melbourne Airport BoM Station**	**Data Period:** 1970 to 2019	**Data Type:** Measured Data

Figure 3-1: Annual Wind Rose for Melbourne Airport Weather Station (1970 to 2019)

3.3.2 LOCAL METEOROLOGY

3.3.2.1 INTRODUCTION

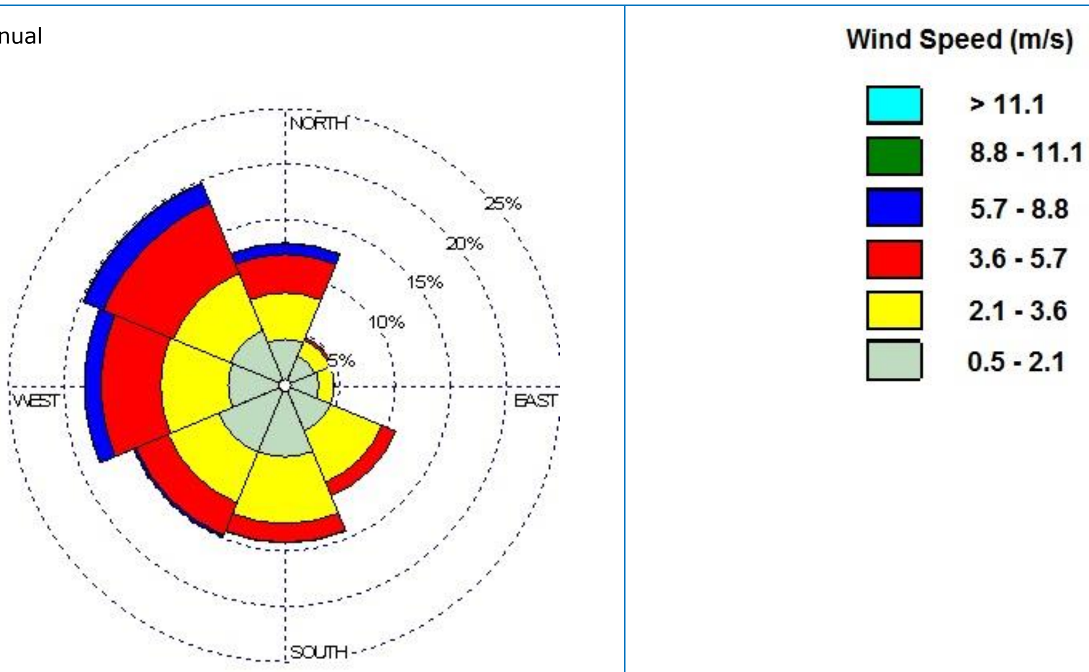
A three dimensional meteorological field was required for the air dispersion modelling that includes a wind field generator accounting for slope flows, terrain effects and terrain blocking effects. The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research and can be used to develop meteorological input files for the AERMOD dispersion model for each hour of the modelling period (2012 to 2016). The TAPM derived dataset for 12 continuous months of hourly data from the year 2016 has been used to provide further information on the local meteorological influences. Details of the modelling approach are provided in Section 6.

3.3.2.2 WIND SPEED AND DIRECTION

Figure 3-2 presents the annual wind rose from the TAPM derived dataset for the year 2016 at the development location. In addition, the 9am and 3pm wind roses from the TAPM derived dataset at the closest long term BoM station (Melbourne Airport are provided for comparison with the long term data collected at that location. Key features of the winds are:

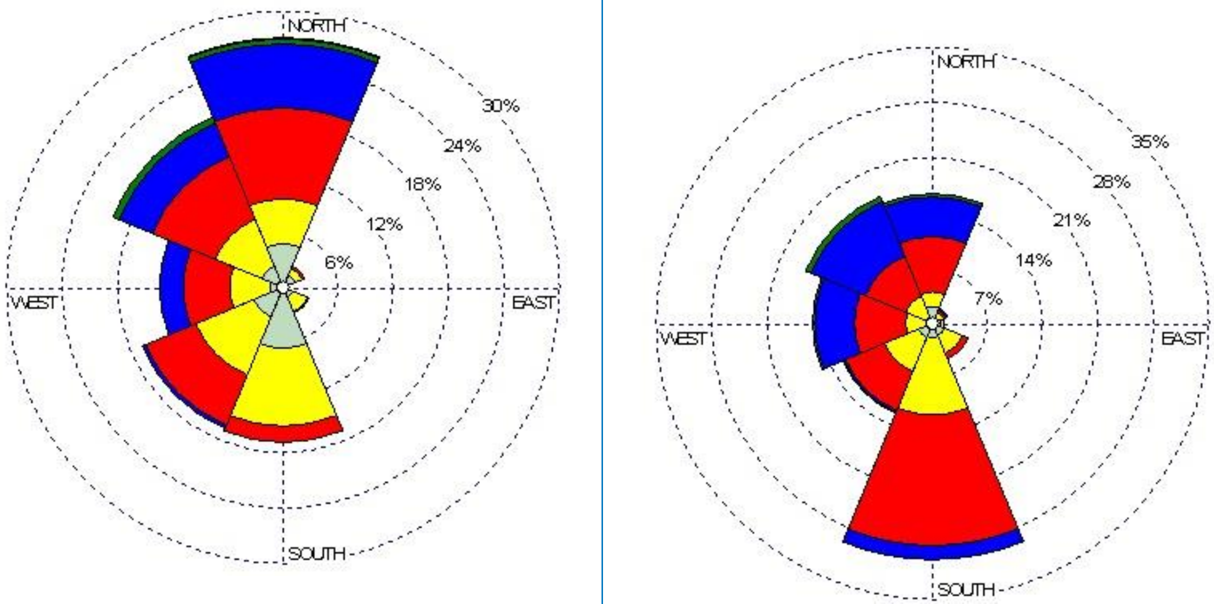
- Winds are predominantly from the northwest to southwest with average wind speed of 2.8 m/s;
- The strongest winds (>5.7m/s) occur from the west and northwest; and
- The 9am and 3pm wind roses for the TAPM derived dataset at Melbourne Airport are generally consistent with the long term measured data from the Melbourne Airport BoM Weather Station.

Annual



Location: Site	**Data Period:** Jan 2016 to Dec 2016	**Data Type:** TAPM extract

9am **3pm**



Location: Melbourne Airport	**Data Period:** Jan 2016 to Dec 2016	**Data Type:** TAPM extract

Figure 3-2 Annual and 9am and 3pm Wind Roses for the TAPM Derived Dataset, 2016

3.3.3 ATMOSPHERIC STABILITY

The Pasquill-Gifford stability classification scheme denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small. Figure 3-3 shows the stability class percentages from the

TAPM derived meteorological data for the project site. The data identifies that Stability Class D is the most common; this stability class is indicative of neutral conditions neither enhancing nor impeding odour dispersion.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds.

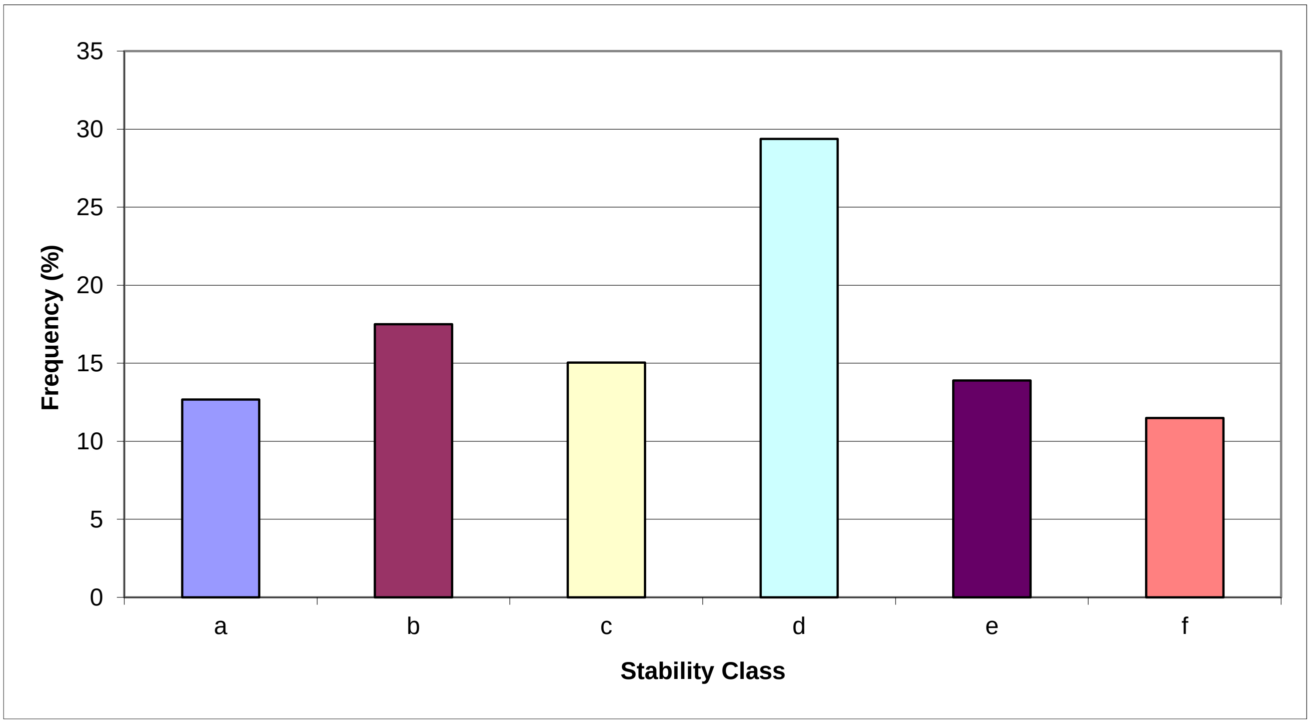


Figure 3-3 Stability Class Percentages for the TAPM Derived Data, 2014

3.3.4 MIXING HEIGHT

Mixing height is defined as the height of the layer adjacent to the ground over which an emitted or entrained inert non-buoyant tracer will be mixed (by turbulence) within a time scale of about one hour or less.

Diurnal variations in mixing depths are illustrated in Figure 3-4. As would be expected, an increase in the mixing depth during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

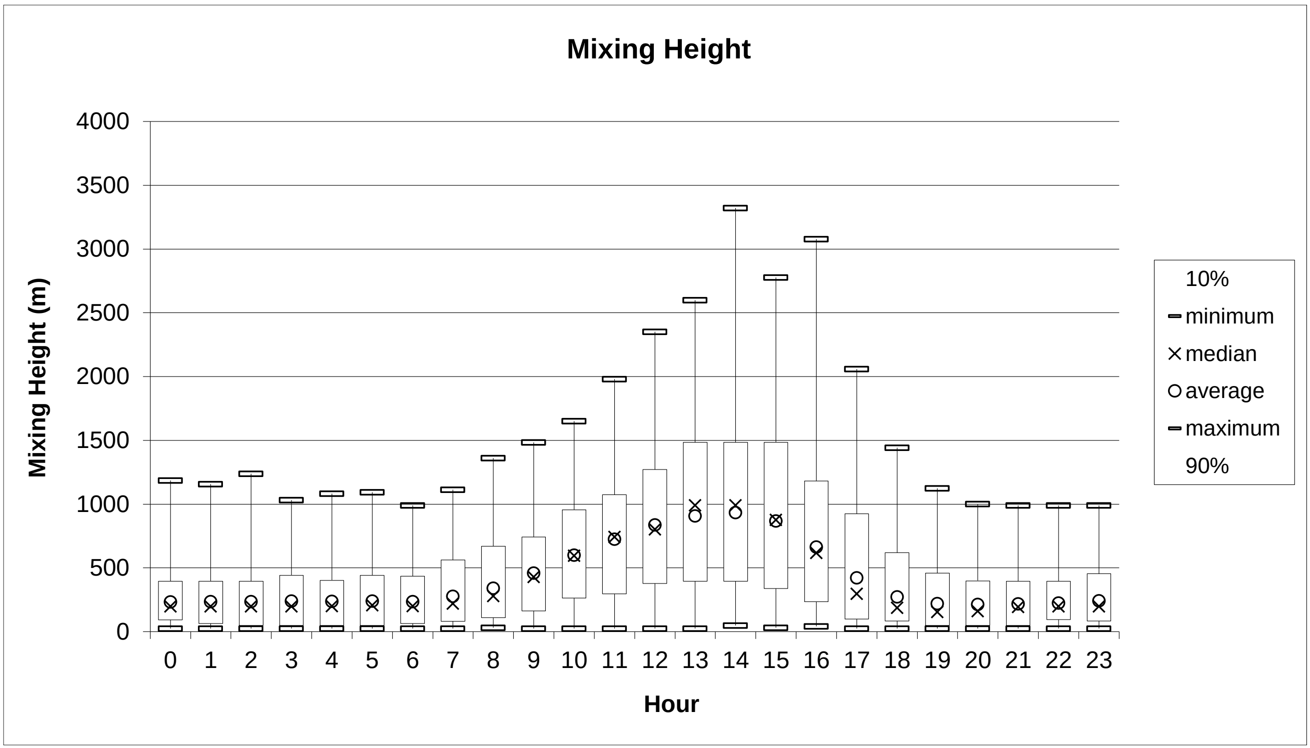


Figure 3-4 Mixing Height of the TAPM Derived Data, 2016

4 METHODOLOGY

4.1 OVERVIEW

The impact assessment has been carried out for the assessment of the proposed Project emissions as follows:

- An emissions inventory of PM10, PM2.5, NO_2 and SO_2 for the proposed Project was compiled using manufacturer specification data as provided by Cement Australia for the operation of the Project (outlined in Section 4.2).
- The emissions data was used as input for air dispersion modelling. The modelling techniques were based on a combination of measured meteorological data from the closest BoM Station, The Air Pollution Model (TAPM) prognostic meteorological model (developed by CSIRO), and the AERMOD dispersion model with reference to the requirements of the EPA Publication 1551 – Guidance notes for using the regulatory air pollution model AERMOD in Victoria.
- The atmospheric dispersion modelling results were assessed by comparison with the assessment criteria described in the Guideline for Assessing and Minimising Air Pollution in Victoria and the National Environment Protection Measure, described in Section 2.2.1.

4.2 EMISSIONS INPUT PARAMETERS

4.2.1 EMISSIONS SCENARIOS

Emissions to air from the operational stage of the proposed Project have been included in this assessment for the worst-case operational data as provided by Cement Australia and conservatively modelled as 24/7. The worst-case emissions are derived from maximum allowable emissions for the identified sources.

4.2.2 EMISSION CONTROLS & ESTIMATION INPUTS

As discussed in Section 4.2.1, the emissions to air from the operational stage of the proposed Project have been included in this assessment for the worst-case operational data as provided by Cement Australia and the Mill Supplier. The primary assumptions and controls that will be adopted and used in the derivation of these emissions are as follows:

- The maximum achievable finished product rate is 63tph and maximum truck loading rate is 160tph.
- GBFS of high moisture content will be received and transferred by an enclosed belt conveyor to a fully enclosed storage shed for subsequent distribution to the milling circuit.
- Bag filters are proposed for collection of dust from the discharge points. The dust emissions are derived from the estimated maximum dust concentrations released into the atmosphere following capture by these filters.
- Combustion emissions are conservatively based on a maximum hourly natural gas consumption and maximum expected concentrations of contaminants.
- At least 55% of the airflow passed through the bag filters is returned to the mill for energy efficiencies.

Table 4-1 summarises the data adopted to derive the emissions.

Table 4-1: Summary of emissions data inputs

Parameter	Value	Unit	Comment
Plant Capacity	400,000	tonnes	Ground Granulated Blast Furnace Slag
Moisture	8 - 12	%	-
Mill Rate	63	tph	Finished Product Rate
Natural Gas Consumption	811	Nm^3/h	Maximum, based on air temp of 15 °C and maximum
	5,148,005	Nm^3/h	Total per annum
NOX emissions	505	kg/annum	NO_x Max = 48 ppm from Mill Supplier
SOX emissions	133.88	kg/annum	SO_x Max < 9 ppm from Mill Supplier
Mill Air Exit Temp	95	°C	-
	192,000	m^3/h	At 95 °C

Air Flow through Mill	142,435	Nm^3/h	-
Particulate (dust emission)	10	mg/Nm^3	Maximum, guarantee for the Process Bag Filter
Air discharged to stack	45	%	Maximum, significant part of airflow returned to mill -
Mill Process	0.640958	kg/hr	Maximum dust emissions to atmosphere
	4.07	tonnes	Maximum total per annum
	15.38	kg/day	Maximum total per day
Fugitive Dust Collectors	10	mg/Nm^3	Guarantee for the Nuisance Bag Filters
Loading Spouts	900	Nm^3/h	Air to be collected, based on Silo Blower $10m^3/min$ and Airslide Fan $5m^3/min$
	160	tph	-
	0.009	kg/hr	Maximum dust emissions to atmosphere
	22.500	kg	Maximum total per annum
	0.062	kg/day	Maximum total per day
Silo	1,600	Nm^3/h	Air flow through silo filter
	0.016	kg/hr	Maximum dust emissions to atmosphere
	101.587	kg	Total per annum
	0.278	kg/day	Total per day
Transfer Points	2,000	Nm^3/h	Air flow through transfer point filter
	0.020	kg/hr	Maximum dust emissions to atmosphere
	126.984	kg	Total per annum
	0.348	kg/day	Total per day

4.2.3 SOURCE EMISSIONS DATA

The source emissions input data relevant to the modelling of air emissions for the routine operation of the Project were derived from the supplied data. As discussed in Section 1.3, GBFS of high moisture content will be received and transferred by belt conveyor to a fully enclosed storage shed for subsequent distribution to the milling circuit. The primary emissions point is the mill stack which will be equipped with a baghouse filter. The finished product is transferred via sealed conveyors and bucket elevators from the Mill Circuit Process Bag Filter to a single 3,500T steel silo. The silo and the transfer systems are fitted with dust collection systems to mitigate fugitive dust emissions.

Table 4-2 summarises the point source emissions data including proposed air pollution controls and the locations of the sources.

Table 4-2: Point source emissions data

ID	**UTM Coordinates**		**Stack height (m)**	**Stack diam (m)**	**Exhaust temp (°C)**	**Exit velocity (m/s)**	**Emission rate (g/s)**			**Pollution Control**
	East (m)	**South (m)**					**SO_2**	**NO_x**	**PM[a]**	
Mill Stack	3161,121	5811,837	52	2.2	95	9.5	1.03	3.88	0.18	Baghouse filter
Loading Spout 1	316,170	5811,845	5	0.6	20	0.88	-	-	0.003	Baghouse filter
Loading Spout 2	316,176	5811,847	5	0.6	20	0.88	-	-	0.003	Baghouse filter

Silo	316,101	5811,830	40	0.6	20	1.57	-	-	0.004	Baghouse filter
Transfer point	316,185	5811,849	20	0.6	20	2.0	-	-	0.006	Baghouse filter

a PM emission rate conservatively modelled as PM_{10} and $PM_{2.5}$ emissions.

4.3 MODELLING METHODOLOGY

The meteorological data used in the dispersion modelling was processed in two steps. Synoptic scale meteorological data were first processed in The Air Pollution Model (TAPM) for supplementary data and then further processed with reference to the EPA Victoria guidelines "Construction of input meteorological data files for EPA Victoria's regulatory air pollution model (AERMOD)" to produce the wind field and weather data suitable for dispersion modelling with AERMOD. The TAPM modelling methodology is discussed in Section 4.3.1.

4.3.1 TAPM

The Air Pollution Model, or TAPM, is a three-dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. TAPM solves the fundamental fluid dynamics and scalar transport equations to predict meteorology and (optionally) pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflow important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses. TAPM's output for five consecutive years was exported as a surface and upper air station approximating to the site location.

TAPM was configured as follows:

- Centre coordinates – 37.83°S, 144.91°E;
- Dates modelled:
    - 30 December 2011 to 1 January 2013 (2 start-up days)
    - 30 December 2012 to 1 January 2014 (2 start-up days)
    - 30 December 2013 to 1 January 2015 (2 start-up days)
    - 30 December 2014 to 1 January 2016 (2 start-up days)
    - 30 December 2015 to 1 January 2017 (2 start-up days)
- Four nested grid domains of 30 km, 10 km, 3 km and 1 km;
- 41 x 41 grid points for all modelling domains;
- 25 vertical levels from 10 m to an altitude of 8000 m above sea level; and
- The default TAPM databases for terrain, land use and meteorology were used in the model.

4.3.1.1 MEASURED METEOROLOGICAL DATA INPUTS

Measured hourly meteorological data from the BoM Station at Melbourne Airport was used for compilation of the dataset for modelling including:

- 10m wind direction and wind speed; and
- Ambient temperature

4.3.2 AERMOD

Dispersion modelling of the emission source parameters outlined in Section 4.2.3, was undertaken using the currently approved version of the regulatory model in Victoria AERMOD. The following sections discuss the key inputs adopted for the modelling.

4.3.2.1 RECEPTOR GRID

The AERMOD receptor grid was set with a total of 2600 receptors with a southwest corner coordinates of 314871m E and 5810587m S using 50m resolution. The receptor grid also included 7 sensitive receptors representative of the residences and training centre on the site boundary closest to the mill activities.

4.3.2.2 AVERAGING PERIOD

Post processing of the 1-hour, 24-hour and annual average predictions.

4.3.2.3 BUILDING WAKES

The proposed site buildings were incorporated into the model for building wake effects.

4.3.2.4 TERRAIN

The terrain in the surrounding environment is predominantly flat with AHD of approximately 0m. As such, terrain effects were ignored in the modelling.

4.3.3 BACKGROUND

As no appropriate hourly background monitoring data exists for the site, the 70th percentile of observed pollutant concentrations is added as a constant value to the predicted maximum concentration from the model simulation. The background data was derived from the measured data from 2016 reported for the monitoring stations at Footscray for NO_2, PM_{10} and $PM_{2.5}$ and Altona for SO_2 (which is not measured at Footscray) in EPA Victoria publication 1551 (Table 4-3).

Table 4-3 – Background Pollutant Concentrations

Pollutant	Station	Averaging Time	Statistic	Concentration (µg/m³)	Criteria (µg/m³)
Nitrogen Dioxide	Footscray	1 Hour	70th percentile	53.4	160
		Annual	Average	20.5	30
Sulfur Dioxide	Altona	1 Hour	70th percentile	27.7	290
		24 Hour	70th percentile	6.9	57
PM_{10}	Footscray	24 Hour	70th percentile	20.2	50
		Annual	Average	14.1	25
$PM_{2.5}$	Footscray	24 Hour	70th percentile	8.4	25
		Annual	Average	6.9	8

5 RESULTS

Table 5-1 and Table 5-2 present the maximum predicted concentrations at the seven sensitive receptors modelled (in isolation and cumulative) for the gases and particulate pollutants for the Mill Stack height of 52m and compares them with the AQACs.

Appendix A provides the isopleth plots showing the spatial distribution of the maximum cumulative predictions for NO_2, SO_2, PM_{10} and $PM_{2.5}$ for the Project.

It is noted that the maximum predicted contribution of the proposed Project to the PM_{10} and $PM_{2.5}$ levels are approximately 2.5% and 5% of the predicted 24 hour average cumulative concentrations, respectively. In addition, the contribution of the proposed Project to the NO_2 and SO_2 levels are approximately 26% and 15% of the predicted 1 hour average cumulative concentrations, respectively. The contribution of the proposed Project emissions is much lower than background in all cases.

The results show that the maximum predicted concentrations are well below the relevant criteria at all receptors. The emissions from the operation of the proposed Project are not predicted to adversely impact upon the sensitive receptors.

Table 5-1: Maximum Predicted Concentrations for the 52m Mill Stack Height – NO_2 and SO_2

	In isolation				Cumulative			
ID	**NO_2 (µg/m³)**		**SO_2 (µg/m³)**		**NO_2 (µg/m³)**		**SO_2 (µg/m³)**	
Averaging time	**1 Hour**	**Annual**	**1 Hour**	**24 Hour**	**1 Hour**	**Annual**	**1 Hour**	**24 Hour**
R1	13.54	0.07	3.59	0.62	66.93	20.61	31.27	7.54
R2	6.39	0.05	1.70	0.55	59.78	20.59	29.38	7.47
R3	8.73	0.05	2.32	0.25	62.12	20.59	30.00	7.17
R4	11.13	0.10	2.96	0.54	64.52	20.64	30.64	7.46
R5	10.88	0.07	2.89	0.38	64.27	20.61	30.57	7.30
R6	18.88	0.31	5.01	0.72	72.27	20.85	32.69	7.64
R7	14.69	0.27	3.90	0.60	68.08	20.81	31.58	7.52
Criteria	**160**	**30**	**290**	**57**	**160**	**30**	**290**	**57**
Maximum Concentration	18.88	0.31	5.01	0.72	72.27	20.85	32.69	7.64
Criteria met?	✓	✓	✓	✓	✓	✓	✓	✓

Table 5-2: Maximum Predicted Concentrations for the 52m Mill Stack Height – PM_{10} and $PM_{2.5}$

	In isolation				**Cumulative**			
ID	**PM_{10} (µg/m³)**		**$PM_{2.5}$ (µg/m³)**		**PM_{10} (µg/m³)**		**$PM_{2.5}$ (µg/m³)**	
Averaging time	**24 Hour**	**Annual**	**24 Hour**	**Annual**	**24 Hour**	**Annual**	**24 Hour**	**Annual**
R1	0.52	0.06	0.52	0.06	20.72	14.16	8.92	6.96
R2	0.15	0.01	0.15	0.01	20.35	14.11	8.55	6.91
R3	0.10	0.01	0.10	0.01	20.30	14.11	8.50	6.91
R4	0.11	0.01	0.11	0.01	20.31	14.11	8.51	6.91
R5	0.11	0.01	0.11	0.01	20.31	14.11	8.51	6.91
R6	0.14	0.02	0.14	0.02	20.34	14.12	8.54	6.92
R7	0.12	0.02	0.12	0.02	20.32	14.12	8.52	6.92
Criteria	**50**	**25**	**25**	**8**	**50**	**25**	**25**	**8**
Maximum Concentration	0.47	0.06	0.47	0.06	20.72	14.16	8.92	6.96
Criteria met?	✓	✓	✓	✓	✓	✓	✓	✓

6 MITIGATION AND MONITORING

6.1 GENERAL POLLUTANT CONTROL MEASURES

As discussed in Section 4.2.2, the primary pollutant controls that will be adopted are as follows:

- GBFS of high moisture content will be received and transferred by belt conveyor to a fully enclosed storage shed for subsequent distribution to the milling circuit.
- Bag filters are proposed for collection of dust from the discharge points. The dust emissions are derived from the estimated maximum dust concentrations released into the atmosphere following capture by these filters.

6.2 MONITORING

Given the predicted low relative contribution of the proposed Project operating in isolation compared with background (see Section 5), an ambient air monitoring program is not proposed. Instead an emissions testing program is recommended including measurements for NO_2, SO_2, PM_{10} and $PM_{2.5}$ upon commissioning and annually in accordance with relevant Australia/ New Zealand Standard Methodologies to verify source emissions data as limits modelled (Section 4.2.3).

7 CONCLUSION

An air quality assessment for a proposed for a proposed Granulated Blast Furnace Slag (GBFS) grinding station in Port Melbourne, Victoria, Australia has been carried out.

As summarised in Table 7-1, the results of the modelling have shown that while a conservative approach has been adopted for the assessment, the modelled concentrations at all sensitive receptors are predicted to be below the criteria. Furthermore, the predicted contribution of the proposed Project to the NO_2, SO_2, PM_{10} and $PM_{2.5}$ levels is much lower than background.

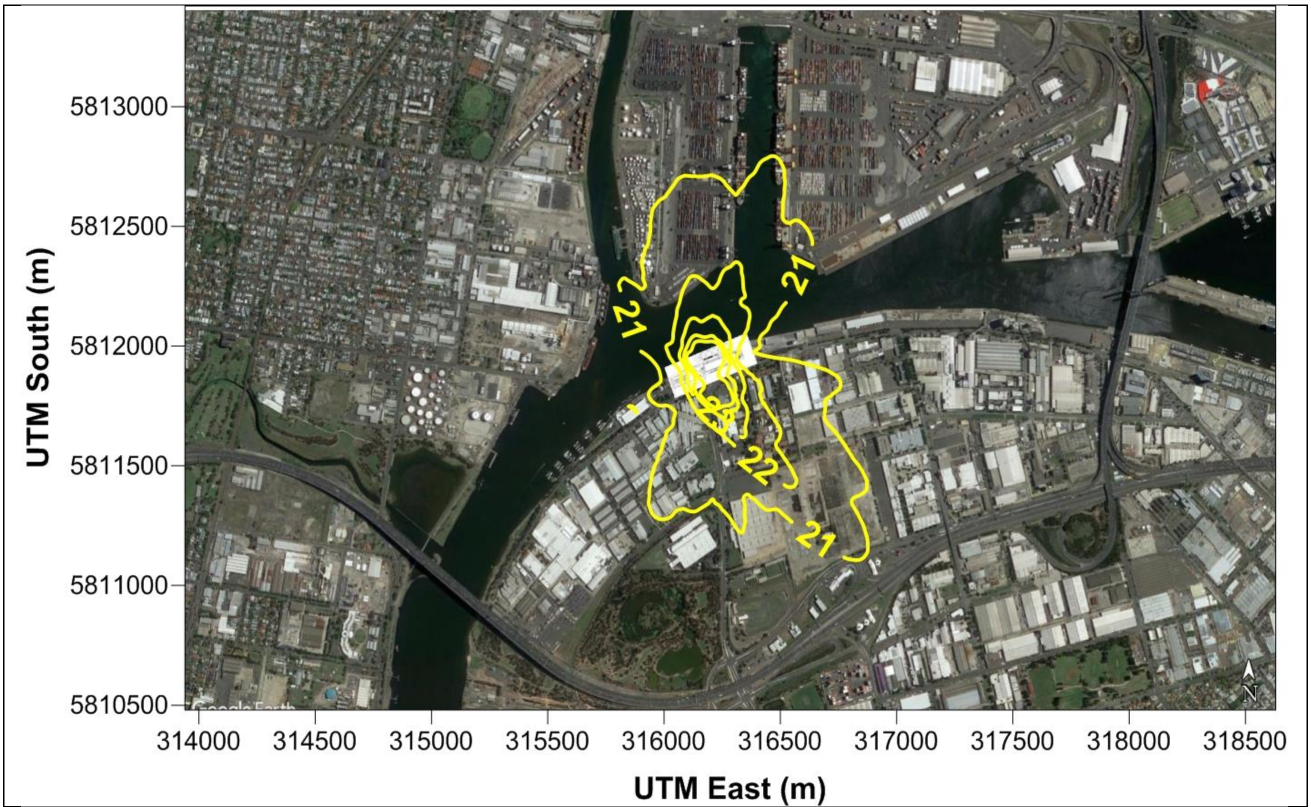
The emissions from the operation of the proposed Project are not predicted to adversely impact upon the sensitive receptors.

Table 7-1 - Summary of Results

Pollutant	Averaging Period	Criteria (µg/m³)	Maximum Prediction at Any Receptor -In Isolation (µg/m³)	Cumulative Maximum Prediction at Any Receptor – Cumulative (µg/m³)	Compliant
PM_{10}	24-hour	50	0.52	20.72	✓
	Annual	25	0.06	14.16	✓
$PM_{2.5}$	24-hour	25	0.52	8.92	✓
	Annual	8	0.06	6.96	✓
NO_2	1 Hour	160	18.88	72.27	✓
	Annual	30	0.31	20.85	✓
SO_2	1 Hour	290	5.01	32.69	✓
	24 Hour	57	0.72	7.64	✓

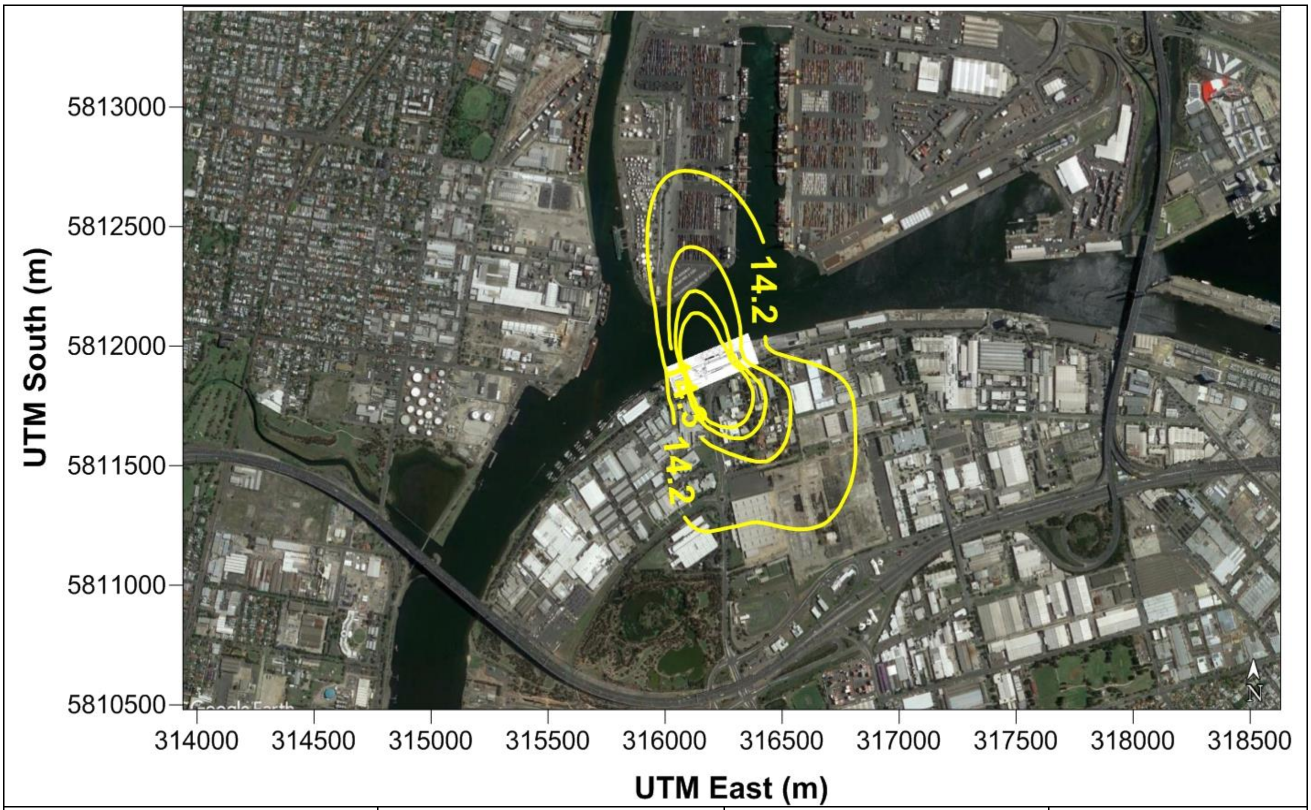
Appendix A Isopleth Plots

Isopleth plots illustrate the spatial distribution of ground-level concentrations across the modelling domain for each time period of interest. However, this process of interpolation causes a smoothing of the base data that can lead to minor differences between the contours and discrete model predictions.



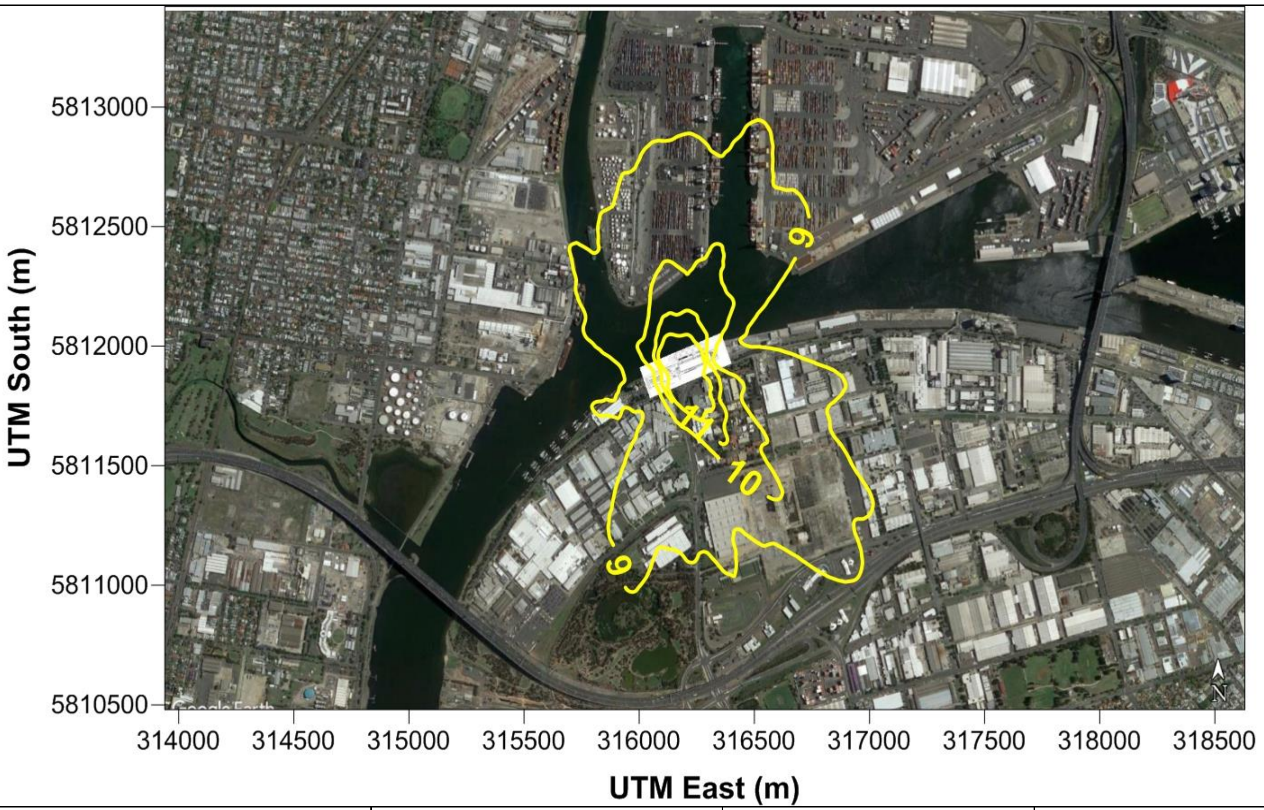
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	24 hour	MAX	50 µg/m^3

Figure A-1: Predicted maximum cumulative 24-hour average concentrations – PM_{10}



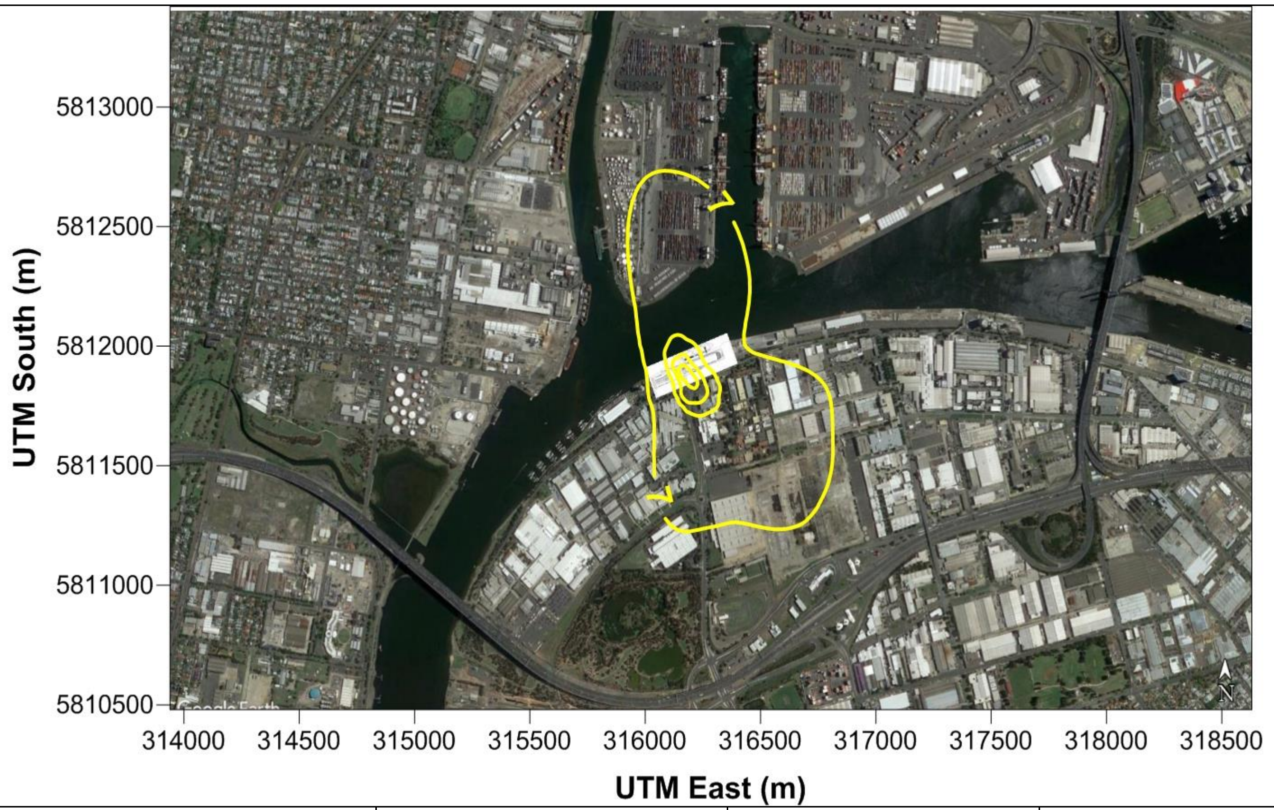
Pollutant:	Averaging Period:	Percentile:	Criteria:
PM_{10}	annual	average	25 µg/m^3

Figure A-2: Predicted maximum cumulative annual average concentrations – PM_{10}



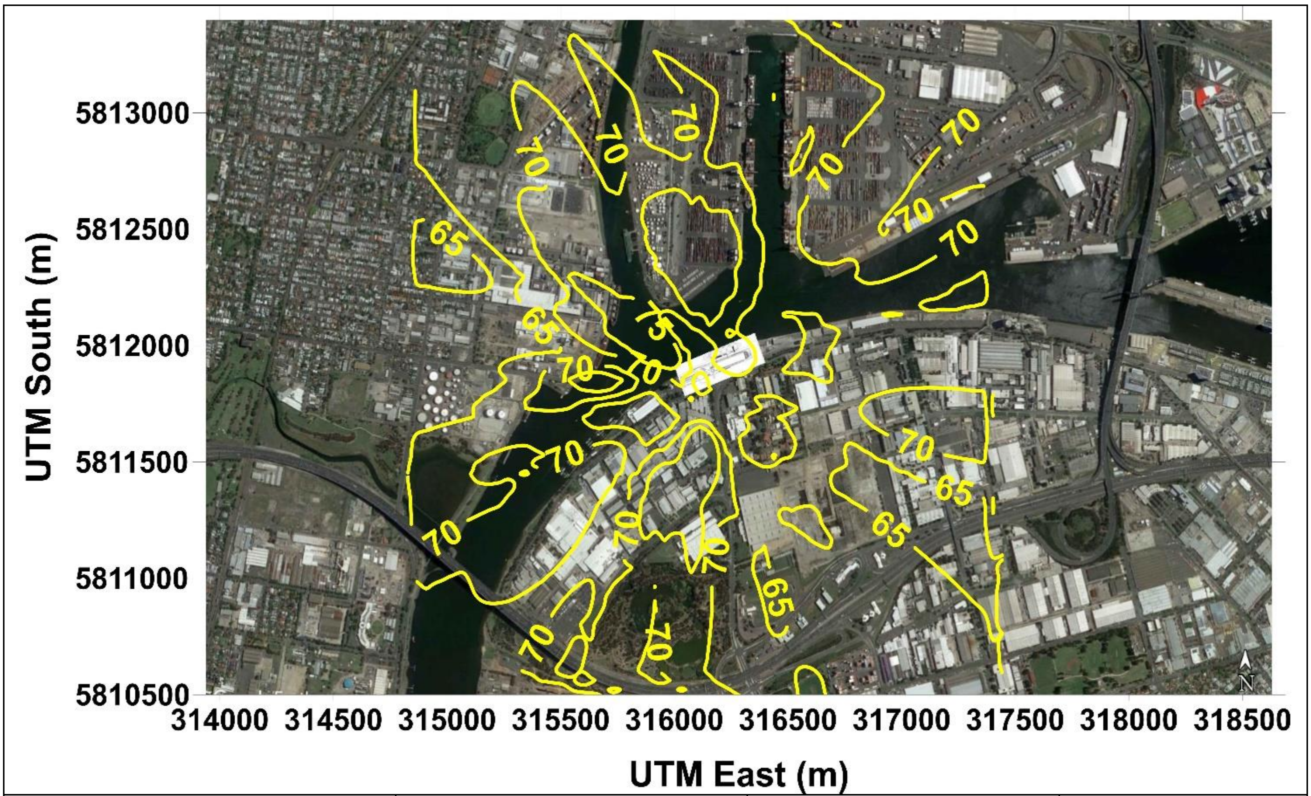
Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	24 hour	MAX	25 µg/m^3

Figure A-3: Predicted maximum cumulative 24-hour average concentrations – $PM_{2.5}$



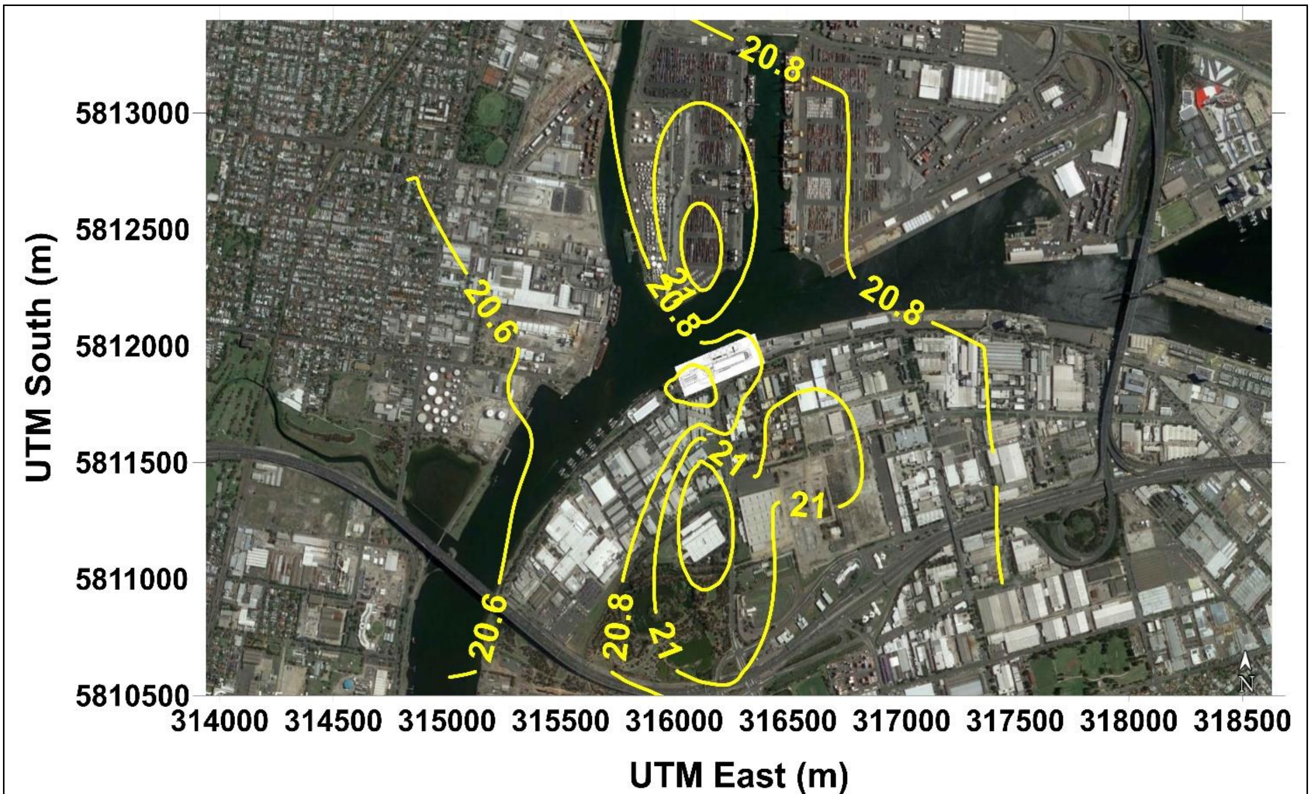
Pollutant:	Averaging Period:	Percentile:	Criteria:
$PM_{2.5}$	annual	average	8 µg/m^3

Figure A-4: Predicted maximum cumulative annual average concentrations – $PM_{2.5}$



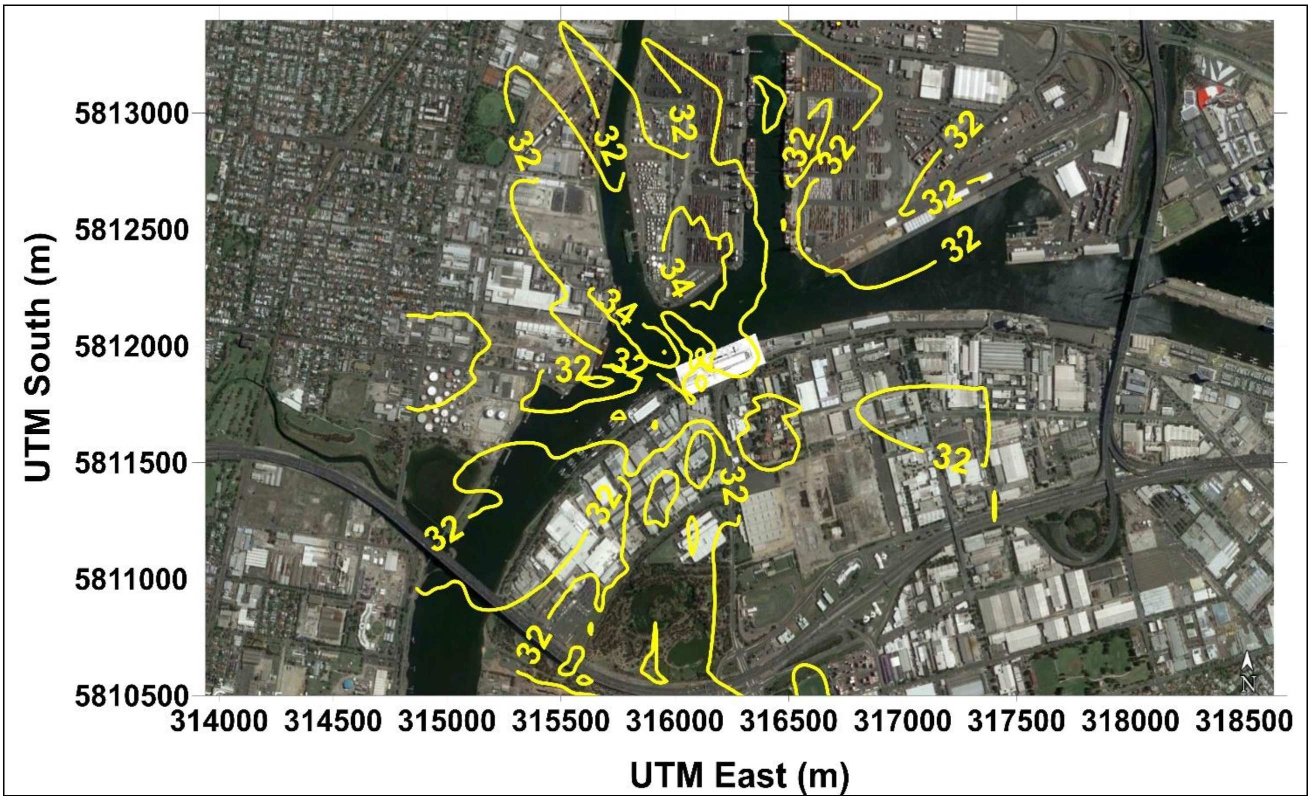
Pollutant:	Averaging Period:	Percentile:	Criteria:
NO_2	1-hour	MAX	160 µg/m^3

Figure A-5: Predicted maximum cumulative 1-hour average concentrations – NO_2



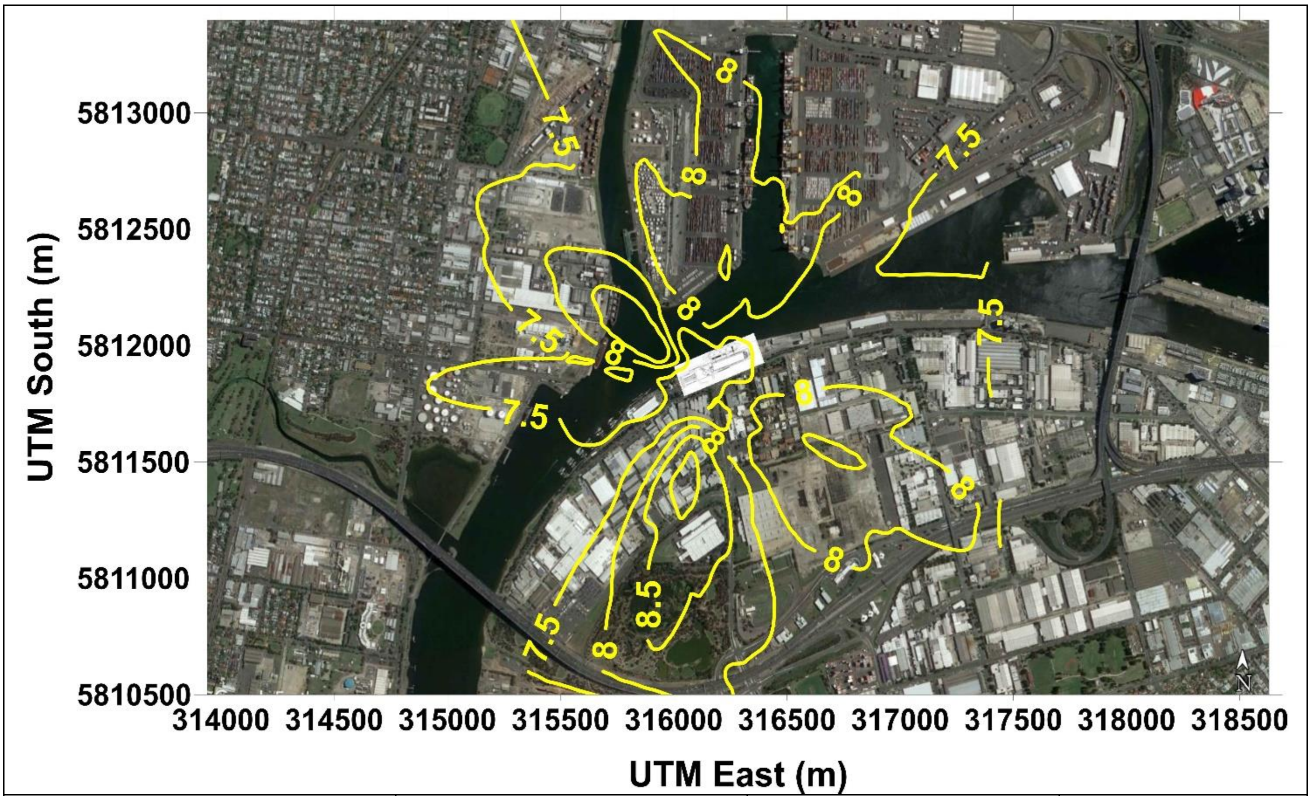
Pollutant:	Averaging Period:	Percentile:	Criteria:
NO_2	annual	average	30 µg/m^3

Figure A-6: Predicted maximum cumulative annual average concentrations – NO_2



Pollutant:	Averaging Period:	Percentile:	Criteria:
SO_2	1-hour	max	290 µg/m^3

Figure A-7: Predicted maximum cumulative 1-hour average concentrations – SO_2



Pollutant:	Averaging Period:	Percentile:	Criteria:
SO_2	24-hour	max	57 µg/m^3

Figure A-8: Predicted maximum cumulative 24-hour average concentrations – SO_2