A C O U S T I C S   A N D   A I R

PROPOSED EXPANSION OF FAIRFIELD SUSTAINABLE RESOURCE CENTRE

AIR QUALITY IMPACT ASSESSMENT

REPORT NO. 17091-AQ
VERSION B

JULY 2020

PREPARED FOR

FAIRFIELD CITY COUNCIL
C/- DFP PLANNING PTY LTD
11 DARTFORD ROAD
THORNLEIGH NSW 2120

WILKINSON MURRAY

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	7 May 2018	Tom Dufty	John Wassermann
A	Final	14 December 2018	John Wassermann	-
B	Final	27 July 2020	John Wassermann	-

Note

All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

Quality Assurance

Wilkinson Murray operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified by SAI Global and Licence No. QEC 13457 has been issued.

Certified System
Quality
ISO 9001
SAI GLOBAL

CASANZ

This firm is a member firm of the Clean Air Society of Australia and New Zealand and the work here reported has been carried out in accordance with the terms of that membership.

Celebrating 50 Years in 2012

Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. Today, with offices in Sydney, Newcastle, Wollongong, Queensland and Hong Kong, Wilkinson Murray services the entire Asia-Pacific region.

50 YEARS 1962–2012

TABLE OF CONTENTS

GLOSSARY OF AIR QUALITY TERMS

Air Pollution – The presence of contaminants or pollutant substances in the air that interfere with human health or welfare or produce other harmful environmental effects.

Air Quality Standards – The level of pollutants prescribed by regulations that are not to be exceeded during a given time in a defined area.

Air Toxics – Any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e. excluding ozone, carbon monoxide, PM-10, sulphur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer; respiratory, cardiovascular, or developmental effects; reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.

Airborne Particulates – Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Sources of airborne particulates include dust, emissions from industrial processes, combustion products from the burning of wood and coal, combustion products associated with motor vehicle or non-road engine exhausts, and reactions to gases in the atmosphere.

Area Source – Any source of air pollution that is released over a relatively small area, but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest that releases hydrocarbons, may be referred to as nonpoint source.

Concentration – The relative amount of a substance mixed with another substance. Examples are 5 ppm of carbon monoxide in air and 1 mg/l of iron in water.

Emission – Release of pollutants into the air from a source. We say sources emit pollutants.

Emission Factor – The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission Inventory – A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Flow Rate – The rate, expressed in gallons -or litres-per-hour, at which a fluid escapes from a hole or fissure in a tank. Such measurements are also made of liquid waste, effluent, and surface water movement.

Fugitive Emissions – Emissions not caught by a capture system.

Hydrocarbons (HC) – Chemical compounds that consist entirely of carbon and hydrogen.

Hydrogen Sulphide (H_2S) – Gas emitted during organic decomposition. Also, a by-product of oil refining and burning. Smells like rotten eggs and, in heavy concentration, can kill or cause illness.

Inhalable Particles – All dust capable of entering the human respiratory tract.

Nitric Oxide (NO) – A gas formed by combustion under high temperature and high pressure in an internal combustion engine. NO is converted by sunlight and photochemical processes in ambient air to nitrogen oxide. NO is a precursor of ground-level ozone pollution, or smog.

Nitrogen Dioxide (NO_2) – The result of nitric oxide combining with oxygen in the atmosphere; major component of photochemical smog.

Nitrogen Oxides (NO_x) – A criteria air polluant. Nitrogen oxides are produced from burning fuels, including gasoline and coal. Nitrogen oxides are smog formers, which react with volatile organic compounds to form smog. Nitrogen oxides are also major components of acid rain.

Mobile Sources – Moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers.

Particulates; Particulate Matter (PM-10) – A criteria air pollutant. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems.

Parts Per Billion (ppb)/Parts Per Million (ppm) – Units commonly used to express contamination ratios, as in establishing the maximum permissible amount of a contaminant in water, land, or air.

PM10/PM2.5 – PM10 is measure of particles in the atmosphere with a diameter of less than 10 or equal to a nominal 10 micrometers. PM2.5 is a measure of smaller particles in the air.

Point Source – A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit, factory smokestack.

Scrubber – An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Source – Any place or object from which pollutants are released.

Stack – A chimney, smokestack, or vertical pipe that discharges used air.

Stationary Source – A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Temperature Inversion – One of the weather conditions that are often associated with serious smog episodes in some portions of the country. In a temperature inversion, air does not rise because it is trapped near the ground by a layer of warmer air above it. Pollutants, especially smog and smog-forming chemicals, including volatile organic compounds, are trapped close to the ground. As people continue driving and sources other than motor vehicles continue to release smog-forming pollutants into the air, the smog level keeps getting worse.

1 INTRODUCTION

Fairfield City Council (FCC) oversees the operation of the Fairfield Sustainable Resource Centre (Fairfield SRC) located at the corner of Hassall Street and Widemere Road, Wetherill Park. Wilkinson Murray has been engaged by FCC to conduct an Air Quality Impact Statement (AQIS) for the existing operation and proposed expansion of Fairfield SRC.

The Fairfield SRC was established in 1997 and accepts construction and demolition waste including roof tiles, clay bricks, concrete and asphalt. The construction waste is crushed or milled to produce recycled materials, such as sand, road base, cement stabilised sands and aggregates for use in civil construction, landscaping and domestic building applications. The SRC stockpiles waste materials and processed materials.

The site currently operates above its approved limits, council is seeking to gain approval to process 550,000 tonnes to allow the site to operate at full capacity (the Proposal). To accommodate the additional throughput, it is proposed that part of the site known as Canal Road be infilled to allow for additional area for stockpiling and processing of material.

Wilkinson Murray has been engaged by DFP Planning, on behalf of Fairfield City Council, to prepare an Air Quality Impact Assessment (AQIA) for the Proposal. This AQIA will form part of the EIS for the Proposal.

1.1 Assessment Requirements

This AQIA has been prepared to support the Environmental Impact Statement (EIS) for approval of the Proposal and addresses the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 8184 reissued 6th May 2019) for the Proposal. Table 1-1 provides a summary of the SEARs which are relevant to this report and the section where they have been addressed in this report.

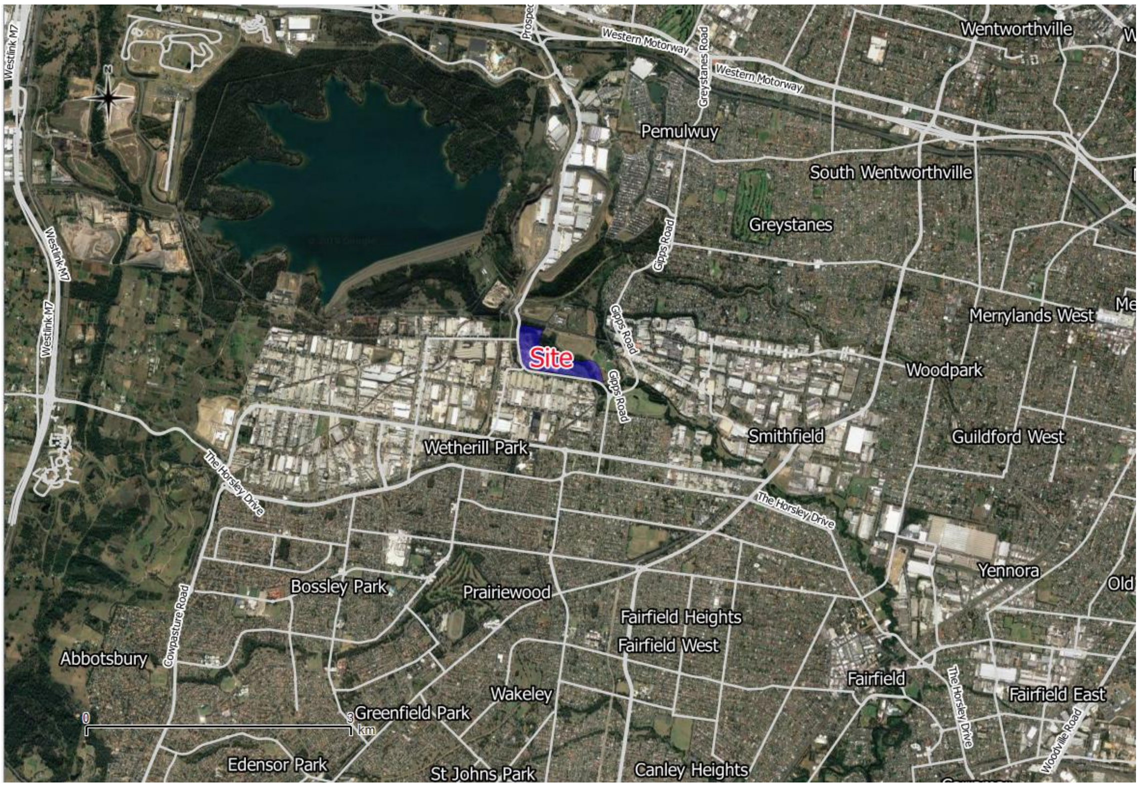
Table 1-1 SEARs (SSD 8184) compliance table (Air Quality)

SEARs	Where addressed
A quantitative assessment of potential air quality dust and odour impacts of the development in accordance with the relevant Environment Protection Authority guidelines.	Section 5
This include the identification of existing and potential future sensitive receivers and consideration of approved and/or proposed developments in the vicinity.	Section 2
The details of buildings and air handling systems and strong justification for any material handling, processing or stockpiling external to a building.	Section 1 Section 7
Details of proposed mitigation, management and monitoring measures	Section 6

1.2 Proposal Overview

The SRC is located at the corner of Hassall Street and Windemere Road, Wetherill Park, within the Wetherill Park industrial precinct, south of the Prospect Reservoir. Figure 1-1 shows the location of the site relative to surrounding suburbs and roads.

Figure 1-1 Site location



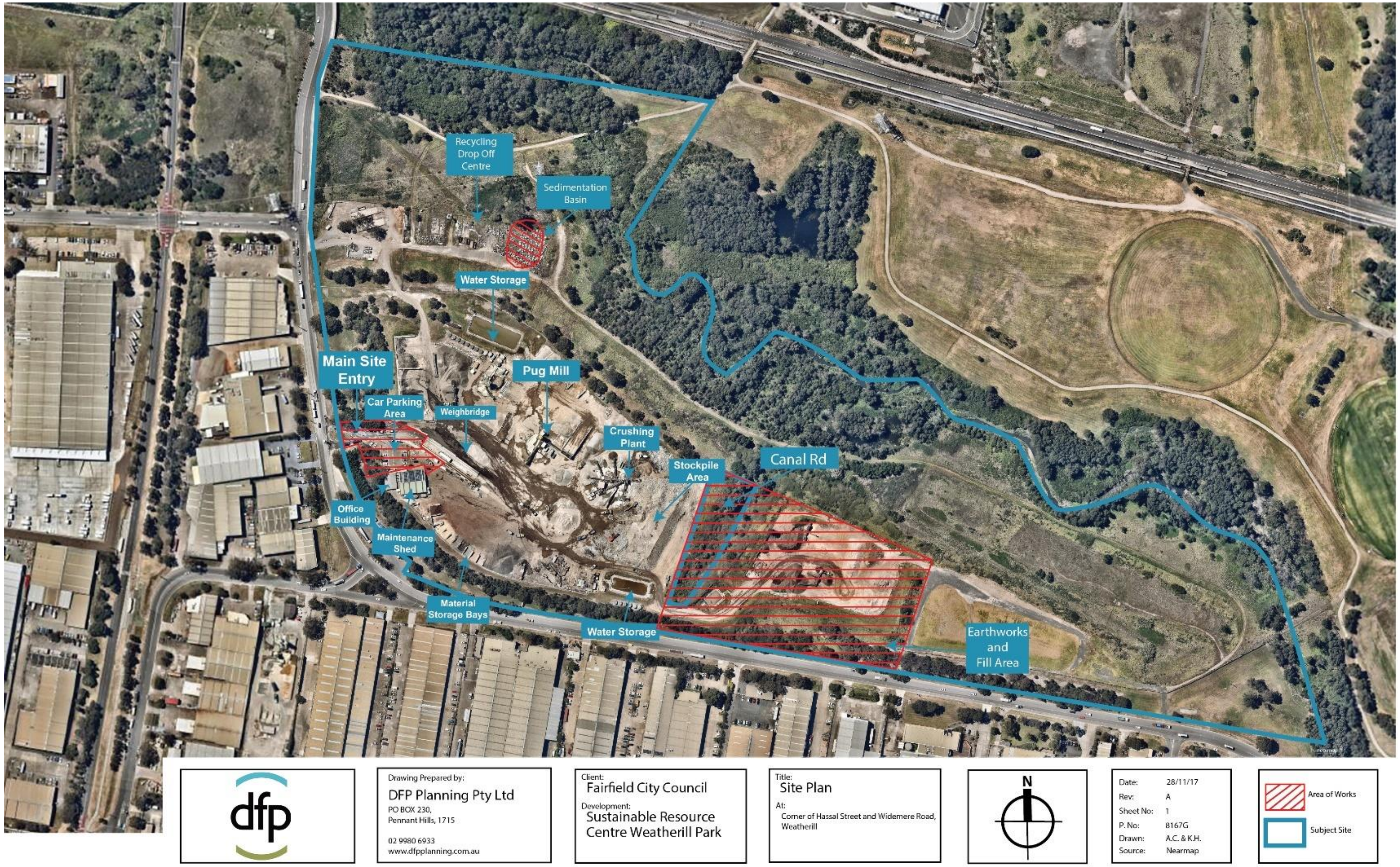
The existing facility is approved and licenced to receive 180,000 tonnes per year. The facility is however understood to have been operating in excess of that currently licensed for some time, with approximately 520,000 tonnes being received during the 2017 calendar year.

An application has accordingly been formulated which seeks approval to licence the facility generally in accordance with current operations, whereby a capacity to 550,000 tonnes per year is being sought. The increased Centre capacity is proposed to be facilitated through the filling of an existing gully running north-south through the centre of the site, allowing the creation of a new large temporary stockpiling area for excess material.

In order to fill the gully approximately 31,000m^3 of fill material will be brought in over a period of 18-24 months. This will be achieved by approximately 6-8 truck movements per day. A front end loader will be used to fill the gully and a vibratory roller will be used to compact the soil.

The site currently has a fixed crushing plant, a fixed pug mill, 2 mobile crushing and screening plants. The locations of the plant are not expected to change significantly as part of the proposal. The site layout including location of the main equipment is shown in Figure 1-2.

Figure 1-2 Site layout (Source: DFP Planning Pty Ltd)



2 EXISTING ENVIRONMENT

2.1 Surrounding Land Use & Sensitive Receptors

The land use surrounding the Proposal is predominantly industrial to the south, east and west. The nearest residential areas are located approximately 950m to the north-east and 750m to the south-east. Boral Quarry is located to the north. The nearest, and most potentially affected, receptors are identified in Table 2-1 and shown on Figure 2-1.

Figure 2-1 Sensitive receptors

Table 2-1 Sensitive receptors

Receptor	Type	Address	Distance to site boundary (m)
R1	Residential	5 Hyland Road	823
R2	Residential	63 Munro Street	990
R3	Residential	31 Kurrajong Road	800
R4	Recreational	Gipps Street Sporting Complex 1	280
R5	Recreational	Gipps Street Sporting Complex 2	370
R6	Recreational	Gipps Street Sporting Complex 3	370
R7	Recreational	Gipps Street Sporting Complex 4	320
R8	Recreational	Rosford Street Reserve 1	850
R9	Recreational	Rosford Street Reserve 2	870
R10	Residential	60 Rosford Street	675
R11	Residential	46 Rosford Street	760
R12	Residential	62 Rosford Street	700
R13	Commercial	1 Davis Road	30
R14	Commercial	5 Widemere Road	60
R15	Commercial	3 Widemere Road	55
R16	Commercial	1A Widemere Road	40
R17	Commercial	130 Hassal Sreet	70
R18	Commercial	122 Hassal Street	50
R19	Commercial	7 Hyland Street	560
R20	Commercial	114 Hassal Street	50
R21	Commercial	100 Hassal Street	180
R22	Commercial	94 Hassal Street	110

2.2 Local Meteorology

Meteorological conditions strongly influence air quality. Most significantly, wind speed, wind direction, temperature, relative humidity, and rainfall affect the dispersion of air pollutants, and are key inputs into dispersion models. The following sub-sections discuss the local meteorology near the Proposal site and identify a representative set of meteorological data for use in the dispersion modelling to be undertaken for this assessment.

Long-term meteorological data for the area surrounding the Site is available from the Bureau of Meteorology (BOM) operated Automatic Weather Station (AWS) at the Horsley Park Equestrian Centre (Horsley Park). The Horsley Park AWS is located approximately 5.5 kilometres west of the Proposal site and records observations of a number of meteorological data, including wind speed, wind direction, temperature, humidity, and rainfall.

As recommended by the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, meteorological data from the Horsley Park AWS have been reviewed over a period of five consecutive years (2012 to 2016).

2.2.1 Wind

Figure 2-2 to Figure 2-7 present annual and seasonal windrose plots for the Horsley Park AWS for the period 2012 to 2016, inclusive. The plots show similar patterns of wind speed and wind direction over the five-year period, with northerly to north-easterly winds being prevalent in summer and autumn, and westerly winds being prevalent in winter and spring. Wind speed and wind direction during 2013 are generally representative of the five-year period and have therefore been adopted for assessment purposes.

Figure 2-2 Horsley Park AWS windroses, 2012

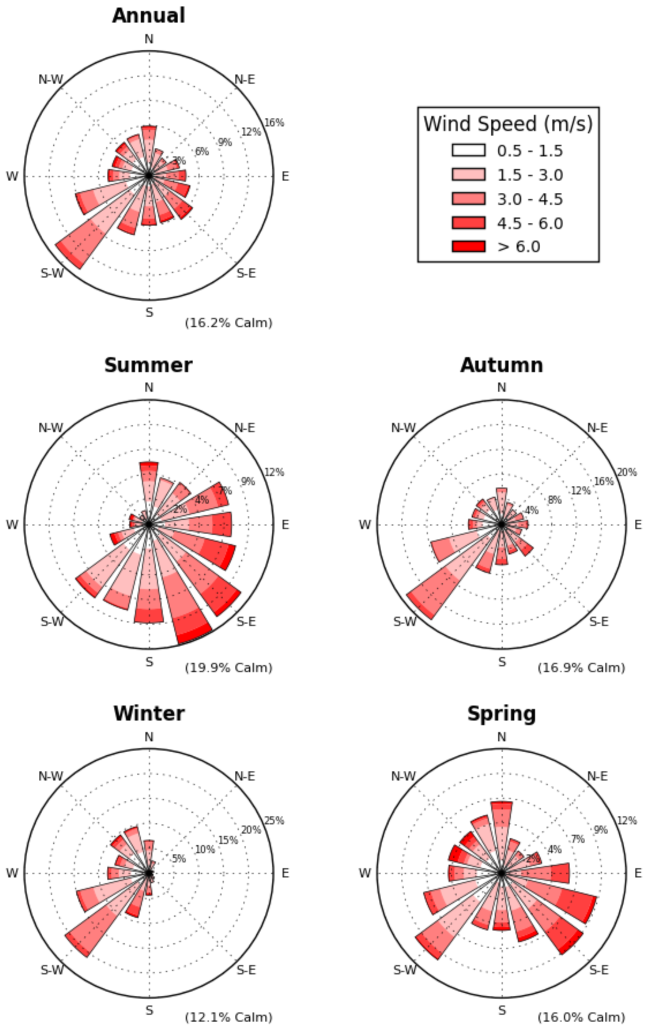


Figure 2-3 Horsley Park AWS windroses, 2013

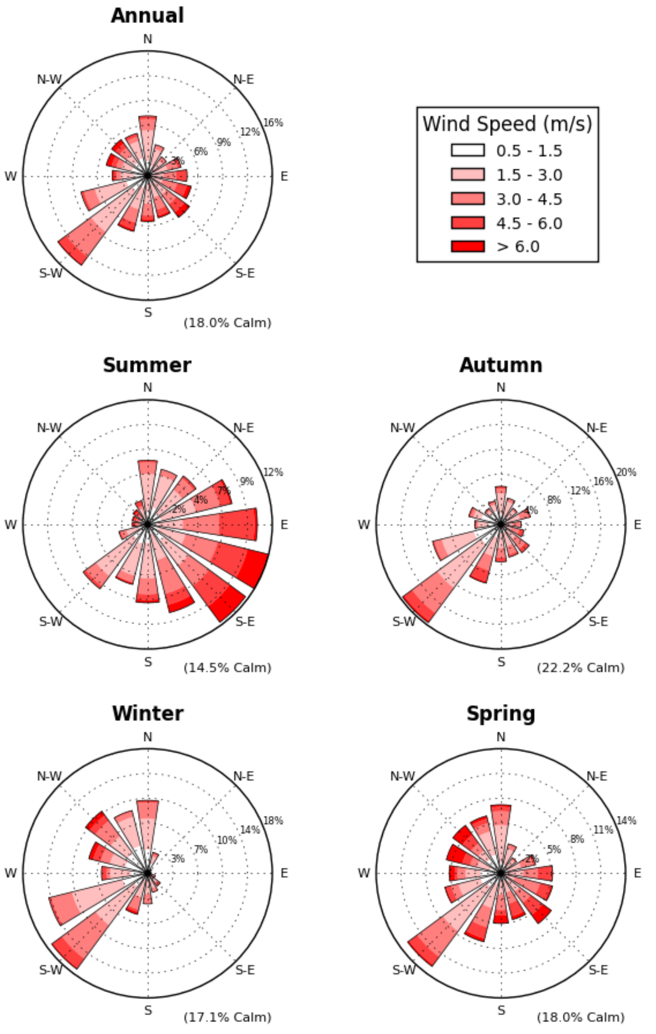


Figure 2-4 Horsley Park AWS windroses, 2014

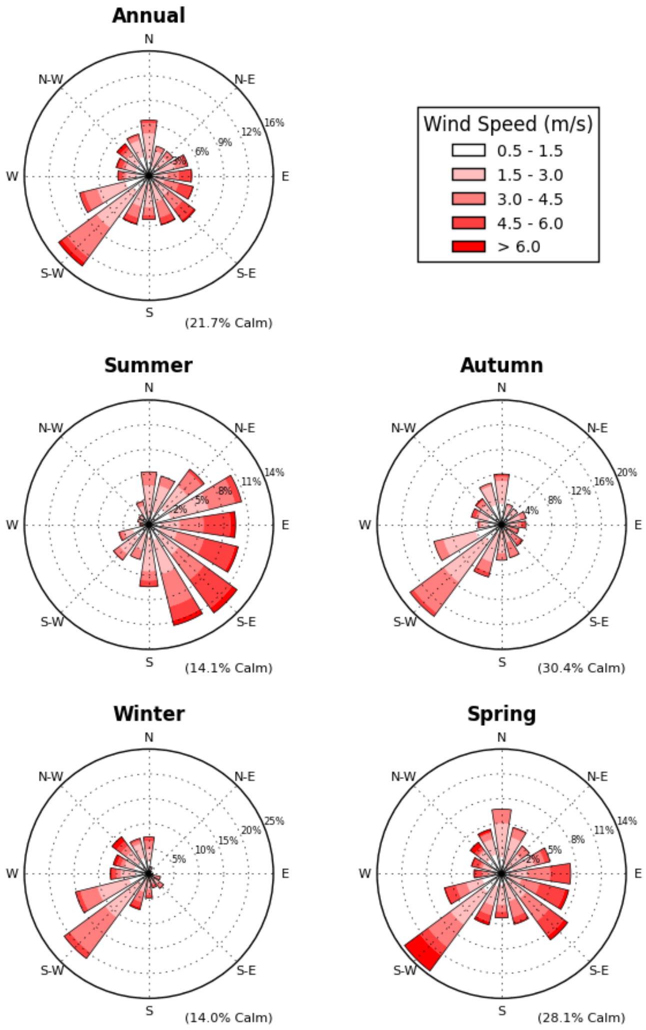


Figure 2-5 Horsley Park AWS windroses, 2015

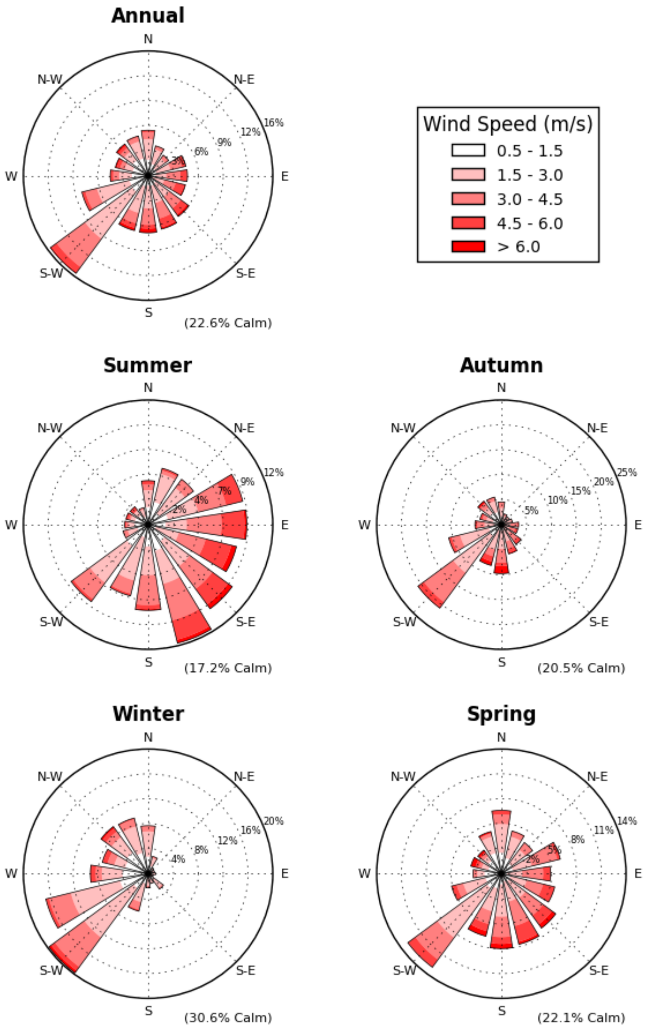


Figure 2-6 Horsley Park AWS windroses, 2016

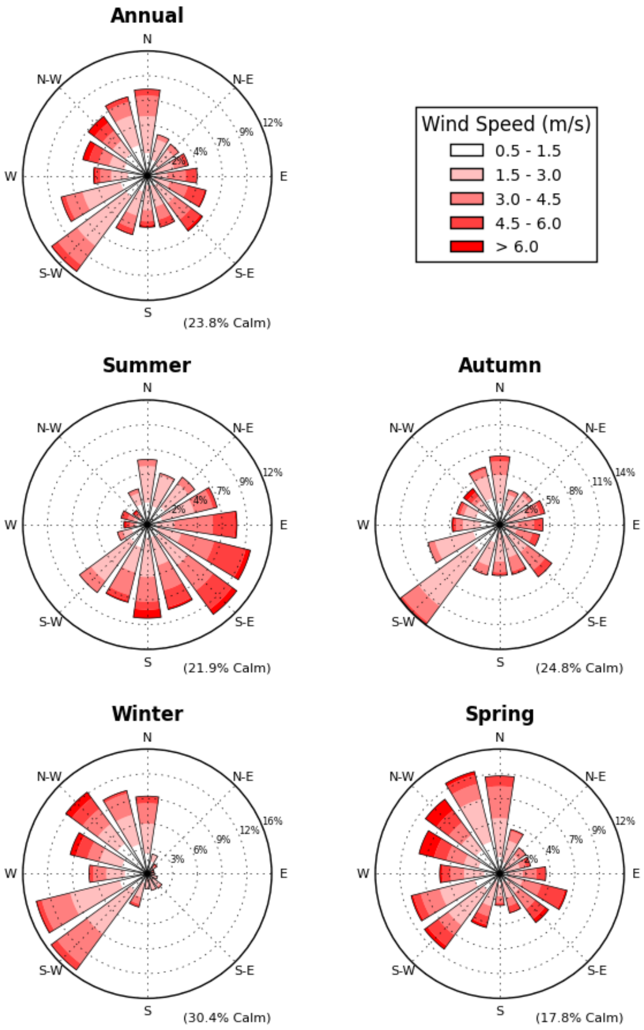
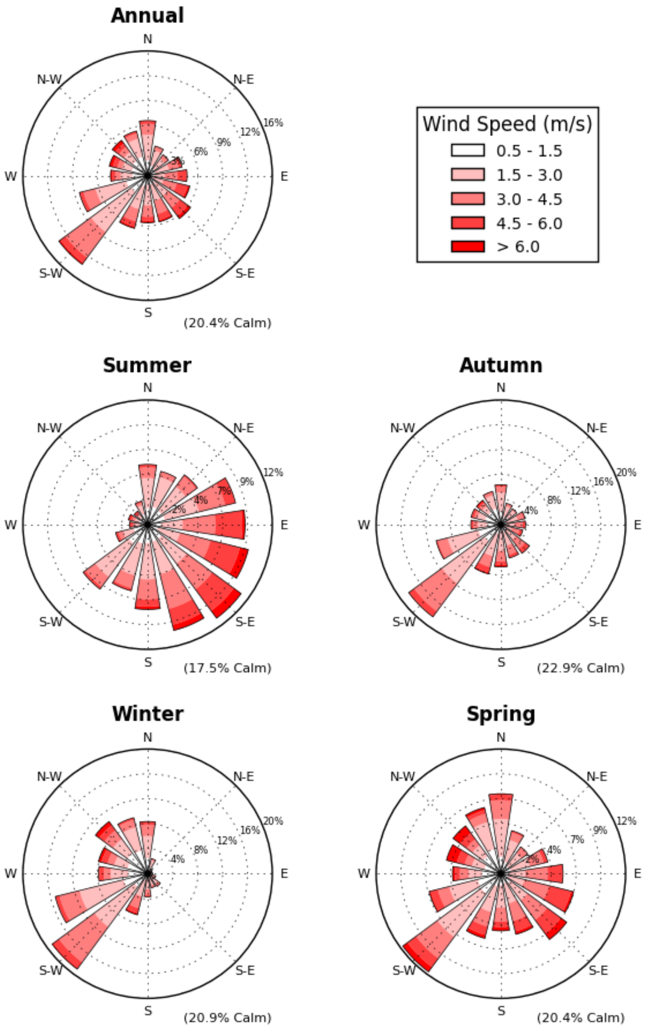


Figure 2-7 Horsley Park AWS windroses, 2012-2016



2.2.2 Temperature Humidity & Rainfall

Average monthly values for temperature, humidity, and rainfall over the period 2012 to 2016 are presented in Table 2-2.

Long-term climate statistics are presented in Table 2-2. Temperature data recorded at the Horsley Park AWS indicates that January is the hottest month of the year, with a mean daily maximum temperature of 28.5°C. July is the coolest month with a mean daily minimum temperature of 5.6°C. March is the wettest month with an average rainfall of 98 mm falling over 8 days. There are on average 84 rain days per year, delivering 875mm of rain.

Table 2-2 Climate averages for Horsley Park AWS, 2012-2016

Obs.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Observations													
Temp (°C)	21.3	21	19.6	16.9	13.5	10.7	9.6	11.1	14.5	17.4	18.4	20.6	16.2
Hum (%)	75	79	79	77	80	79	76	70	65	65	70	70	74
3pm Mean Observations													
Temp (°C)	26.8	26.3	24.8	22.4	19.2	16.5	15.9	17.4	19.6	22.1	23.4	25.9	21.7
Hum (%)	52	54	55	52	57	55	50	45	45	46	50	49	51
Daily Minimum & Maximum Temperatures													
Min (°C)	17.7	17.8	16.2	13	9.9	7.5	6.1	6.8	9.4	12.1	14.3	16.4	12.3
Max (°C)	28.5	28	26.4	23.7	20.4	17.4	16.9	18.8	21.4	23.9	25.6	27.5	23.2
Rainfall													
Rain (mm)	95.8	96.5	98	76.6	69.9	77.2	55.7	50.7	46.4	58.3	73.2	75.9	875
Rain (days)	8	8.1	8.4	7	6.4	7	5.6	5.7	6.1	6.8	7.3	7.5	83.9

2.3 Local Ambient Air Quality

To adequately assess the potential air quality impacts of the Proposal, consideration should be given to the existing ambient air quality in the surrounding area.

2.3.1 Odour

The most significant potential sources of odour near sensitive receptors are the existing activities at the Fairfield SRC. During site visits, no sources of offensive or nuisance odour were detected at sensitive receptors. Further, the Fairfield SRC has no history of odour complaints. Therefore, existing odour levels at sensitive receptors are understood to be negligible.

2.3.2 On-Site Dust Deposition Gauge

As part of current operations, 5 dust deposition gauges are located around the boundary of the site. Figure 2-8 gives the approximate location of the dust deposition gauges on-site.

Table 2-3 gives the annual average deposition from each gauge from 2011 to 2017. Exceedances of the criteria are shown in bold.

Figure 2-8 Approximate locations of dust deposition gauges

Table 2-3 Site dust deposition gauge data

Year	Monthly average dust deposition ($g/m^2/month$)				
	DDG1	DDG2	DDG3	DDG4	DDG5
2011	2.8	1.4	**4.2**	**4.7**	3.8
2012	1.9	1.7	2.4	3.3	2.3
2013	2.2	2.7	2.6	3.5	2.3
2014	2.1	3.1	3.3	3.9	1.5
2015	2.2	**6.6**	**4.1**	3.2	2.6
2016	2.0	**6.9**	3.4	3.4	2.0
2017	1.9	2.6	2.9	3.6	1.7

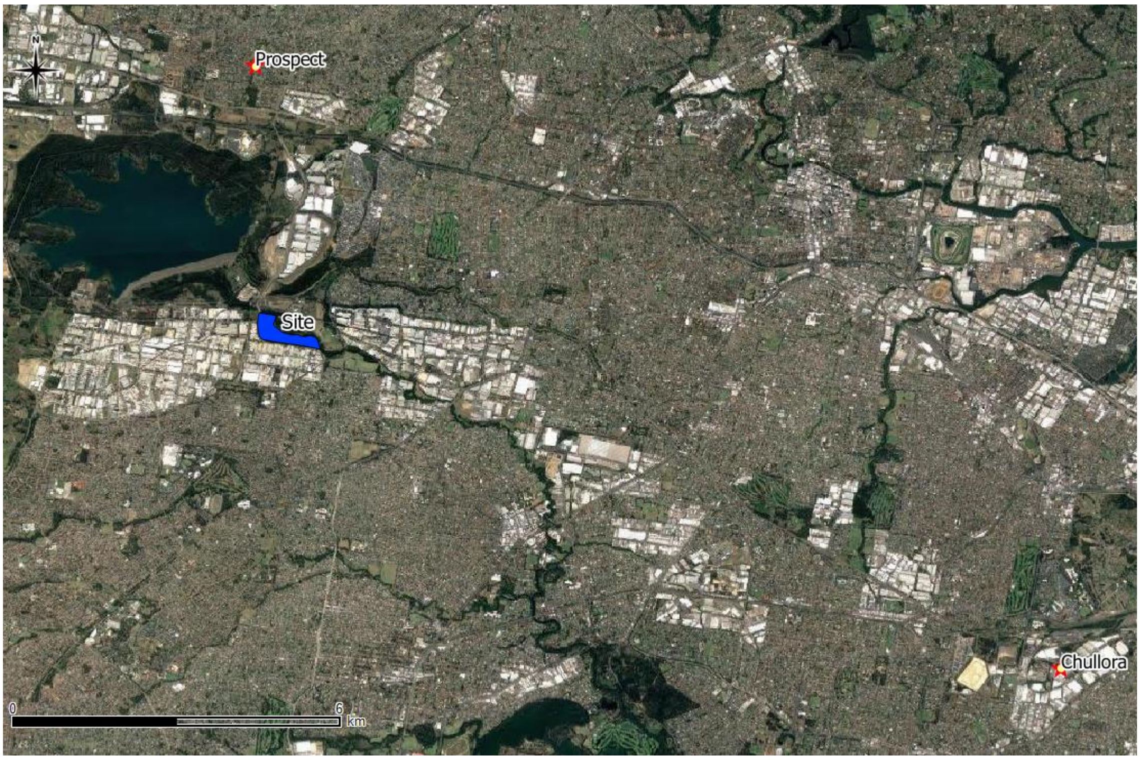
A review of the historic deposition data shows that the total deposition criteria of $4g/m^2/month$ is exceeded in 2011 at DDG3 and DDG3 and in 2015 at DDG3. Particularly large exceedances occurred in 2015 and 2016 at DDG2; however, this monitoring point is located on the north-west boundary of the site and is not considered representative of the nearest receptors. The exceedances at DDG2 are likely a result of localised activity near the monitoring point during that period.

It is important to note that these exceedances on-site do not necessarily result in exceedances at the sensitive receptors.

2.3.3 Ambient Dust & Particulate Matter

The dust deposition gauge data from on-site is not considered to be representative of the ambient dust deposition due to the impact from current operations on the site. Therefore, there is no site-specific data available to determine the existing ambient concentrations of dust and particulate matter at sensitive receptors near the Proposal. The NSW Office of Environment and Heritage (OEH) operates a network of air quality monitoring stations across NSW. The OEH monitoring station location considered to be most representative of the area surrounding the Proposal is located in Prospect. The Prospect monitoring station is located approximately 4.5 kilometres to the north of the site. The prospect monitoring site does not have $PM_{2.5}$ data available prior to 2015. The nearest monitoring site that has $PM_{2.5}$ monitoring data is Chullora, located 15km to the south-west of the site. Figure 2-9 below shows the location of the OEH monitoring site relative to the proposal site.

Figure 2-9 OEH monitoring site locations



A summary of the PM_{10} and $PM_{2.5}$ monitoring results from 2013 collected at the Prospect and Chullora monitoring sites is presented in Table 2-4 and Table 2-5. 2013 was selected as the most representative year based on long-term meteorological comparison.

Table 2-4 2013 Particulate matter monitoring results – Prospect

Pollutant	Annual average (µg/m³)	24-hour average (µg/m³)	
		Maximum	90th Percentile
PM_{10}	19.2	81.8 (36.7)	29.9

Table 2-5 2013 Particulate matter monitoring results – Chullora

Pollutant	Annual average (µg/m³)	24-hour average (µg/m³)	
		Maximum	90th Percentile
PM_{10}	18.3	69.4 (35.1)	25.7
$PM_{2.5}$	8.4	49.2 (20.7)	13.6

Figure 2-10 and Figure 2-11 shows the 24-hour PM_{10} and $PM_{2.5}$ data for 2013 at the Prospect and Chullora monitoring stations.

Figure 2-10 Background PM10 data Prospect 2013

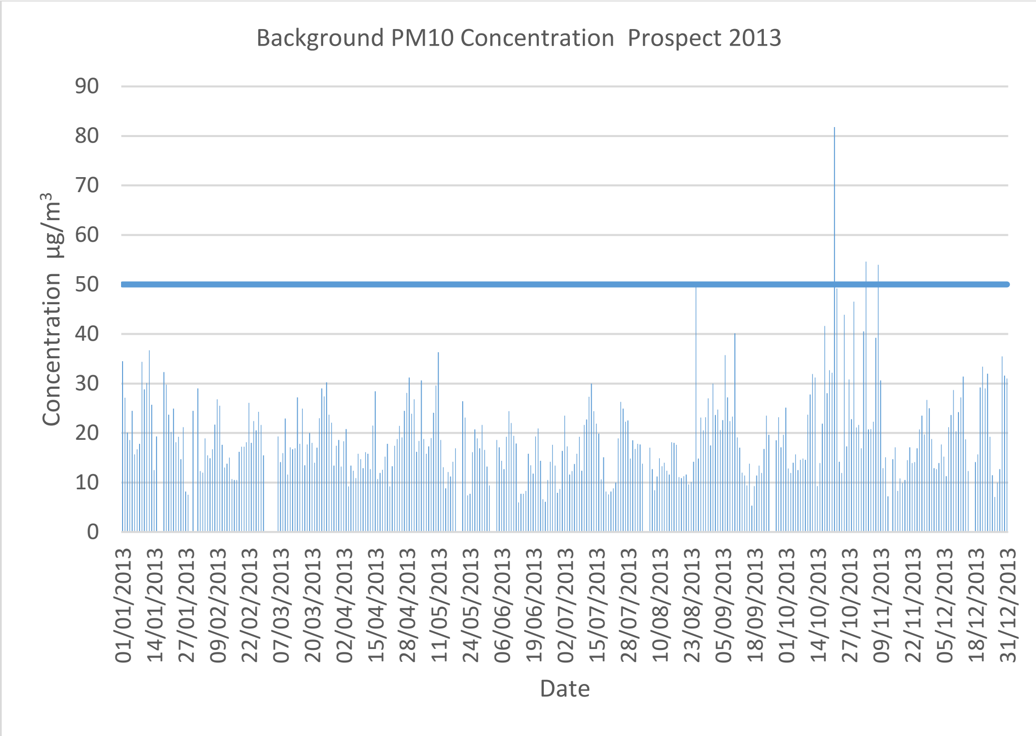
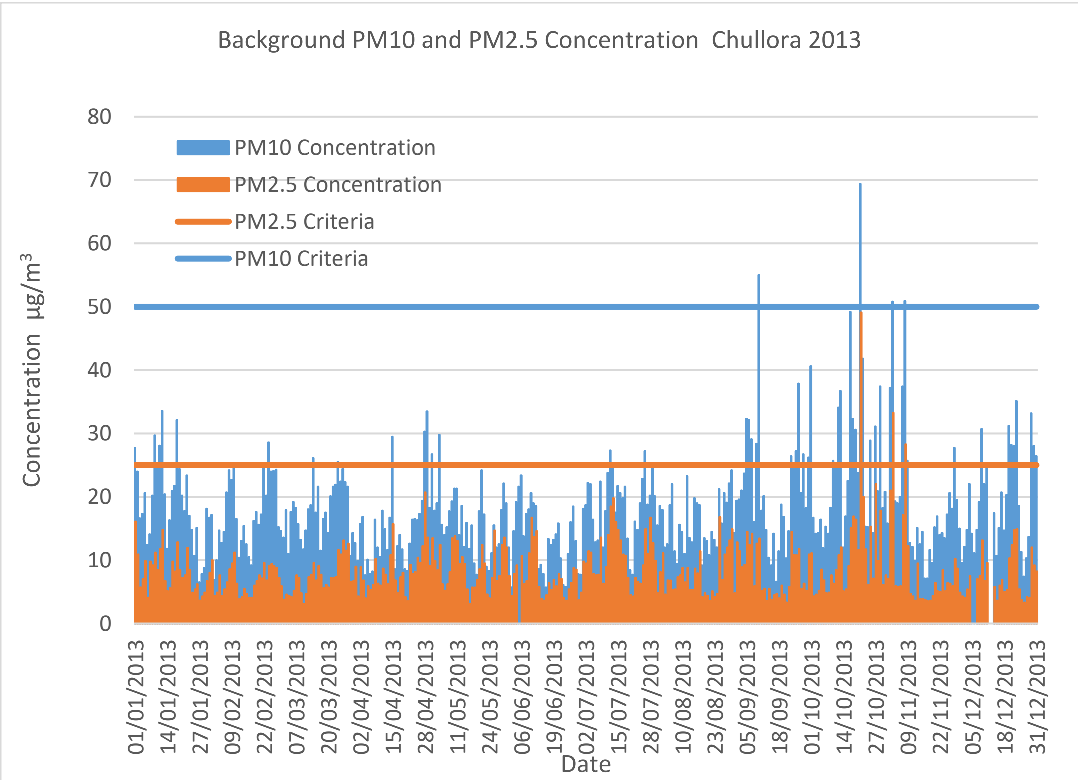


Figure 2-11 Background PM_{10} and $PM_{2.5}$ data Chullora 2013



When characterising typical ambient air quality, impacts from extreme events such as bushfires and dust storms are usually excluded. Hazard reduction burning events on 25 August 2013 and bushfire events on 10 September 2013 have been excluded. Between 17 October 2013 and 8 November 2013, the 24-hour average PM_{10} and $PM_{2.5}$ were exceeded on multiple occasions due to large bushfires in the Blue Mountains and Greater Western Sydney, the exceedances and high levels in this period have also been excluded. The values in brackets in Table 2-4 represent the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations measured at Prospect and Chullora, excluding these events event. The PM_{10} data between the two monitoring sites has a strong correlation (correlation factor >0.85). The Prospect PM_{10} is on average 5% higher than the values at Chullora. Therefore, the $PM_{2.5}$ data at Chullora has been adjusted in order to be conservative. These values will be adopted for assessment purposes.

The historic deposited dust levels at the site are not considered representative of the ambient levels due to the impact of the sites existing operations. There are no readily available site specific Total Suspended Particulates (TSP) monitoring data. The Prospect and Chullora monitoring sites do not measure these components; however, estimates of the background levels for the area are required to assess the impacts of the Proposal on TSP and deposited dust.

Estimates of the annual average background TSP concentrations can be determined from a relationship between measured PM_{10} concentrations. This relationship assumes that 40% of the TSP is PM_{10} and was established as part of a review of ambient monitoring data collected by co-located TSP and PM_{10} monitors operated for reasonably long periods of time in the Hunter Valley (NSW Minerals Council, 2000).

Applying this relationship with the 2013 annual average PM_{10} concentration of 19.2 µg/m^3 at the Prospect monitoring station estimates an annual average TSP concentration of 48.0 µg/m^3.

To estimate annual average dust deposition levels, a similar process to the method used to estimate TSP concentrations is applied. This approach assumes that a TSP concentration of 90 µg/m^3 will have an equivalent dust deposition value of 4 g/m^2/month; and indicates a background annual average dust deposition of 2.13 g/m^2/month for the area surrounding the project.

Table 2-6 summarises the background air quality adopted for assessment purposes.

Table 2-6 Background air quality adopted for assessment

Pollutant	Averaging period	Adopted background concentration/level
PM_{10}	24-hour	36.7 µg/m^3
	Annual	19.2 µg/m^3
$PM_{2.5}$	24-hour	21.7 µg/m^3
	Annual	8.8 µg/m^3
TSP	Annual	48.0 µg/m^3
Deposited Dust	Annual	2.13 g/m^2/month

3 AIR QUALITY CRITERIA

3.1 Introduction

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016) sets out applicable impact assessment criteria for a number of air pollutants.

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the pollutants of interest in this study and the application air quality criteria for each pollutant.

3.2 Pollutants of Interest

Potential pollutants identified for this development with the potential to result in air quality impacts include odour and dust.

3.3 Impact Assessment Criteria

3.3.1 Odour

NSW legislation prohibits emissions that cause offensive odour to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character and so on and to determine whether the odour would unreasonably interfere with the comfort and repose of the normal person. In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

However, in the approval and planning process for proposed new operations or modifications to existing projects, no actual odour exists, and it is necessary to consider hypothetical odour. In this context, odour concentrations are used and are defined in odour units. The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus, by definition, odour less than one odour unit (1 OU), would not be detectable to most people.

The range of a person's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. Therefore, there can be a wide range of variability in the way odour response is interpreted.

It should be noted that odour refers to complex mixtures of odours, and not "pure" odour arising from a single chemical. Odour from a single, known chemical very rarely occurs (when it does, it is best to consider that specific chemical in terms of its concentration in the air). In most situations, odour will be comprised of a cocktail of many substances that is referred to as a complex mixture of odorous pollutants, or more simply odour.

For developments with potential for odour it may be necessary to predict the likely odour impact that may arise. This is done by using air dispersion modelling which can calculate the level of dilution of odours emitted from the source at the point that it reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

The NSW criteria for acceptable levels of odour range from 2 to 7 OU, with the more stringent 2 OU criteria applicable to densely populated urban areas and the 7 OU criteria applicable to sparsely populated rural areas, as outlined below.

Table 3-1 presents the relevant impact assessment criteria for complex mixtures of odorous pollutants.

Table 3-1 Impact assessment criteria – complex mixtures of odorous pollutants

Population of affected community	Impact assessment criteria (OU)*
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Note: * 99th percentile nose-response time.

The sensitive receivers identified in this assessment are located in an urban setting, and therefore an impact assessment criterion of 2.0 OU/m^3 has been conservatively adopted.

3.3.2 Dust & Particulate Matter

The EPA Approved Methods specifies air quality assessment criteria for assessing impacts from dust generating activities. These criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (NEPC, 1998).

Table 3-2 summarises the air quality goals for dust and particulate matter that are relevant to this study. The air quality goals relate to the total concentrations of dust and particulate matter in the air and not just that from the project. Therefore, some consideration of background levels needs to be made when using these goals to assess impacts.

Table 3-2 Impact assessment criteria – dust and particulate matter

Pollutant	Averaging period	Impact	Criteria
Total suspended particulates (TSP)	Annual	Total	90 µg/m^3
Particulate matter ≤10 µm (PM_{10})	Annual	Total	25 µg/m^3
	24-hour	Total	50 µg/m^3
Particulate matter ≤2.5 µm ($PM_{2.5}$)	Annual	Total	8 µg/m^3
	24-hour	Total	25 µg/m^3
Deposited dust (DD)	Annual	Total	4 g/m^2/month
	Annual	Incremental	2 g/m^2/month

4 DISPERSION MODELLING

4.1 Meteorological Modelling

4.1.1 The Air Pollution Model (TAPM)

No meteorological observation data is available for the Proposal site. The Horsley Park AWS is located approximately 6 kilometres west of the Proposal site. Therefore, site-specific meteorological data was generated through the use of a prognostic model. The prognostic model used was The Air Pollution Model (TAPM), developed and distributed by the Commonwealth Scientific and industrial Research Organisation (CSIRO).

TAPM is an incompressible, non-hydrostatic, primitive equations prognostic model with a terrain-following vertical coordinate for three-dimensional simulations. It predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of large-scale meteorology provided by synoptic analyses. TAPM benefits from having access to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic scale meteorological analyses for various regions around the world.

The prognostic modelling domain was centred at 33.84° S, 150.91° E and involved four nesting grids of 30km, 10km, 3km and 1km with 25 grids in the lateral dimensions and 30 vertical levels.

The TAPM model included assimilation of data collected at the Horsley Park AWS during the year 2013. This modelling year was chosen as being representative of typical meteorological conditions, particularly for wind speed and wind direction, based on a long-term meteorological analysis, as described in Section 2.2

4.1.2 CALMET

The 3-D prognostic wind field from the TAPM simulation was incorporated in a CALMET model as the initial guess wind field. CALMET was run using the 'No-Observations Approach' recommended by TRC (2011).

The CALMET domain was 12x 12km with a grid resolution of 0.20km. Local land use and topographical data (SRTM 3) were used to produce realistic fine scale flow fields in the area surrounding the site.

4.2 Dispersion Modelling

CALPUFF is a non-steady state Gaussian puff dispersion model, developed for the US EPA and approved for use by the NSW EPA. CALPUFF is considered an advanced dispersion model and is intended for use in situations where less advanced Gaussian plume models are not appropriate. CALPUFF is most often used in areas exhibiting one or more of the following features:

- Complex terrain;
- Recirculating coastal sea breezes;
- High frequency of calm winds; and
- Buoyant line sources.

CALPUFF is also the preferred dispersion model for odour, and for this reason has been selected for this assessment.

4.2.1 Peak to Mean Ratios

To account for the time-averaging limitations of the dispersion model, peak-to-mean ratios have been incorporated into all odour flux rates in accordance with the Approved Methods. Peak-to-mean ratios for various source types, as prescribed by the Approved Methods, are presented in Table 4-1.

Table 4-1 Peak-to-mean ratios

Source type	Pasquill-Gifford stability class	P/M60	
		Near-field	Far-field
Area	A,B,C,D	2.5	2.3
	D,E	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A,B,C	12	4
	D,E,F	25	7
Tall wake-free point	A,B,C	17	3
	D,E,F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

Note: * Ratio of peak 1-second average concentrations to mean 1-hour average concentrations.

4.2.2 Building Wake Effects

All emissions associated with this development were modelled using volume sources, which are not affected by building wakes.

4.2.3 Dust Particle Size Distribution

Dust deposition is strongly influenced by particle size. Therefore, the total dust emissions from the Site are separated into three fractions, based on particle size, as presented in Table 4-2. Each fraction is modelled as a separate species in CALPUFF, and the predicted ground level concentrations of $PM_{2.5}$, PM_{10}, TSP and dust deposition levels are calculated as combinations of the relevant fractions.

Table 4-2 Dust particle size distribution

Particle category	Size range	Distribution (% of TSP)
Fine Particles (FP)	<2.5 µg	4.68%
Coarse Matter (CM)	2.5 – 10 µg	34.4%
Rest	10 – 30 µg	60.92

4.3 Emissions to Air

4.3.1 Odour Emissions

Fairfield SRC does not accept putrescible waste and employs two spotters to ensure that all loads that are deemed to contain putrescible waste or asbestos are rejected from the site. Therefore, no significant odour sources have been identified for the normal operations of the facility. However, it is possible despite all precautionary measures, that a customer may deliver a load which contains some putrescible waste, and that it would spend a small amount of time on-site before it is rejected and removed. As a worst case, it is assumed that a partial load of putrescible waste would spend no more than 1 – 2 hours on-site.

A specific odour emission rate (SOER) of 3.65 OU.$m^3/s^2/s$ has been used to represent the likely odour emissions from putrescible waste on the tipping floor. This value is adopted from an assessment of putrescible waste in a resource recovery facility in Newcastle (PAE Holmes, 2011). It is assumed that a partial load of putrescible waste would cover no more than $100m^2$ of the tipping floor.

A summary of the estimate odour emissions from the tipping floor are presented in Table 4-3.

Table 4-3 Odour emission estimate

Source	SOER (OU.$m^3/m^2/s$)	Area (m^2)	Odour flux rate	Peak-to-mean ratio	Peak odour flux rate
Dumping of putrescible load	3.65	100	365	2.3	840

The locations of the modelled odour sources are shown on Figure 4-1.

Figure 4-1 Modelled odour sources

4.3.2 Dust Emissions

Dust emissions from the Proposal have been estimated based on information provided by the client, using emission factors sourced from both locally developed and US EPA developed documentation.

The filling of Canal road as part of the proposal has been included as part of the day-to-day operations however is expected to have negligible effect on the total emissions from the site.

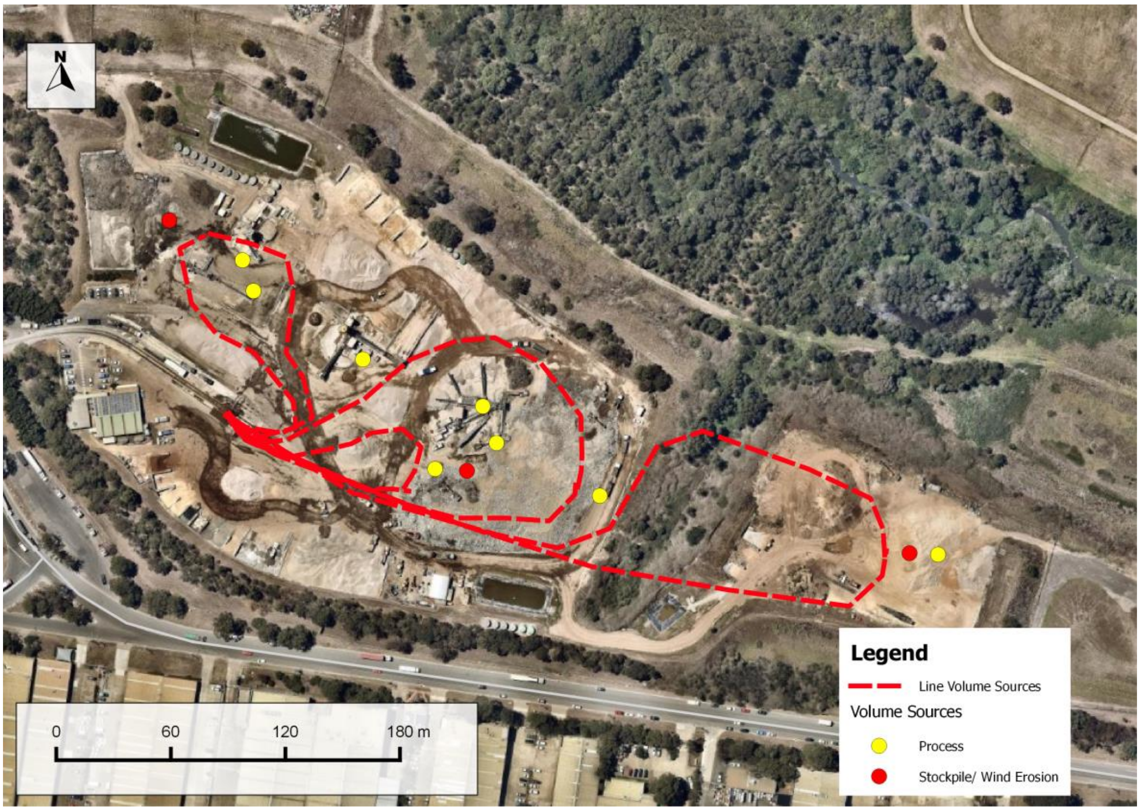
The most significant dust generating activities on the Proposal Site would be waste vehicles driving on unsealed roads to deposit waste at the stockpiles, empty trucks driving on unsealed roads to collect processed materials, processing of materials including crushing and screening and material transfer including into trucks, out into stockpiles and processing equipment. The estimated TSP emissions from these activities are presented in Table 4-4. A detailed emission inventory and emission estimation calculations are presented in Appendix A.

Table 4-4 Estimated worst-case annual TSP emissions (Based on 550,000 tonnes per year)

Activity	TSP emissions (kg/year)
Excavators – loading trucks	38
Excavators – loading screens, crushers	104
Truck - dumping	104
Haul roads – Full trucks	8,730
Haul roads – Empty trucks	6,804
Wind erosion – stockpiles	877
Wind erosion – exposed area	922
Processing	770
Conveyors	104
FEL – filling canal road	3
Total	**18,456**

The haul roads are modelled as a series of sources, distributed approximately along the expected haul routes, which are located throughout the Proposal area. The remaining dust generating activities, as identified in Table 4-4, are located throughout the site were various activities are likely to take place such as the location of stockpiles and screens. The locations of the modelled TSP sources are shown on Figure 4-2. They have been broken down into process sources, including crushing, screening and material handling and static sources including wind erosion form stockpiles. Where sources occur at a proportional rate and are located close to each other they have been combined into a single volume source.

Figure 4-2 Modelled dust sources



5 ASSESSMENT OF IMPACTS

The following section presents quantitative assessments of the potential odour and dust impacts on nearby sensitive receptors from the operation the Proposal.

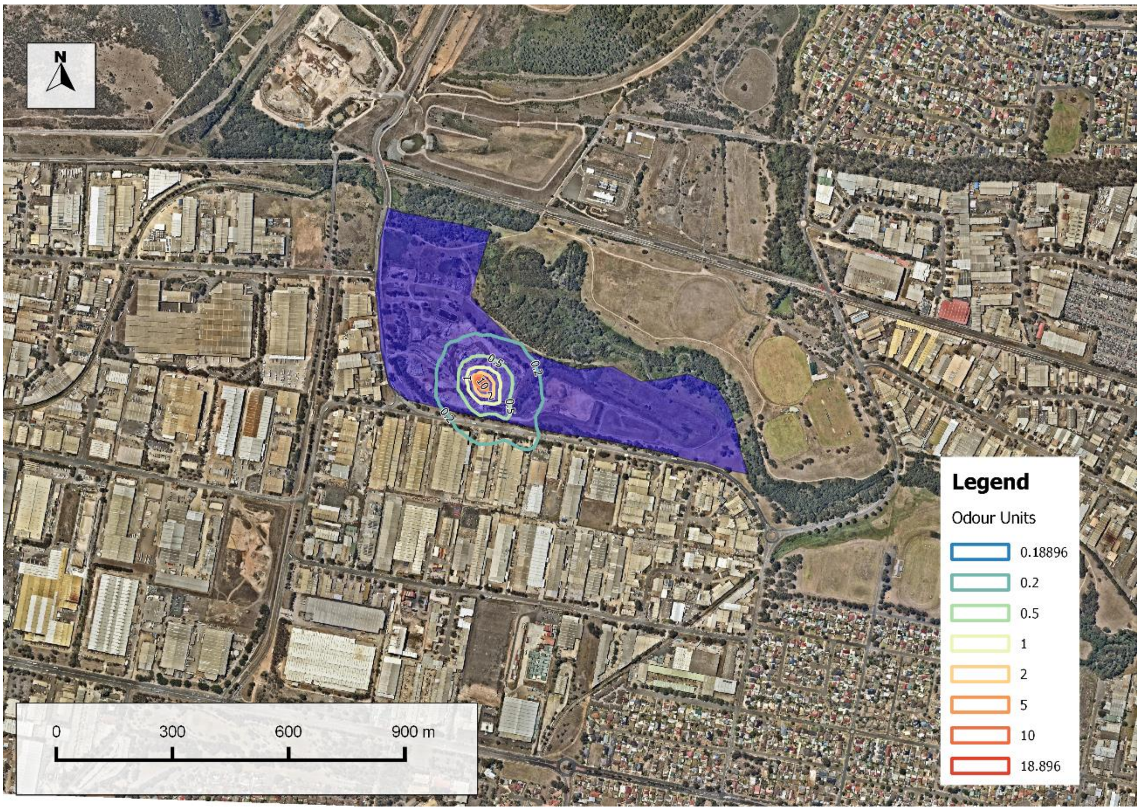
5.1 Assessment of Odour Impacts

Based on dispersion modelling results, the predicted operational odour impacts on nearby receptors is presented numerically in Table 5-1 and graphically via contours in Table 5-1.

Table 5-1 Predicted 99th percentile peak odour concentrations

Receptor	Predicted peak odour concentration (OU/m^3)	Impact assessment criterion (OU/m^3)	Complies? (Yes/ No)
R1	0.01	2.0	Yes
R2	0.01	2.0	Yes
R3	0.01	2.0	Yes
R4	0.02	2.0	Yes
R5	0.02	2.0	Yes
R6	0.01	2.0	Yes
R7	0.02	2.0	Yes
R8	0.00	2.0	Yes
R9	0.00	2.0	Yes
R10	0.01	2.0	Yes
R11	0.00	2.0	Yes
R12	0.01	2.0	Yes
R13	0.04	2.0	Yes
R14	0.03	2.0	Yes
R15	0.04	2.0	Yes
R16	0.04	2.0	Yes
R17	0.10	2.0	Yes
R18	0.26	2.0	Yes
R19	0.01	2.0	Yes
R20	0.12	2.0	Yes
R21	0.03	2.0	Yes
R22	0.02	2.0	Yes
R1	0.05	2.0	Yes

Figure 5-1 Predicted 99th percentile peak odour concentrations



Review of Table 5-1 indicates that the predicted 99th percentile odour concentrations are well below the established impact assessment criterion of 2.0 OU/m^{3}at the most potentially affected sensitive receptors.

5.2 Assessment of Dust Impacts for 550,000 tonnes per year

5.2.1 TSP & Particulate Matter

Table 5-2 represents the dispersion modelling results for TSP and particulate matter at sensitive receptors. Contour plots of the incremental 24-hour average PM_{10} and $PM_{2.5}$ concentrations are presented in Figure 5-2 and Figure 5-4. Contour plots of the incremental annual average PM_{10}, $PM_{2.5}$ and TSP concentrations are presented in Figure 5-3, Figure 5-5 and Figure 5-6.

Table 5-2 Predicted TSP & particulate matter impacts at sensitive receptors for 550,000 tonnes per year

Receptor	TSP		PM_{10}				$PM_{2.5}$			
	Annual		24-hour		Annual		24-hour		Annual	
	Increment	Total	Increment	Total	Increment	Total	Increment	Total	Increment	Total
Goal	**90 µg/m³**		**50 µg/m³**		**25 µg/m³**		**25 µg/m³**		**8 µg/m³**	
R1	0.3	48.3	2.7	39.4	0.2	19.4	0.3	22.0	0.0	**8.8**
R2	0.2	48.2	1.5	38.2	0.1	19.3	0.2	21.9	0.0	**8.8**
R3	0.3	48.3	1.8	38.5	0.2	19.4	0.2	21.9	0.0	**8.8**
R4	1.3	49.3	6.3	43.0	0.7	19.9	0.8	22.5	0.1	**8.9**
R5	0.7	48.7	8.7	45.4	0.4	19.6	1.1	22.8	0.0	**8.8**
R6	0.7	48.7	7.9	44.6	0.4	19.6	1.0	22.7	0.0	**8.8**
R7	1.2	49.2	7.4	44.1	0.7	19.9	0.9	22.6	0.1	**8.9**
R8	0.2	48.2	2.2	38.9	0.1	19.3	0.3	22.0	0.0	**8.8**
R9	0.1	48.1	1.0	37.7	0.1	19.3	0.1	21.8	0.0	**8.8**
R10	0.2	48.2	2.0	38.7	0.1	19.3	0.3	22.0	0.0	**8.8**
R11	0.2	48.2	1.3	38.0	0.1	19.3	0.2	21.9	0.0	**8.8**
R12	0.2	48.2	2.0	38.7	0.1	19.3	0.3	22.0	0.0	**8.8**
R13	1.9	49.9	10.4	47.1	1.0	20.2	1.2	22.9	0.1	**8.9**
R14	1.3	49.3	8.1	44.8	0.7	19.9	0.9	22.6	0.1	**8.9**
R15	1.4	49.4	8.8	45.5	0.7	19.9	1.0	22.7	0.1	**8.9**
R16	1.7	49.7	9.9	46.6	0.9	20.1	1.1	22.8	0.1	**8.9**
R17	4.1	52.1	22.8	**59.5**	2.1	21.3	2.7	24.4	0.2	**9.0**
R18	9.5	57.5	32.9	**69.6**	5.1	24.3	5.0	**26.7**	0.5	**9.3**
R19	0.3	48.3	4.0	40.7	0.2	19.4	0.5	22.2	0.0	**8.8**
R20	7.0	55.0	32.8	**69.5**	3.4	22.6	3.9	**25.6**	0.4	**9.2**
R21	2.1	50.1	12.1	48.8	1.1	20.3	1.6	23.3	0.1	**8.9**
R22	1.1	49.1	7.0	43.7	0.6	19.8	0.9	22.6	0.1	**8.9**

Figure 5-2 Incremental PM_{10} 24-hour average concetration for 550,000 tonnes per year

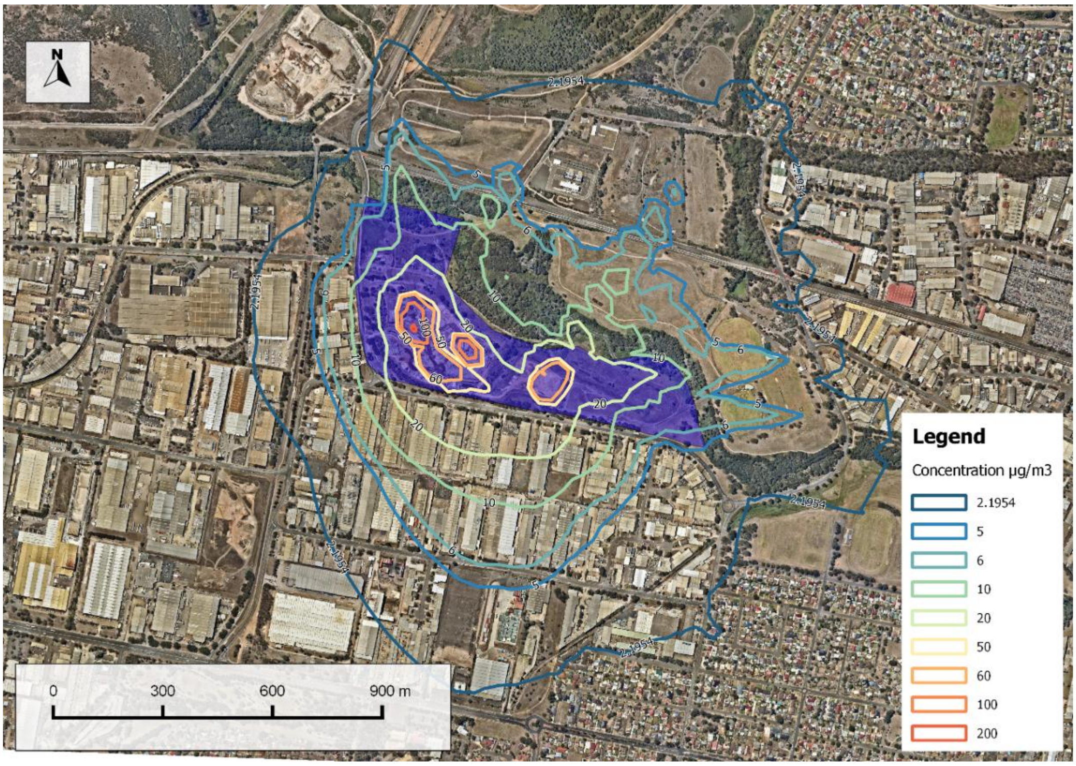


Figure 5-3 Incremental PM_{10} annual average concentration for 550,000 tonnes per year

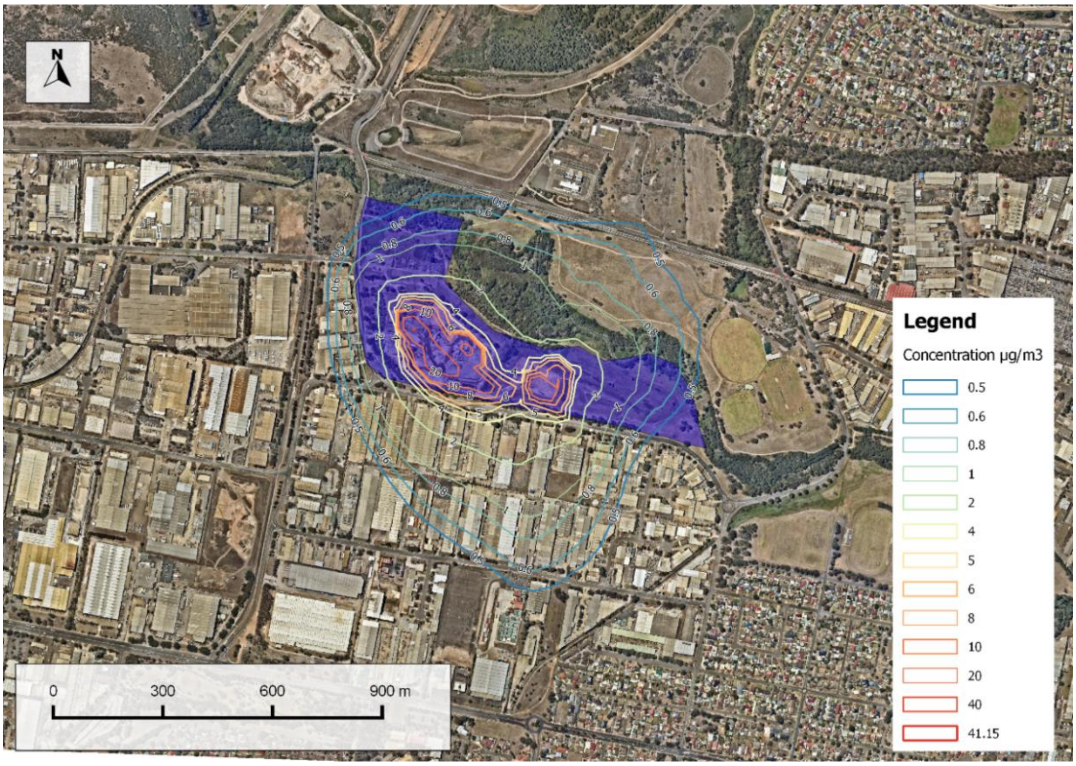


Figure 5-4 Incremental $PM_{2.5}$ 24-hour average concentration for 550,000 tonnes per year

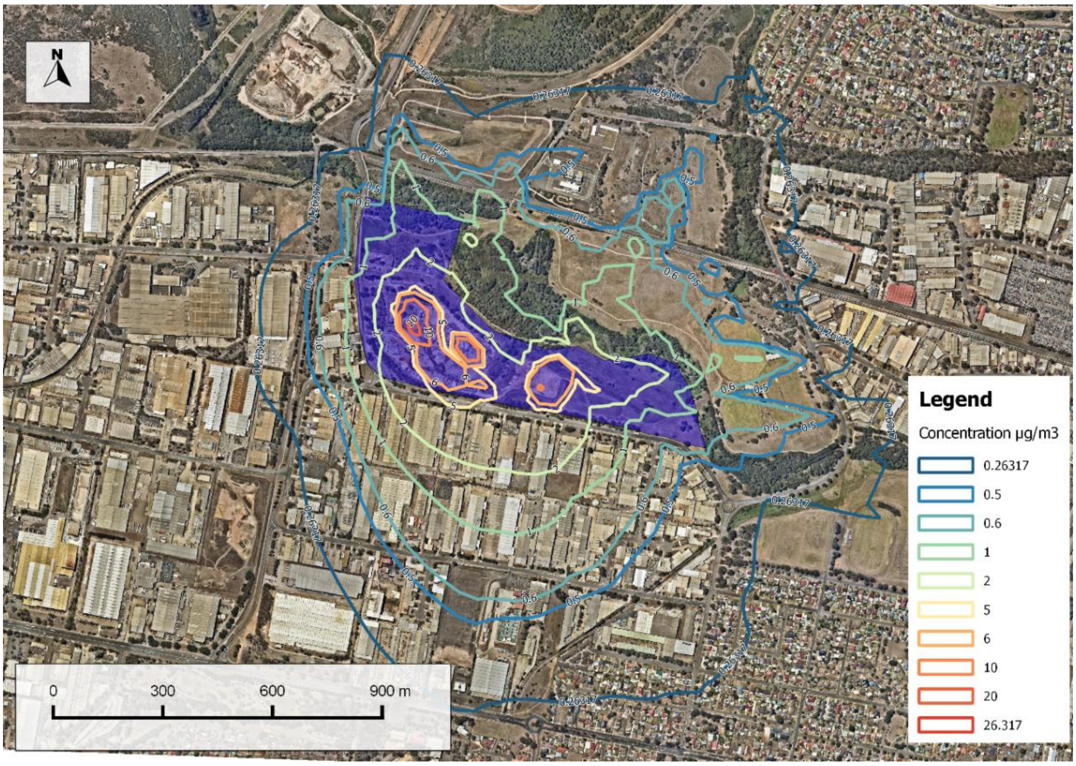


Figure 5-5 Incremental $PM_{2.5}$ annual average concentration for 550,000 tonnes per year

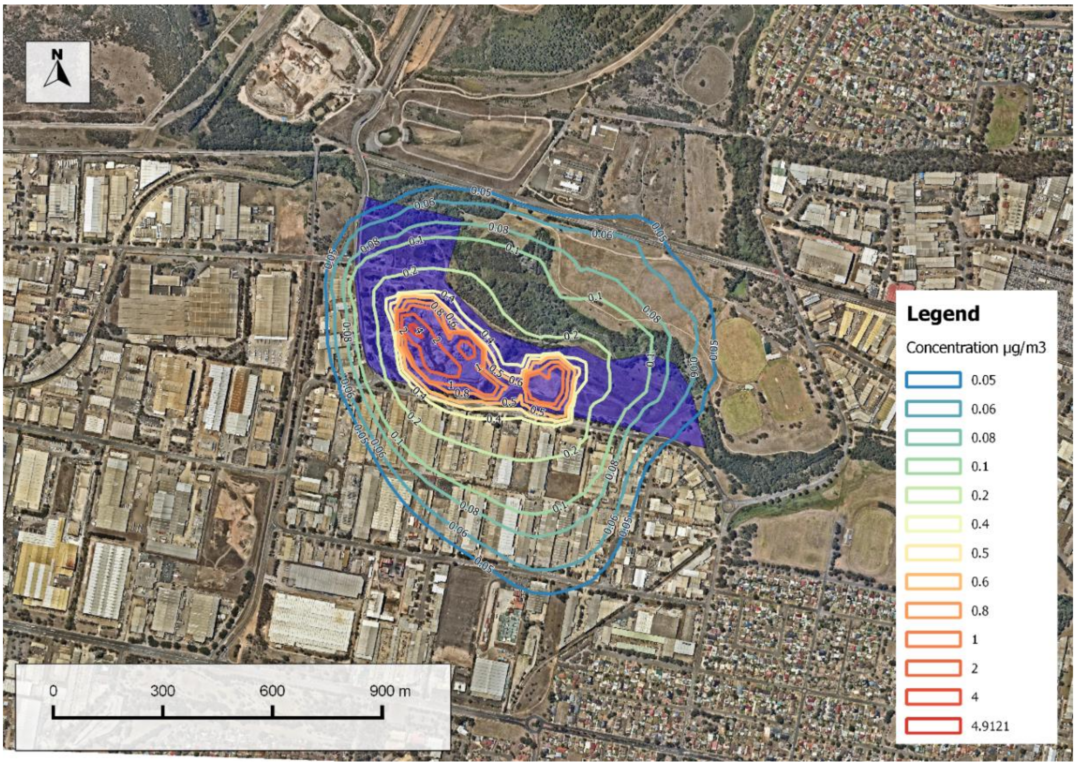
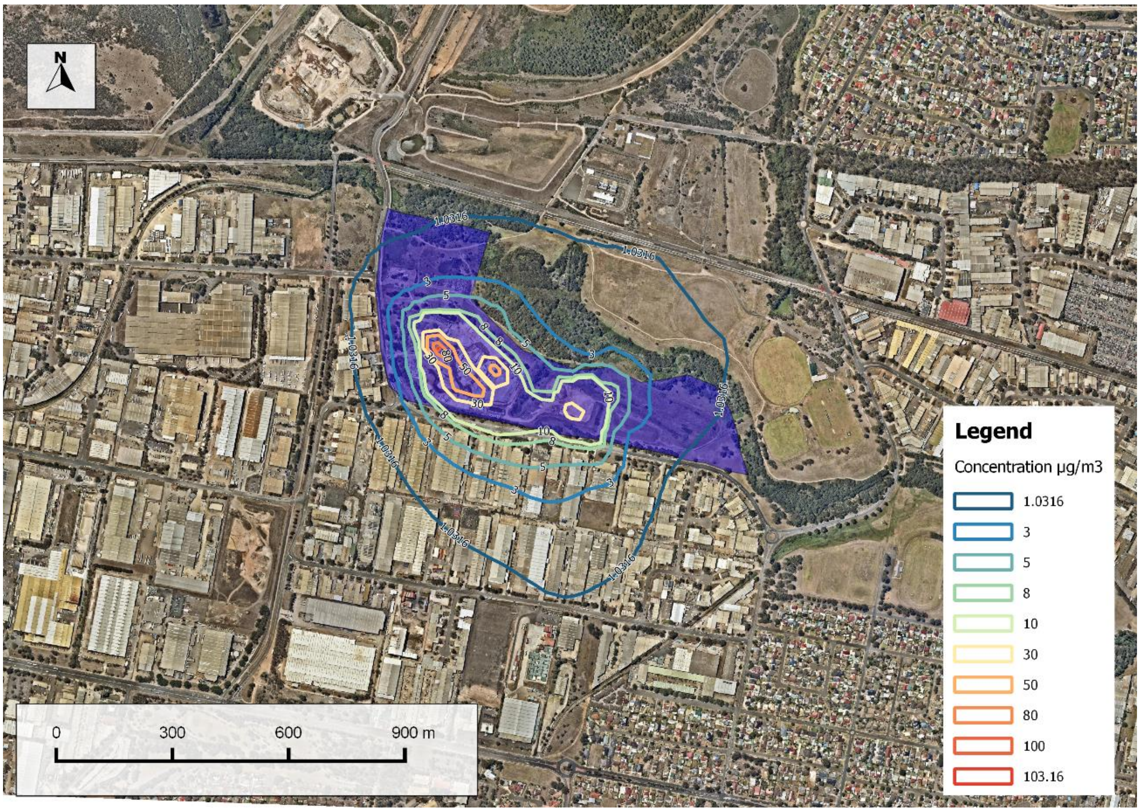


Figure 5-6 Incremental TSP annual average concentration for 550,000 tonnes per year



A review of Table 6-2 demonstrates that TSP concentrations, due to the Proposal, comply with the impact assessment criteria at all receptors. However, it can be seen that the 24-hour average PM_{10} concentration is exceeded at R17, R18 and R20 and that the 24-hour average $PM_{2.5}$ concentration is exceeded at R18 and R20. As per the Approved Methods, a contemporaneous assessment is required to demonstrate that no additional exceedances of the criteria occur.

The predicted levels show that the annual average PM2.5 concentration will be exceeded at all receivers despite only a minor contribution from the project. This is due to elevated background levels. The worst-case PM2.5 annual average concentration at surrounding receptors due to the project was 0.5µg/m3. This represents approximately 5.7% of the PM2.5 criteria and is considered an acceptable contribution to the airshed.

5.2.2 Contemporaneous PM_{10} & $PM_{2.5}$ assessment for 550,000 tonnes per year

A contemporaneous PM_{10} assessment was conducted using 2013 daily average background data from prospect and daily average predicted values at the affected receivers. Figure 5-7, Figure 5-8 and Figure 5-9 show the contemporaneous results at R17, R18 and R20 respectively.

Figure 5-7 2013 contemporaneous PM_{10} assessment at R17

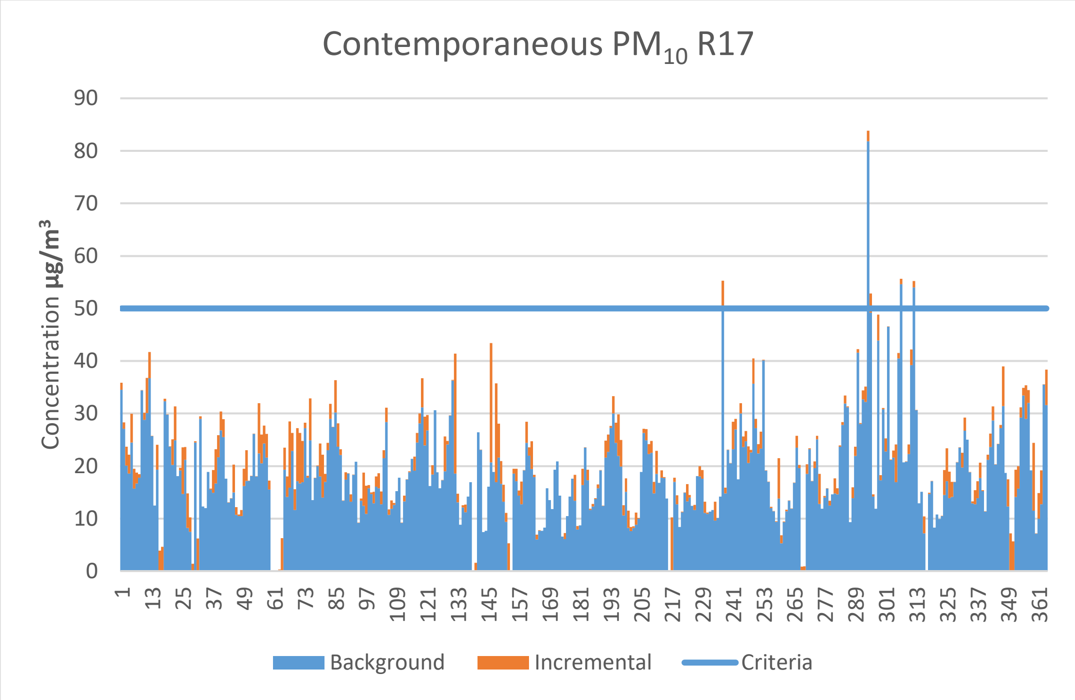


Figure 5-8 2013 contemporaneous PM_{10} assessment at R18

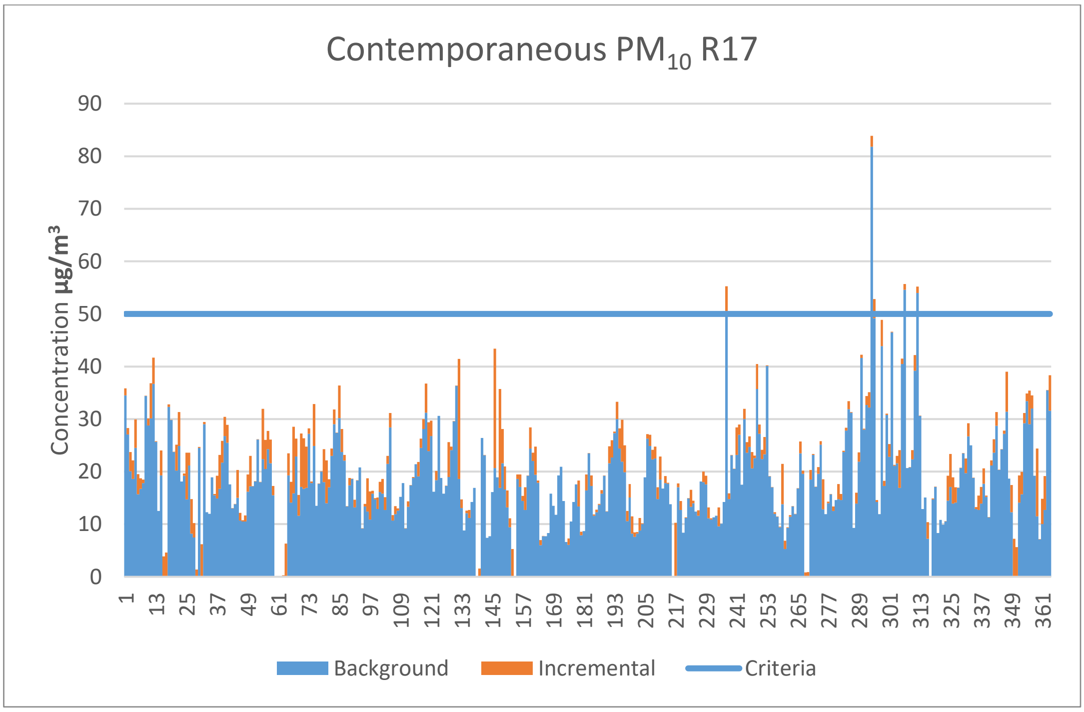
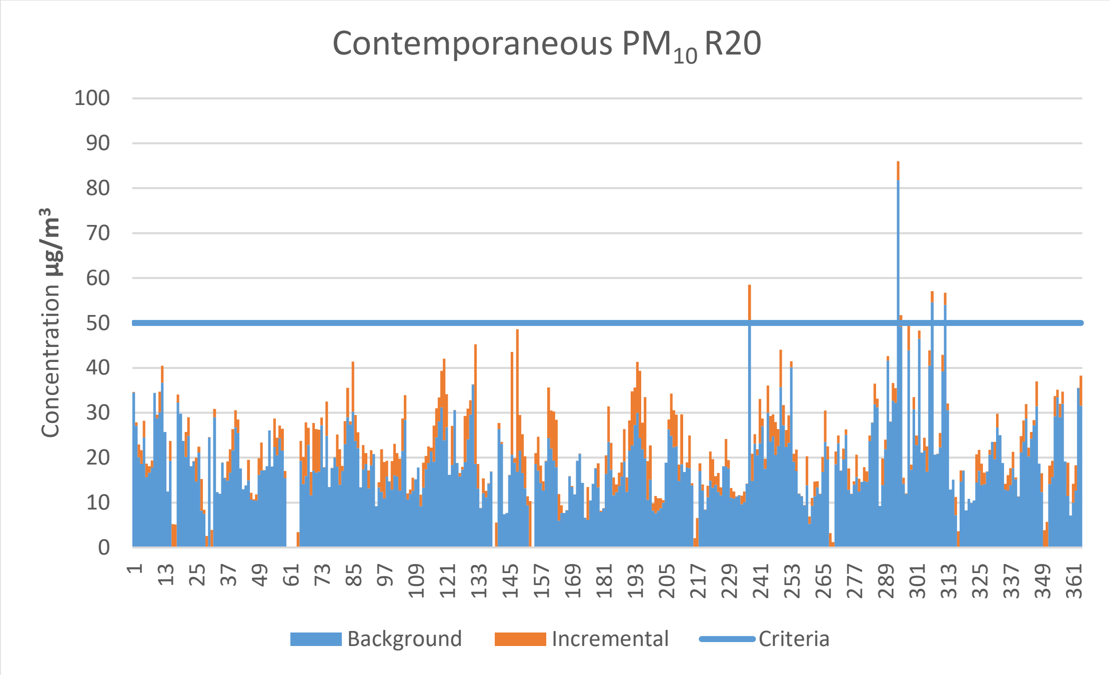


Figure 5-9 2013 contemporaneous PM_{10} assessment at R20



A contemporaneous $PM_{2.5}$ assessment was conducted using 2013 daily average background data from Chullora and daily average predicted values at the affected receivers. The daily average background data was increased by 5% to reflect the difference between Chullora and Prospect as per 2.3.3. Figure 5-10 and Figure 5-11 show the contemporaneous results at R17 and R18 respectively.

Figure 5-10 2013 contemporaneous $PM_{2.5}$ assessment at R17

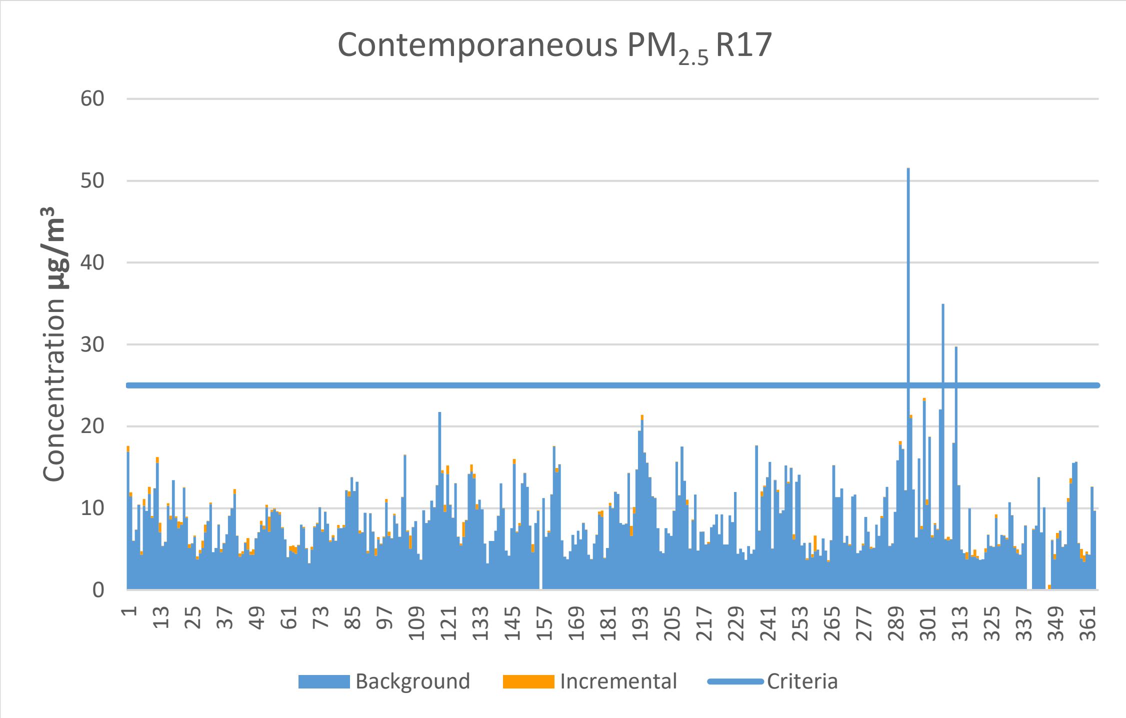
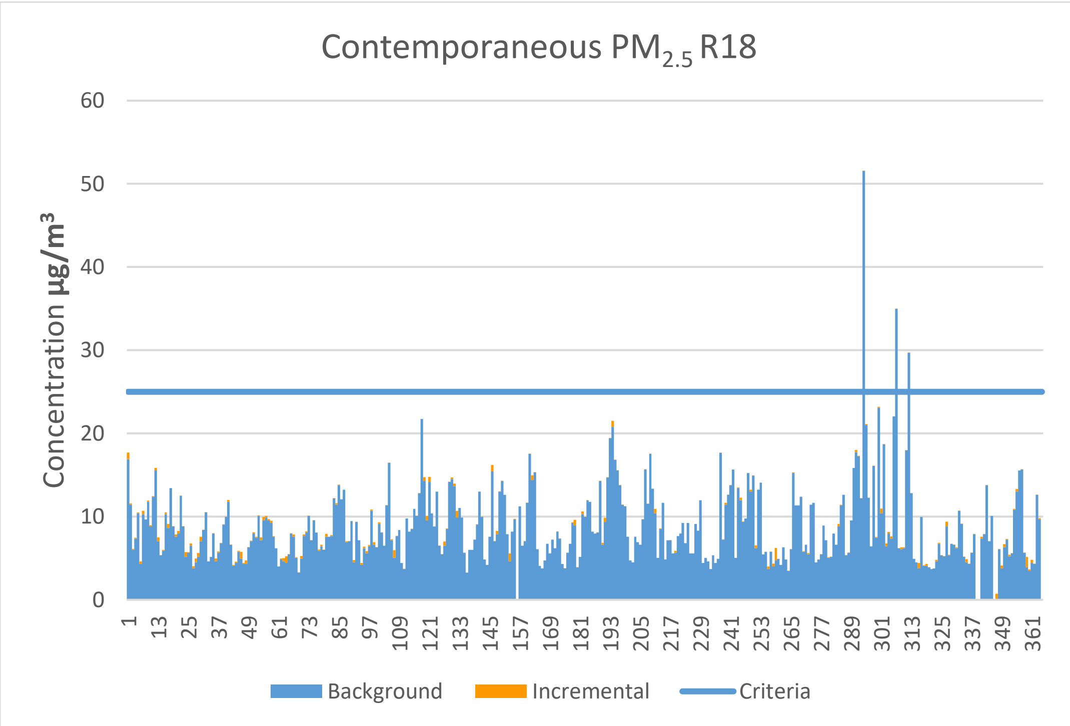


Figure 5-11 2013 contemporaneous $PM_{2.5}$ assessment at R18



A review of Figure 5-7 to Figure 5-10 clearly shows that the total PM_{10} and $PM_{2.5}$ concentrations for the majority of days is below the criteria. However, it can be seen that in some instances the PM_{10} criterion are exceeded when background and incremental levels are combined.

Table 5-3 below summaries the number of exceedances before and after the inclusion of the project.

Table 5-3 Number of Exceedances of ambient criteria with & without development

Receiver	Pollutant	Exceedances	
		Ambient only	With development
R17	PM_{10}	4	5
	$PM_{2.5}$	3	3
R18	PM_{10}	4	6
	$PM_{2.5}$	3	3
R20	PM_{10}	4	5

Several additional exceedances of the PM_{10} criterion occur at receivers R17, R18 and R20. These exceedances occur on 22 and 25 October 2013 and are caused by the elevated background particulate levels caused at the time by bushfires in the Blue Mountains. On these dates, the highest concentration due to the project is 8.2 µg/m^3 at R18 on 25 October 2013. This equates to 15.7% of the total concentration on that day.

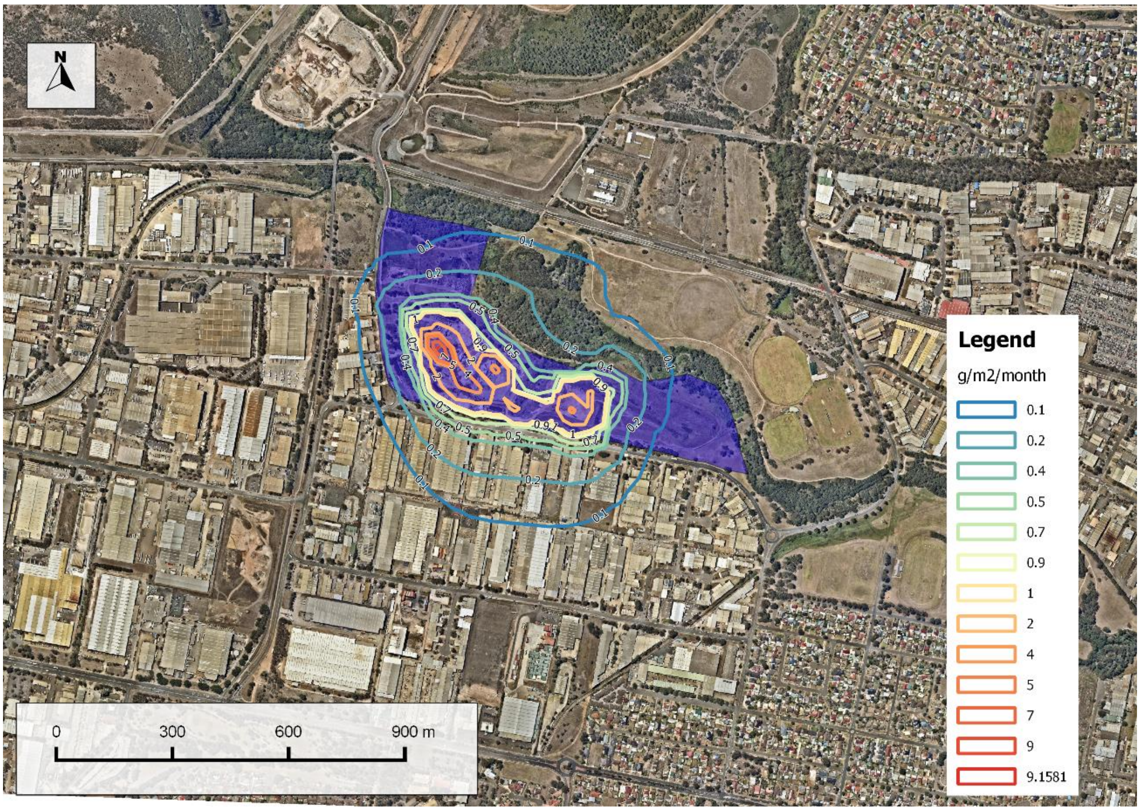
5.2.3 Deposited Dust

Table 5-4 presents the dispersion modelling results for deposited dust at sensitive receptors. Contour plots of the incremental deposited dust are presented in Figure 5-12.

Table 5-4 Predicted deposited dust impacts at sensitive receptors

Receiver	Deposited dust	
	Annual	
	Increment	Total
	2 g/m^2/month	4 g/m^2/month
R1	0.0	2.1
R2	0.0	2.1
R3	0.0	2.1
R4	0.1	2.2
R5	0.0	2.2
R6	0.0	2.2
R7	0.1	2.2
R8	0.0	2.1
R9	0.0	2.1
R10	0.0	2.1
R11	0.0	2.1
R12	0.0	2.1
R13	0.2	2.3
R14	0.1	2.2
R15	0.1	2.2
R16	0.1	2.3
R17	0.3	2.4
R18	0.5	2.6
R19	0.0	2.1
R20	0.5	2.6
R21	0.1	2.3
R22	0.1	2.2

Figure 5-12 Incremental deposited dust



Review of Table 5-4 presents the dispersion modelling results for deposited dust at sensitive receptors. Contour plots of the incremental deposited dust are presented in Figure 5-12.

Table 5-4 demonstrates that deposited dust levels, due to the Proposal, are below the impact assessment criteria at all sensitive receptors.

6 MITGATION & MANAGEMENT

The preceding air quality impact assessment has demonstrated that the Project is expected to comply with relevant air quality criteria. Notwithstanding this, responsible developments should implement reasonable and feasible measures to reduce their burden on local and regional air quality. To this end, the following section presents a number of measures to manage odour and dust emissions from the site.

6.1 Odour Management

As per existing operations Fairfield SRC does not accept putrescible waste. The following odour management measures should continue to be implemented for the Proposal:

- Procedures for staff to report the presence of strong odours around the perimeter of the Proposal site; and
- Two spotters and cameras are used to ensure that all loads that are deemed to contain putrescible waste or asbestos are rejected from the site.

6.2 Dust Management

The following dust management measures should be considered for the Proposal:

- Engines of trucks and mobile plant to be switched off when not in use;
- Maintain and service plant in accordance with manufacturer's specifications;
- Provide water sprays to suppress visible dust leaving the site;
- Limit vehicle speeds to 20km/h;
- Cover vehicle loads if transporting material off-site;
- Reduce drop heights during loading and unloading of material;
- Use water carts to suppress visible dust leaving the site (Level 2 watering in excess of 2l/m^2/hour);
- Minimise areas of exposed surfaces;
- Minimise amount of stockpiled materials;
- Where possible, apply barriers, covering or temporary rehabilitation to exposed areas; and
- Apply final capping and/or rehabilitate areas as soon as practicable.

6.3 Dust Monitoring

Maintain the existing 5 dust deposition gauges located around the boundary of the site to monitor dust in the future. Figure 2-8 provides the location of the dust deposition gauges on-site.

7 CONCLUSION

An Air Quality Impact Assessment has been conducted for the proposal at the Fairfield Sustainable Resource Centre.

Potential odour and dust impacts associated with the day-to-day operational activities for the Proposal have been assessed in general accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

The filling of Canal Road as part of the proposal has been included as part of the day-to-day operations however is expected to have negligible effect on the total emissions from the site.

Quantitative assessments of potential odour and dust impacts from the operation of the Proposal have been conducted, based on TAPM meteorological simulations and the CALPUFF dispersion modelling system.

The results of the dispersion modelling indicate that odour and dust at sensitive receptors due to the operation of the Proposal comply with the established criteria at all l sensitive receptors.

A contemporaneous assessment of $PM_{2.5}$ showed that no additional exceedances of the criteria occurred due to impact from the project. A contemporaneous assessment of PM_{10} showed that up to three additional exceedances could be expected for the modelled year 2013 at the three most affected commercial receivers. These exceedances occur during periods of elevated background levels caused by bush fires and the contribution from the project is considered minor.

The Air Quality Impact Assessment clearly has demonstrated compliance with all relevant NSW air quality policies principally the Approved Methods for the *Modelling and Assessment of Air Pollutants in New South Wales (EPA, 2016)* with the proposed mitigation methods and as such no further mitigation methods are required such as enclosing stockpiles in buildings.

8 REFERENCES

NSW Environmental Protection Authority (2016)

"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW", January 2017.

PAE Holmes (2010)

"Air Quality Impact Assessment – Proposed Modification to the Northern Extension Landfill at Eastern Creek", March 2011

SPCC (1983)

"Air Pollution from Coal Mining and Related Developments", State Pollution Control Commission.

US EPA (1985 and updates)

"Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition, United States Environmental Protection Agency.

APPENDIX A

DUST EMISSIONS INVENTORY

A.1 Particulate Emission Factor Equations

Vehicles on unpaved roads

TSP emissions from vehicles on unpaved roads are a function of the mass of the vehicles and the amount of silt loading on the road. The following US EPA emission factor (US EPA, 1985 and updates) is used to calculated emissions from paved roads:

$$E[kg/VKT] = \frac{0.4536}{1.6093} \times k \times \left(\frac{sL}{12}\right)^{0.7} \left(\frac{W \times 1.1023}{3}\right)^{0.45}$$

Where:

k = 4.9 for TSP, 1.5 for PM_{10}

sL = road surface silt loading [g/m^2]

W = average vehicle weight [tons]

Loading / unloading / transferring material

Each tonne of material handles will generate quantities of particulate matter that will depend on the wind speed and the moisture content of the material according to the US EPA emission factor (US EPA, 1985 and updates) shown below:

$$E[kg/t] = k\,(0.0016)\left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2.0}\right)^{1.4}}\right)$$

Where:

k = 0.74 for TSP

U = wind speed [m/s]

M = moisture content [%]

Crushing

Particulate emission factors for crushing have been taken from the US EPA (US EPA, 1985 and updates) and are summarised below:

Activity	Emission Factor [kg/t]		
	TSP	**PM_{10}**	**$PM_{2.5}$**
Tertiary crushing (uncontrolled)	0.0027	0.0012	*
Screening (uncontrolled)	0.0125	0.0043	*

* No emissions data available

Wind erosion

Particulate emission factors for wind erosion, taken from US EPA emission factor equations (US EPA, 1985 and updates), are 0.1 kg/ha/h for TSP, 0.05 kg/ha/h for PM_{10}, and 0.0075 kg/ha/h for $PM_{2.5}$.

A.2 Emission Estimates

Table A-1 Summary of TSP Emissions

Emission source	Emission rate (g/s)	Emission factor (kg/tonne)	Control	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value
Dumping into main stockpile	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
dumping into rear stockpile	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
dumping into gully	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
load into screen	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
load into crusher	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
load into truck	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
load into pugmill	1.25E-03	1.10E-04	0%	throughput (tpa)	150,000	Windspeed (m/s)	2	Moisture content (%)	10		
crusher	6.85E-02	6.00E-04	0%	throughput (tpa)	400,000						
pugmill	1.71E-02	6.00E-04	0%	throughput (tpa)	100,000						
screens	1.59E-01	1.10E-03	0%	throughput (tpa)	200,000						
material transfer	4.18E-03	1.10E-04	0%	throughput (tpa)	500,000	Windspeed (m/s)	2	Moisture content (%)	10		
Conveyor- crusher	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
Conveyor- screen	3.35E-03	1.10E-04	0%	throughput (tpa)	400,000	Windspeed (m/s)	2	Moisture content (%)	10		
Conveyor- pugmill	1.25E-03	1.10E-04	0%	throughput (tpa)	150,000	Windspeed (m/s)	2	Moisture content (%)	10		
Inbound - main stock pile	1.48E-01	4.25E-03	75%	length (km)	0.107	silt loading (%)	7	vehicle mass (t)	40	tonnes per load	20
Outbound- main stockpile	1.37E-01	3.92E-03	75%	length (km)	0.135	silt loading (%)	7	vehicle mass (t)	20	tonnes per load	20
Inbound Gully	1.64E-02	8.33E-03	75%	length (km)	0.21	silt loading (%)	7	vehicle mass (t)	40	tonnes per load	20
Outbound Gully	1.49E-02	7.58E-03	75%	length (km)	0.261	silt loading (%)	7	vehicle mass (t)	20	tonnes per load	20
Inbound roadbase	9.56E-02	5.02E-03	75%	length (km)	0.173	silt loading (%)	7	vehicle mass (t)	20	tonnes per load	20
Outbound roadbase	1.30E-01	6.82E-03	75%	length (km)	0.172	silt loading (%)	7	vehicle mass (t)	40	tonnes per load	20

Emission source	Emission rate (g/s)	Emission factor (kg/tonne)	Control	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value
inbound rear stockpile	2.37E-01	1.49E-02	75%	length (km)	0.376	silt loading (%)	7	vehicle mass (t)	40	tonnes per load	20
outbound rear stockpile	1.84E-01	1.16E-02	75%	length (km)	0.4	silt loading (%)	7	vehicle mass (t)	20	tonnes per load	20
wind erosion - main stock piles	3.77E-02		50%	area (ha)	0.49	emission factor	0.4	rain days>0.25	112		
wind erosion - road base stock piles	1.03E-02		50%	area (ha)	0.1338	emission factor	0.4	rain days>0.25	112		
wind erosion - screen stock piles	4.24E-03		50%	area (ha)	0.055	emission factor	0.4	rain days>0.25	112		
wind erosion - rear stock piles	1.45E-02		50%	area (ha)	0.1879	emission factor	0.4	rain days>0.25	112		
wind erosion - exposed areas	7.02E-02		50%	area (ha)	0.911	emission factor	0.4	rain days>0.25	112		
Total	**1.4**										