Environmental Impact Statement

APPENDIX

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AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

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Report

WASTE RECYCLING FACILITY– AIR QUALITY AND GREENHOUSE GAS ASSESSMENT

CARDNO PTY LTD

Job ID. 20863

16 June 2016

PROJECT NAME:	Waste Recycling Facility– Air Quality and Greenhouse Gas Assessment
JOB ID:	20863
DOCUMENT CONTROL NUMBER	AQU-NW-004-20863
PREPARED FOR:	Cardno Pty ltd
APPROVED FOR RELEASE BY:	Jane Barnett
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DOCUMENT CONTROL

VERSION	DATE	COMMENT	PREPARED BY	REVIEWED BY
Draft 01	22/02/2016	First Draft	Francine Manansala	Judith Cox
Draft 02	29/02/2016	Cardno comments	Francine Manansala	Jane Barnett
Draft 03	10/06/2016	Remodel of crusher	Francine Manansala	Jane Barnett
Final	16/06/2016	Final report	Francine Manansala	Jane Barnett

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1 INTRODUCTION

Pacific Environment has been commissioned by Cardno Pty Ltd (Cardno) to conduct an air quality and greenhouse gas assessment on the proposed Waste Recycling Facility (WRF) at the Enviro Recycling Pty Ltd site located within the Revesby industrial area, New South Wales (NSW).

The air quality assessment is based on the use of the computer-based dispersion model (CALPUFF) to predict off site dust levels. Potential odour emissions are also addressed. To assess the effect that emissions could have on existing air quality (primarily dust), the dispersion model predictions have been compared to relevant regulatory air quality criteria.

The assessment follows a conventional approach using the procedures outlined in the NSW Environment Protection Authority's (EPA) document titled "*Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*" (**DEC, 2005**). Other documents such as the "Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW, Australia'" (**TRC, 2010**) were considered for modelling.

In summary, this report provides information on the following:

- Summary of existing and proposed operations.
- Summary of air quality criteria.
- Meteorological conditions in the area.
- Emission sources and estimates of these emissions.
- Methods used to predict off-site impact levels from expected emissions from the site.
- Expected dispersion patterns and predicted impacts.

1.1 Secretary's Environmental Assessment Requirements

This air quality and greenhouse gas assessment has been prepared in consideration of the Secretary's Environmental Assessment Requirements (SEARs) for the EIS. Table 1.1 summarises the SEARs and the section of the report in which they are addressed.

Table 1.1: Secretary's Environmental Assessment Requirements

Requirements for Air Quality	Section addressed
An assessment of the potential air quality, dust and odour impact of the project on surrounding landowners in accordance with relevant EPA guidelines.	Whole report Detailed in Section 7.2
Details of the building's mechanical ventilation to ensure sufficient air change suitable for maintaining a healthy environment.	Not relevant to this assessment
A description of the mechanical extraction system and method of treatment prior to discharge to the external environment.	Not relevant to this assessment
Details of the building doors or other structures that effectively contain emissions.	Section 6.3
A greenhouse gas assessment.	Section 8
Details of proposed mitigation, management and monitoring measures.	Section 9

Additional consultation was carried out with Bankstown Council and on 4 March 2016, Council advised of the following additional air quality matters to be considered as part of the EIS preparation:

"Assess the potential air quality impacts to the surrounding area, including but not limited to the residential dwellings south of the M5 and east of Queen Street."

This area has been included in the assessment.

2 LOCAL SETTING AND PROJECT DESCRIPTION

The proposed WRF is to be located on Violet Street, Revesby in NSW (see **Figure 2.1**).

In March 2015 Enviro Recycling was granted approval by Bankstown City Council for the operation of a small scale recycling operation (30,000 tonnes) at 51 Violet Street, Revesby. The facility has been in operation since June 2015 and processes construction and demolition waste. The existing Project layout is shown in **Figure 2.2**.

Enviro Recycling Pty Ltd (Enviro Recycling) is now seeking approval to expand the operation to the south of the existing site incorporating 57-67 Violet Street. The expanded facility would cover an area of approximately 19,400 m^2 including processing facilities, stockpile/storage and handling areas, vehicular access and manoeuvring areas. The proposed Project layout is shown in **Figure 2.3**.

The proposed waste recycling facility would process up to 250,000 tonnes per year of general solid waste (non-putrescible) as defined in Schedule 1 of the Protection of the Environment Operations Act 1997 (POEO Act). Primarily the facility would accept the following:

- Construction and Demolition (C&D) waste including crushed concrete, road base materials, soil, bricks, stones, masonry, timber, metal, gyprock, batteries, glass, bottles, paper, cardboard mulch and landscaping materials.
- Commercial and Industrial (C&I) waste including paper, cardboard, glass, timber, metals, plastics, whitegoods and other materials from C&I sources.
- Green waste, soils and timber.

Material would be brought to the site and sorted into recyclables and then on-sold to the end user or further processing facility. The residual, non-reusable materials would be transferred to a licensed landfill site.

Figure 2.1 Location of the site

Figure 2.2: Existing Project layout

Figure 2.3: Proposed Project layout

3 AIR QUALITY ASSESSMENT CRITERIA

The air quality criteria relevant to this assessment are those related to particulate matter (PM), or commonly called dust. There are various classifications of particulate matter with State regulatory authorities often providing standards, goals, objectives, criteria or targets for:

- Total suspended particulates (TSP), to protect against nuisance amenity impacts;
- Particulate matter with equivalent aerodynamic diameter less than or equal to 10 microns (PM_{10}), to protect against health impacts;
- Particulate matter with equivalent aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), to protect against health impacts; and
- Deposited dust, to protect against nuisance amenity impacts.

Air quality impacts from the Project will be determined by the level of compliance with the air quality criteria set by the EPA as part of their Approved Methods (**DEC, 2005**). The impact assessment criteria refer to the total pollutant load in the environment and impacts from new sources of these pollutants must be added to existing background levels for compliance assessment. In other words, consideration of background dust levels needs to be made when using these goals to assess potential impacts.

The criteria are health-based, that is they are set at levels to protect against health effects, including for the most vulnerable in society. The EPA criteria are consistent with the National Environment Protection Measures for Ambient Air Quality (referred to as the Ambient Air-NEPM) (**NEPC, 1998**). However, the EPA's criteria includes averaging periods, which are not included in the Ambient Air-NEPM, and also references other measures of air quality, namely dust deposition and TSP. **Table 3.1** summarises the air quality goals for concentrations of particulate matter that are relevant to this study.

The NEPM goals for $PM_{2.5}$ have not been adopted by the EPA for assessment of impacts from specific projects.

Table 3.1: Relevant air quality assessment criteria

Pollutant	Criterion	Averaging Period	Agency
Total suspended particulate (TSP)	90 µg/m³	Annual	NH&MRC
Particulate matter < 10 µm (PM_{10})	50 µg/m³	24-hour	NSW EPA
	30 µg/m³	Annual	NSW EPA
Particulate matter < 2.5 µm ($PM_{2.5}$)	25 µg/m³	24-hour	NEPM
	8 µg/m³	Annual	NEPM
Deposited dust	2 g/m²/month	Annual (maximum increase)	NSW EPA
	4 g/m²/month	Annual (maximum total)	NSW EPA

4 METHODOLOGY

4.1 Approach to Assessment

The overall approach to the assessment follows the "Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales" (**DEC, 2005**), hereafter referred to as the Approved Methods, using the Level 3 assessment methodology. The Approved Methods specify how assessments based on the use of air dispersion models should be completed. They include guidelines for the preparation of meteorological data to be used in dispersion models and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the Project.

The air dispersion modelling conducted for this assessment is based on an advanced modelling system using the models TAMP and CALMET/CALPUFF.

The modelling system works as follows:

- The Air Pollution Model, or TAPM, is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period based on historical global meteorological data. 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 was developed by the CSIRO Division of Atmospheric Research. Detailed description of the TAPM model and its performance is provided in **Hurley (2008)** and **Hurley and Edwards et al (2008)**.
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates fine resolution three-dimensional meteorological data based upon input data of observed ground and upper level meteorological data, as well as modelled meteorological data generated for example by TAPM.

  CALMET includes an objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. It produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the three-dimensional meteorological fields that are utilised in the CALPUFF dispersion model (i.e. the CALPUFF dispersion model requires meteorological data in three dimensions). CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region.

- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field. It is a multi-layer, multi species, non-steady-state puff dispersion model[a] that can simulate the effects of time-varying and space-varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across released puffs and takes into account the complex arrangement of emissions from point, area, volume and line sources (**Scire et al., 2000**).

CALMET/CALPUFF is endorsed by the US EPA and recommended by the NSW EPA for use in complex terrain and non-steady state conditions (that is, conditions that change in time and space).

[a] Gaussian plume models are considered steady-state because the plume equation is independent of time, that is, dispersion from the source to receptor is instantaneous for each hour of meteorological data. CALPUFF however, 'remembers' the plume from the previous hour taking into account residual concentrations at each grid point from the hours before and is therefore non-steady-state.

4.2 Model Specifications

One recent year of meteorology, 2013, was modelled for this project to represent various seasonal and diurnal weather conditions experienced at the project location. 2013 was chosen as the most recently available meteorological dataset and was compared to previous years of data to ensure that it was not an anomalous year in terms of wind patterns. It was found to be consistent with wind patterns seen at the site in previous years.

Surface meteorological observations from the Bureau of Meteorology (BoM) station Bankstown Airport were used along with a TAPM three dimensional output, to construct a three-dimensional meteorological data file for 2013 using CALMET. Modelling was conducted according to the Approved Methods.

Located in a flat regional area and only 2.8 km northwest of the project, the Bankstown Airport is considered a representative meteorological station for this assessment.

4.2.1 TAPM Setup

For this project, TAPM was set up with four domains, composed of 33 grid points along both the x and the y axes, centred on latitude -33˚56' and longitude 151˚0.5'. Each nested domain had a grid resolution of 30 km, 10 km, 3 km, and 1 km, respectively. The model output from the inner most domain was processed via CALTAPM to generate a 3D.dat for input to CALMET.

4.2.2 CALMET Setup

CALMET was set up with "hybrid" option, driven by surface observations and 3D.dat for upper air data.

It was modelled with a horizontal domain size of 10 km x 10 km, with a fine resolution of 100 m to resolve localised wind conditions. The project site was located in the model of the domain. Vertical cell face heights are 0, 20, 40, 80, 160, 320, 640, 1280, 2500, and 3600 m. They are dense near the surface to better represent the meteorology in lower atmosphere, where the emissions are to be dispersed and receptors are located.

High resolution of terrain and land use data were used for CALMET. The terrain data was produced from Shuttle Radar Topography Mission (SRTM) data, and land use from Australian Collaborative Land Use and Management Program (ACLUMP) data. SRTM data has a resolution of approximately 90 m. ACLUMP data has fine resolution for the project area.

The project area is located on the UTM zone 56 south.

4.2.3 CALPUFF Setup

CALPUFF is the dispersion module of the CALMET/CALPUFF suite of models. It is a multi-layer, multi species, non-steady-state puff dispersion model that can simulate the effects of time-varying and space-varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across released puffs and takes into account the complex arrangement of emissions from point, area, volume and line sources (**Scire *et al.*, 2000**).

Each dust generating source was represented by a series of volume sources situated according to their location. Model predictions were made across the domain at gridded receptors at a spacing of 100m x 100m over a 4km x 4km area.

5 EXISTING ENVIRONMENT

5.1 Meteorology

5.1.1 Wind Speed and Direction

Wind speed and direction are highly important for plume dispersion. Wind direction dictates the direction in which the plume travels. Thus, over a long period, the temporal variation of wind directions determines the spatial pattern of average ground level concentrations. Wind speed influences the initial dilution of the plume as it leaves the source, with higher wind speeds generally resulting in lower plume concentrations.

The wind roses show the frequency of occurrence of winds by direction and strength. Some guidance on the interpretation of wind roses is presented in **Appendix A**. Wind speed and direction data were extracted from the CALMET generated wind field at the project location and compared against the measured data at the BoM Bankstown Airport AWS. These wind roses are presented in **Figure 5.1**.

On an annual basis for both datasets, wind directions are fairly uniformly distributed in all directions although wind from the northeast (NE), southwest (SW) and northwest (NW, WNW, NNW) are slightly more frequent than from other directions. Seasonal variations are very strong, with predominant wind directions of NE, ENE and SE in summer, and predominant wind directions in the quadrant of SW - NNW in winter. The annual percentage of calms (wind speeds <0.5 m/s) are also comparable.

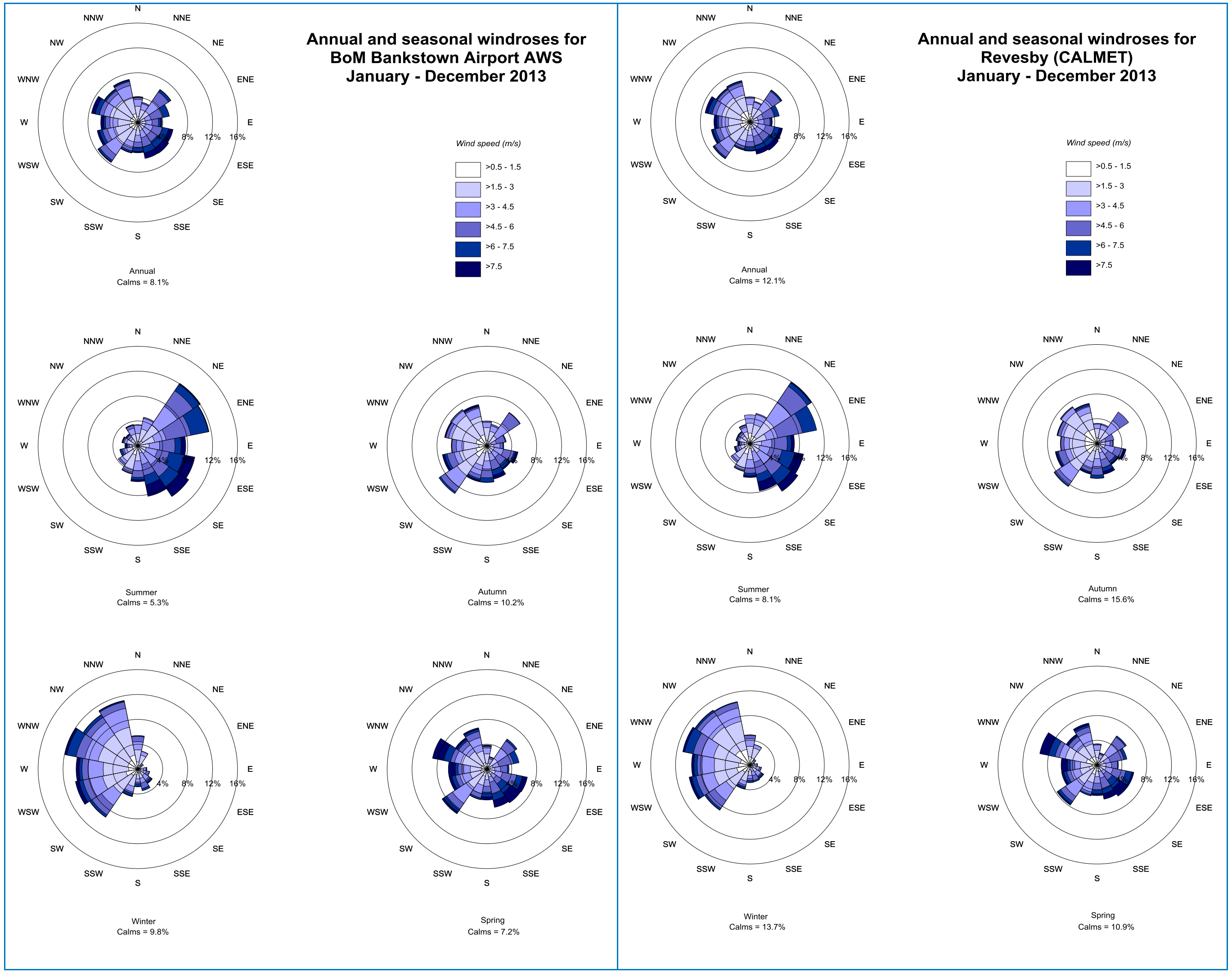


Figure 5.1: Annual and seasonal wind roses for the project area, 2013

5.1.2 Atmospheric Stability

Atmospheric turbulence is an important factor in plume dispersion. Turbulence acts to increase the cross-sectional area of the plume due to random motions, thus diluting or diffusing a plume. As turbulence increases, the rate of plume dilution or diffusion increases. Weak turbulence limits plume diffusion and is a critical factor in causing high plume concentrations downwind of a source, particularly when combined with very low wind speeds.

Turbulence is related to the vertical temperature gradient, the condition of which determines what is known as stability, or thermal stability. For traditional dispersion modelling using Gaussian plume models, categories of atmospheric stability are used in conjunction with other meteorological data to describe atmospheric conditions and thus dispersion.

The most well-known stability classification is the Pasquill-Gifford scheme , which 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 early mornings. Under these conditions plumes can remain relatively undiluted for considerable distances downwind.

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. 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.

The CALMET-generated meteorological data can be used to estimate stability classes and the frequency distribution of estimated stability classes is presented in **Figure 5.2**. The data show a high proportion of neutral conditions (36% D-class) and stable conditions (39% E and F-class).

It is noted that a turbulence based scheme within CALPUFF was used in the modelling and the P-G stability class frequency is shown for information only. The use of turbulence based dispersion coefficients is recommended (**TRC, 2010**) and the US EPA has replaced P-G-based dispersion with a turbulence-based approach in their regulatory model (AERMOD) and is in accordance with best science practice and model evaluation studies.

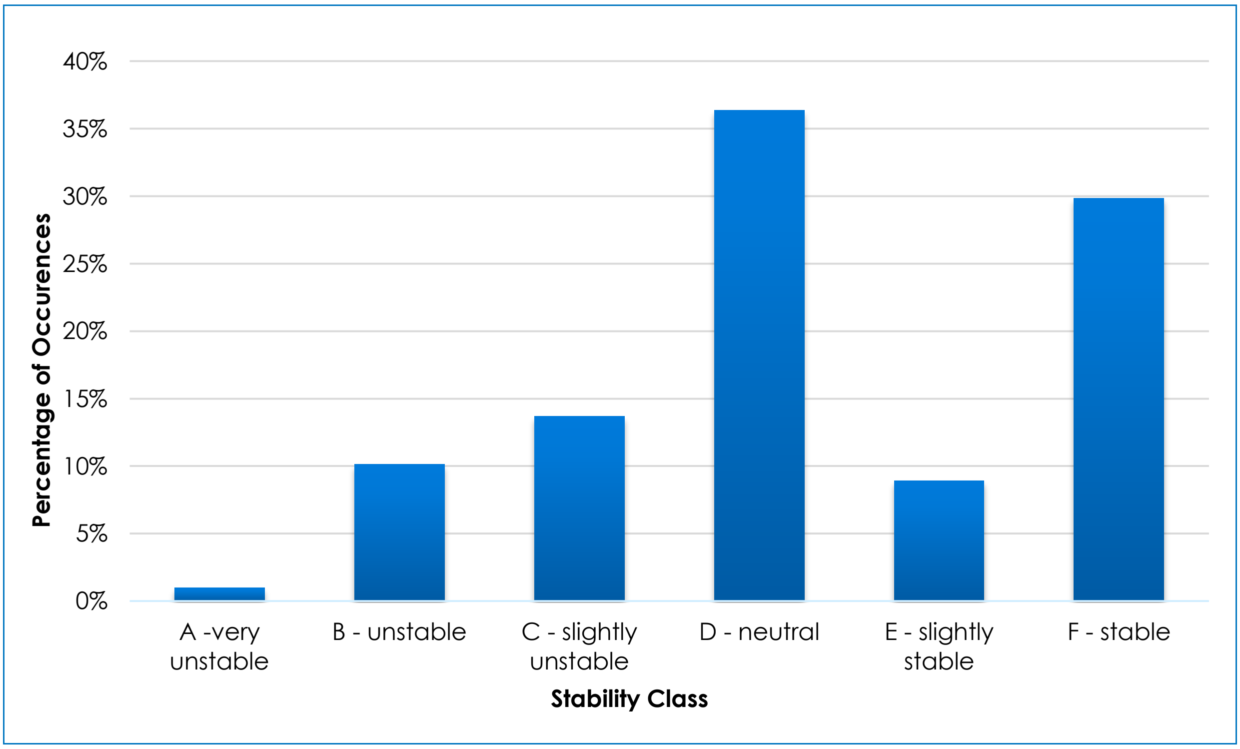


Figure 5.2 Stability class summary

5.1.3 Mixing Height

Mixing height is the depth of the atmospheric mixing layer near the surface. It is beneath an elevated temperature inversion layer. It is an important parameter in air pollution meteorology as vertical diffusion or mixing of a plume is generally considered to be limited by the mixing height. This is because the air above this layer tends to be stable, with restricted vertical motions.

The estimated diurnal variation of mixing height at the site is presented in **Figure 5.3**. The diurnal cycle is clear in this figure. At night, mixing height is normally relatively low. After sunrise, it increases in response to convective mixing due to solar heating of the earth's surface. The estimated mixing height behaviour is consistent with expectations.

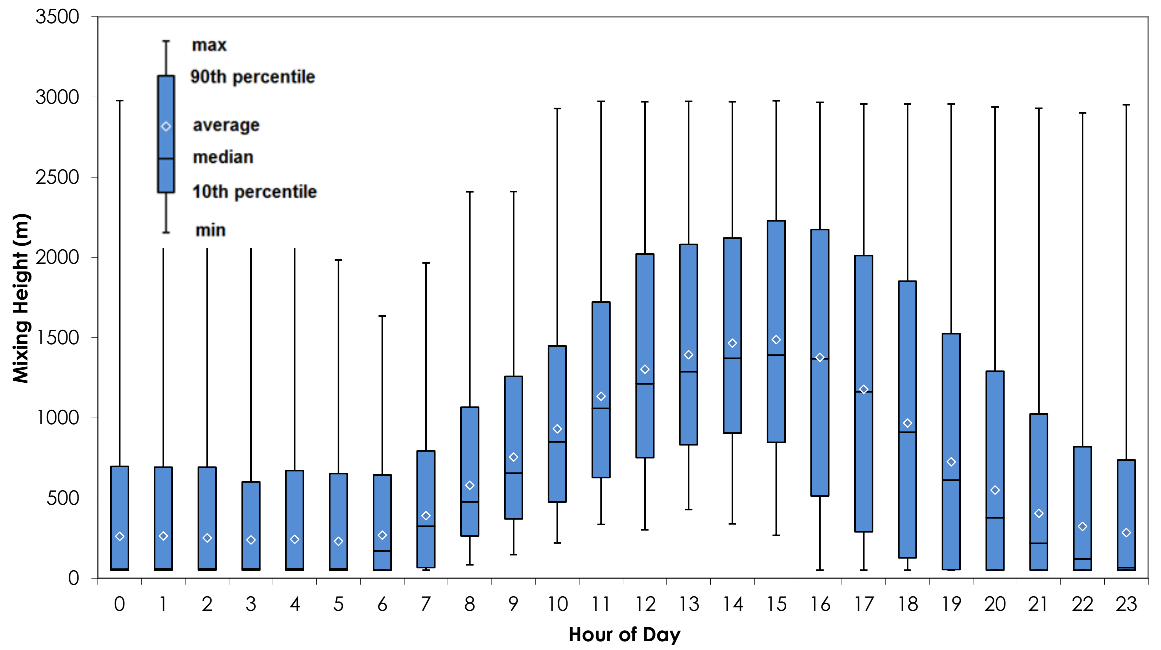


Figure 5.3 Mixing height vs. hour of day

5.2 Existing Air Quality

Air quality standards and criteria refer to pollutant levels that include the contribution from specific projects combined with existing sources. To fully assess impacts against all the relevant air quality standards and criteria (see **Section 3**) it is necessary to have information or estimates on existing dust concentration and deposition levels for the area in which the Project is likely to contribute to these levels.

No air quality data are collected in the immediate vicinity of the site. Chullora, the closest monitoring station to the site, is operated by the NSW Office of Environment and Heritage (OEH) and is located approximately 6 km to the northeast of the Project.

5.2.1 PM_{10} concentrations

The Chullora monitoring site measures concentrations of PM_{10} by Tapered Element Oscillating Microbalance (TEOM). These data are published online, and the last six years of data are summarised in **Table 5.1.** The median 24-hour average values for each year is presented together with the annual average. Presenting the median reduces the influence of extreme weather events such as bushfires and dust storms which result in short-term elevated concentrations over 50 µg/m³ that are clearly not representative of average conditions.

Table 5.1: PM_{10} monitoring data at the OEH Chullora site

Year	Median 24h PM_{10} (µg/m³)	Annual Average PM_{10} (µg/m³)
2010	17	18
2011	18	20
2012	17	18
2013	17	18
2014	17	18
2015	16	18
Average	**17**	**18**

Figure 5.4 presents the 24-hour average PM_{10} data collected at the OEH Chullora site from 2010 to 2016. The data show significant variability in day-to-day 24-hour average PM_{10} concentrations at Chullora. There were 13 occasions where the 24-hour average impact assessment criterion of 50 µg/m³ was exceeded over the six year period. These are most likely the result of regional weather events affecting measurements at this monitor.

The measurements show that there are exceedances of 50 µg/m³ from time to time, but the majority of concentrations are less than 30 µg/m³. To exceed 50 µg/m³, the contribution from the Project would therefore need to contribute more than 20 µg/m³ on those occasions. Results presented in **Section 7** show that this is extremely unlikely.

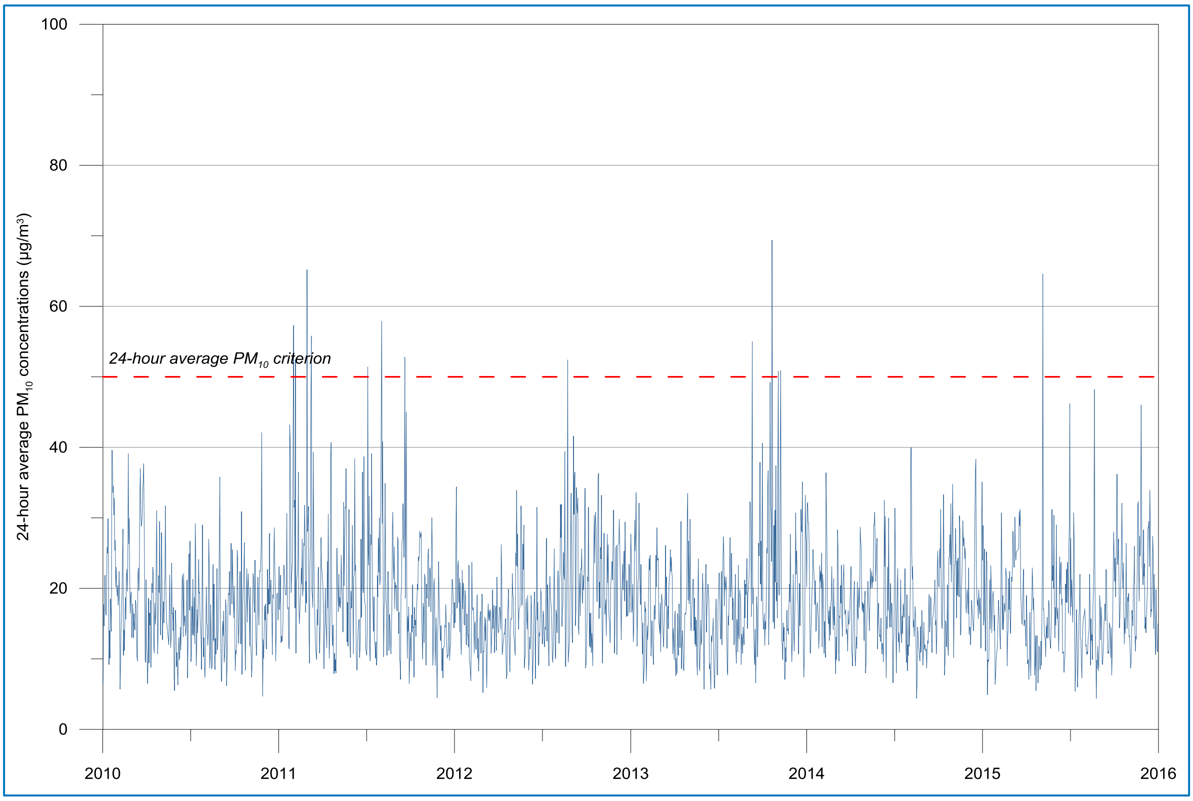


Figure 5.4: Measured 24-hour average PM_{10} concentrations at Chullora (2010-2016)

5.2.2 $PM_{2.5}$ concentrations

The Chullora monitoring site also measures concentrations of $PM_{2.5}$. It is noted that during 2012, the OEH made a decision to replace its continuous TEOM $PM_{2.5}$ monitors with USEPA-equivalent Beta Attenuation Monitors (BAMs). This is the main reason for the increase in the measured concentrations between 2012 and 2014. It is well documented that there are considerable uncertainties in the measurement of $PM_{2.5}$ (**AQEG, 2012**).

The last six years of $PM_{2.5}$ data collected at Chullora are summarised in **Table 5.2.** The median of the maximum 24-hour average values for each year is presented together with the annual average.

Table 5.2: $PM_{2.5}$ monitoring data at the OEH Chullora site

Year	Median 24h PM_{10} (µg/m³)	Annual Average PM_{10} (µg/m³)
2010	5	6
2011	5	6
2012	5	6
2013	7	8
2014	8	9
2015	7	8
Average	**6**	**7**

Figure 5.5 presents the 24-hour average $PM_{2.5}$ data collected at the OEH Chullora site from 2010 to 2016. The data show significant variability in day-to-day 24-hour average $PM_{2.5}$ concentrations at Chullora. There were four occasions where the 24-hour average advisory reporting standard of 25 µg/m³ was exceeded over the six year period. These are most likely the result of regional weather events affecting measurements at this monitor. In late 2013 there were significant bushfire events across Sydney which is likely to be the cause of the exceedances at that time.

The measurements show that there are exceedances of 25 µg/m³ from time to time, but the majority of concentrations are less than 10 µg/m³ up to 2012 but higher in following years due to the change in instrumentation as discussed above. To exceed 25 µg/m³, the contribution from the Project would therefore need to contribute more than 10 µg/m³ on those occasions. Results presented in **Section 7** show that this is extremely unlikely.

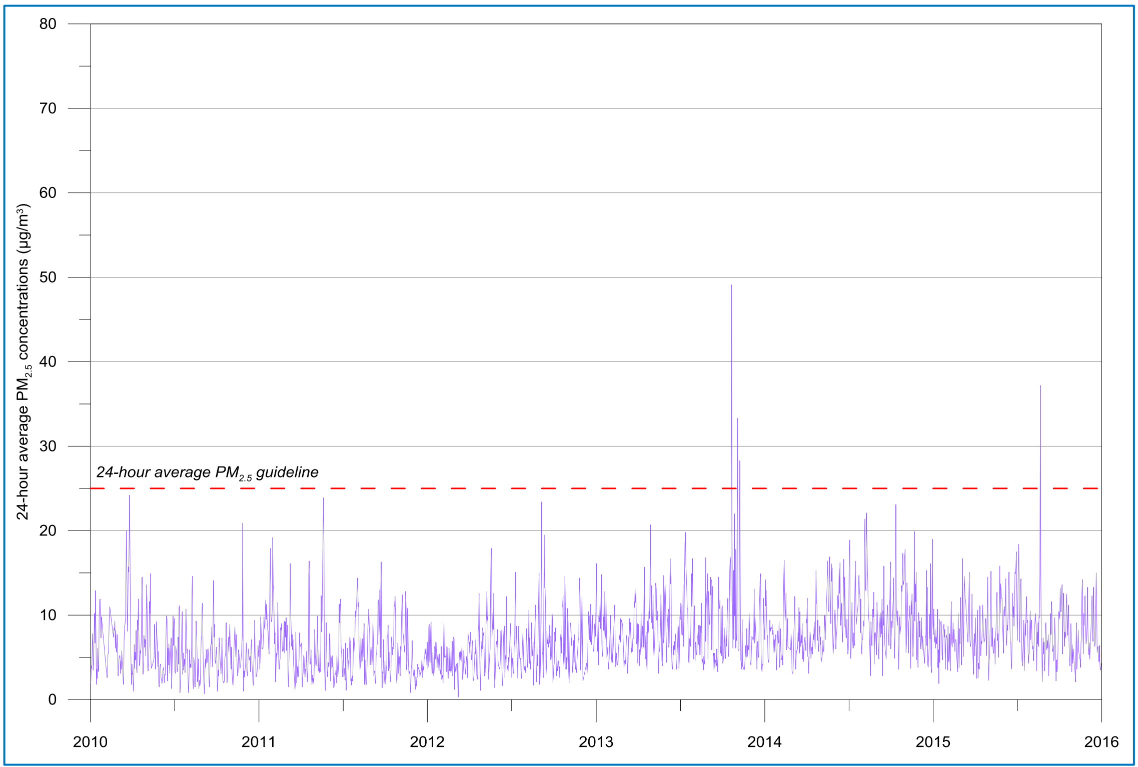


Figure 5.5: Measured 24-hour average $PM_{2.5}$ concentrations at Chullora (2010-2016)

5.2.3 Summary of background data

It is noted that OEH data were not available for TSP concentrations or dust deposition levels.

Monitoring data from areas in the Hunter Valley where co-located TSP and PM_{10} monitors have been operated for reasonably long periods of time indicate that long term average PM_{10} concentrations are approximately 40% of the corresponding long-term TSP concentration (**NSW Minerals Council, 2000**). This ratio is likely to be higher in urban areas of Sydney, but in the absence of any other information, a value of 45 µg/m³ for annual average TSP has been derived from the annual average PM_{10} (18 µg/m³) and assumes that 40% of the TSP is PM_{10}.

Annual average dust deposition has been conservatively taken to be 2 g/m²/month, based on similar previous studies where dust deposition data were not available.

In summary, from the available monitoring data it has been assumed that the following background concentrations apply in the vicinity of the project.

- Annual average PM_{10} of 18 µg/m³.
- Annual average $PM_{2.5}$ of 7 µg/m³.
- Annual average TSP of 48 µg/m³.
- Annual average dust deposition of 2 g/m²/month.

6 EMISSION ESTIMATION

6.1 Modelling scenarios

Two modelling scenarios have been modelled as part of this assessment. These include:

- Existing – Current operations of the Revesby WRF
- Future – Proposed operations of the Revesby WRF

6.2 Particle Size Categories

The modelling has been based on the use of three particle-size categories: 0 to 2.5 µm – referred to as $PM_{2.5}$ or 'FP' (fine particles), 2.5 to 10 µm – referred to as 'CM' (coarse matter) and 10 to 30 µm – referred to as 'Rest'. Various combinations of these particle size groups make up those being modelled, as follows:

- $PM_{2.5}$ = FP
- PM_{10} = FP + CM
- TSP = FP + CM + Rest

Emission rates of TSP, PM_{10} and $PM_{2.5}$ have been calculated using emission factors developed both within NSW and by the US EPA (see **Appendix B**). Modelling was undertaken for each size fractions which are assumed to emit according to the distribution above and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mass mean of the particle size range.

For the current assessment the operations were represented by a series of volume sources located according to the site layout.

6.3 Emissions Estimates

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed. Dust generating activities were represented by a series of volume sources situated according to the location of activities for the modelled scenarios (**Figure 6.1** and **Figure 6.2**). **Table 6.1** summarises the activities that have been assumed to occur at each of these locations.

All activities have been modelled for the hours of 6am to midnight as specified in the Project brief, with the exception of wind erosion which has been modelled for 24 hours per day. Relevant dust emission controls have been taken into account, including water sprays on the crushing and screening operations (hoppers, transfer points, impact bars and conveyor belts). There are also dust suppression sprays at the material storage bays and internal misting/fogging systems in the buildings to reduce dust emissions.

For both scenarios shown in **Figure 6.1** and **Figure 6.2**, corresponding emissions inventories have been developed. The information used for developing the inventories has been based on the operational descriptions and project site drawings and used to determine haul road distances and routes, stockpile areas, activity operating hours, truck sizes and other details that are necessary to estimate dust emissions.

Table 6.2 summarises the quantities of dust estimated to be released by each activity of the Project.

Table 6.1: Summary of activities at each emission location

Activity	Existing operations (as shown in Figure 6.1)	Proposed operations (as shown in Figure 6.2)
Vehicle movement on site	1, 2, 3, 4, 12, 13, 14, 15	1, 2, 3, 4, 15, 16, 17, 18
Unloading to stockpiles	5, 6	5, 6, 7
Loading concrete to crusher	7	8
Crushing	7	8
Screening	7	8
Unloading sorted materials to stockpiles	-	9, 10
Loading crushed concrete to storage bays	8, 9, 10	5, 6, 7, 11, 12, 13
Loading material to trucks for transport off site	11	14
Wind erosion from storage bays	8, 9, 10	11, 12, 13
Wind erosion from the general site	1, 2, 3, 4, 5, 6, 7, 11, 12, 13, 14, 15	1, 2, 3, 4, 5, 6, 7, 9, 10, 14, 15, 16, 17, 18, 19

Figure 6.1: Location of dust sources for existing operations

Figure 6.2: Location of dust sources for proposed operations

Table 6.2: Summary of estimated emissions

Activity	Existing Operations (kg/year)			Proposed Operations (kg/year)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Hauling waste on site	171	52	5	1,428	437	44
Unloading to stockpiles	68	32	5	564	267	40
Loading concrete to crusher	1	0.3	0.05	564	267	40
Crushing	1	0.4	0.4	150	68	13
Screening	4	1	1	275	93	6
Unloading sorted materials to stockpiles	-	-	-	282	133	20
Loading crushed concrete to storage bays	68	32	5	282	133	20
Loading material to trucks for transport off site	68	32	5	564	267	40
Hauling material off site	171	52	5	1,428	437	44
Wind erosion from storage bays	30	15	2	48	24	4
Wind erosion from the general site	432	216	32	918	459	69
Total	**1,013**	**434**	**61**	**6,503**	**2,585**	**340**

6.4 Odour Emissions

It is noted that there may be some green waste and soils which arrives on site as part of general demolition and construction waste streams. However, it is anticipated that this will be separated and removed from the site in a timely manner (within 48 hours) and as such will not be at the site long enough to be of concern from an odour perspective. There is not anticipated that there will be any processing or extended storage of this organic material on site.

Odour has therefore not been considered further as part of the quantitative assessment.

7 ASSESSMENT OF IMPACTS

This section provides an interpretation of the predicted contours of dust concentration and deposition levels. As discussed earlier, simulations were undertaken for both the existing and proposed operations.

Contour plots have been produced for both scenarios showing the following:

- Maximum predicted 24-hour average PM_{10} concentrations (Project only).
- Maximum predicted 24-hour average $PM_{2.5}$ concentrations (Project only).
- Predicted annual average PM_{10} concentrations (Project and background).
- Predicted annual average $PM_{2.5}$ concentrations (Project and background).
- Predicted annual average TSP concentrations (Project and background).
- Predicted annual average dust deposition levels (Project only and with background).

The air quality criteria listed in **Section 3** were compared with modelling results near the site.

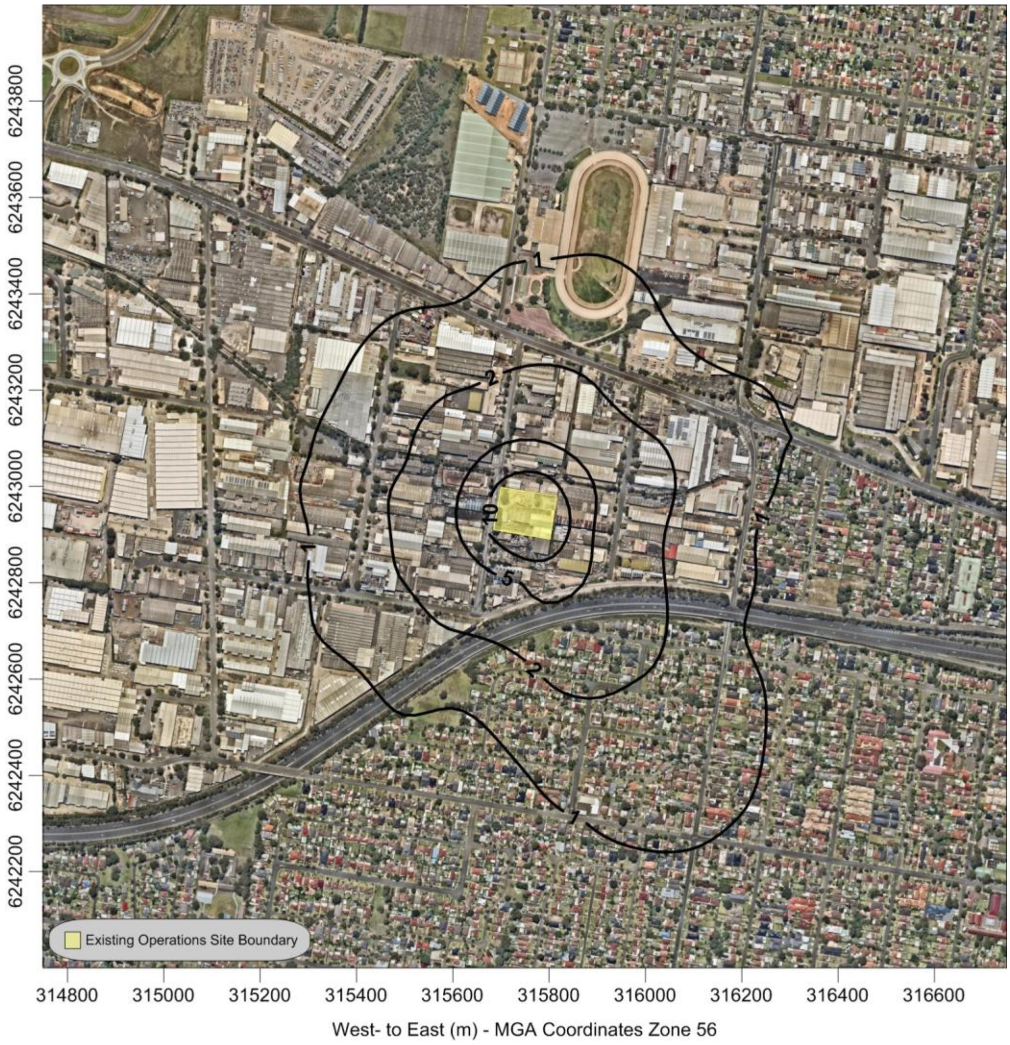
7.1 Existing Operations

Figure 7.1 to **Figure 7.7** present the contour plots for PM_{10}, $PM_{2.5}$, TSP and dust deposition for existing Project operations.

Maximum 24-hour average PM_{10} concentrations from site operations are expected to be less than 10 µg/m^3 at residential areas around the existing Project site. Maximum cumulative 24-hour PM_{10} concentration, taking existing air quality into account, are expected to be less than 30 µg/m^3.

No exceedances of the 24-hour average of 50 µg/m^3 are anticipated as a result of operations at the site.

Predicted concentrations and levels of annual PM_{10}, $PM_{2.5}$, TSP and dust deposition levels are also predicted to be well below the impact assessment criterion as a result of existing Project operations at all nearby residences.



Species: PM10	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Existing – Project Only	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** N/A	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

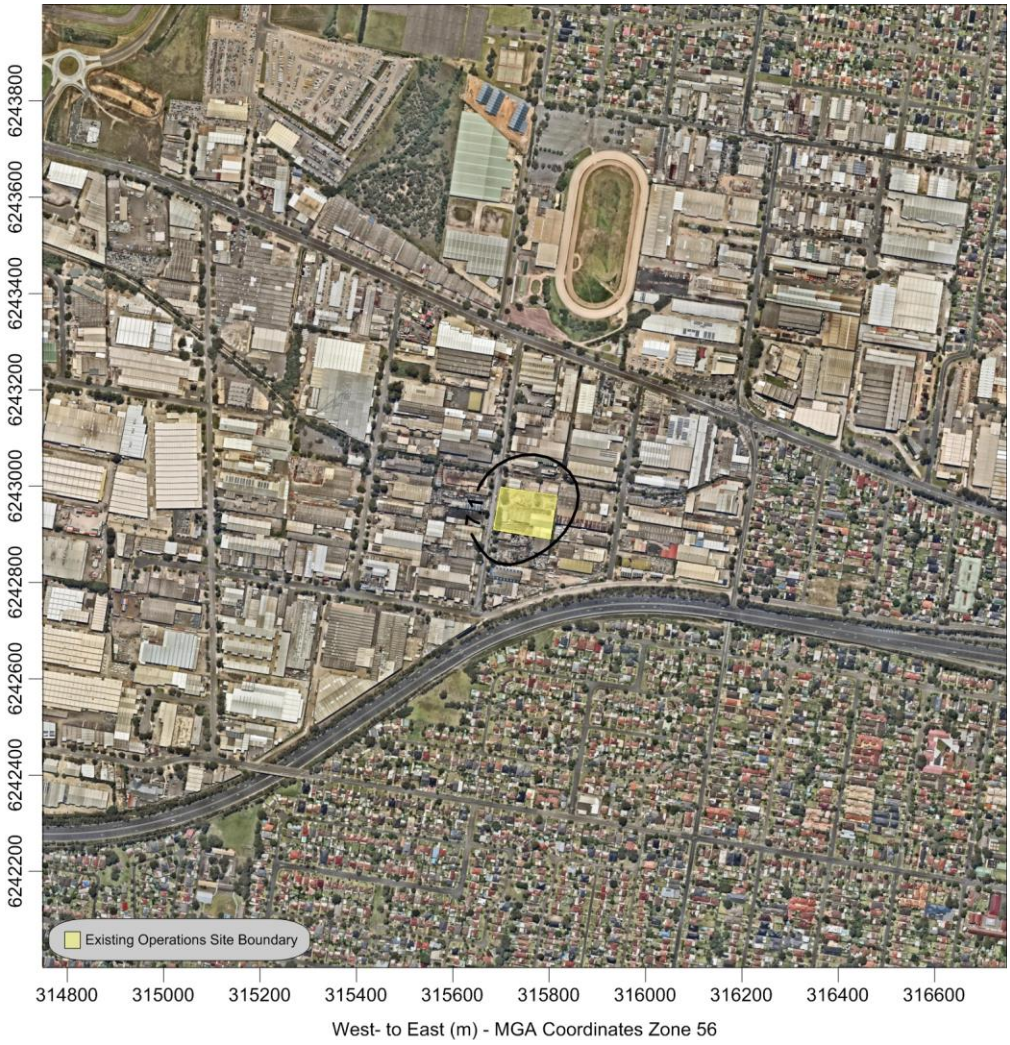
Figure 7.1: Predicted maximum 24-hour average PM_{10} concentrations (µg/m³) from the Project only – Existing Operations

Species: PM2.5	Averaging Time: 24-hour	Percentile: Maximum	Scenario: Existing – Project Only	Location: Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** N/A	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.2: Predicted maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³) from the Project only – Existing Operations

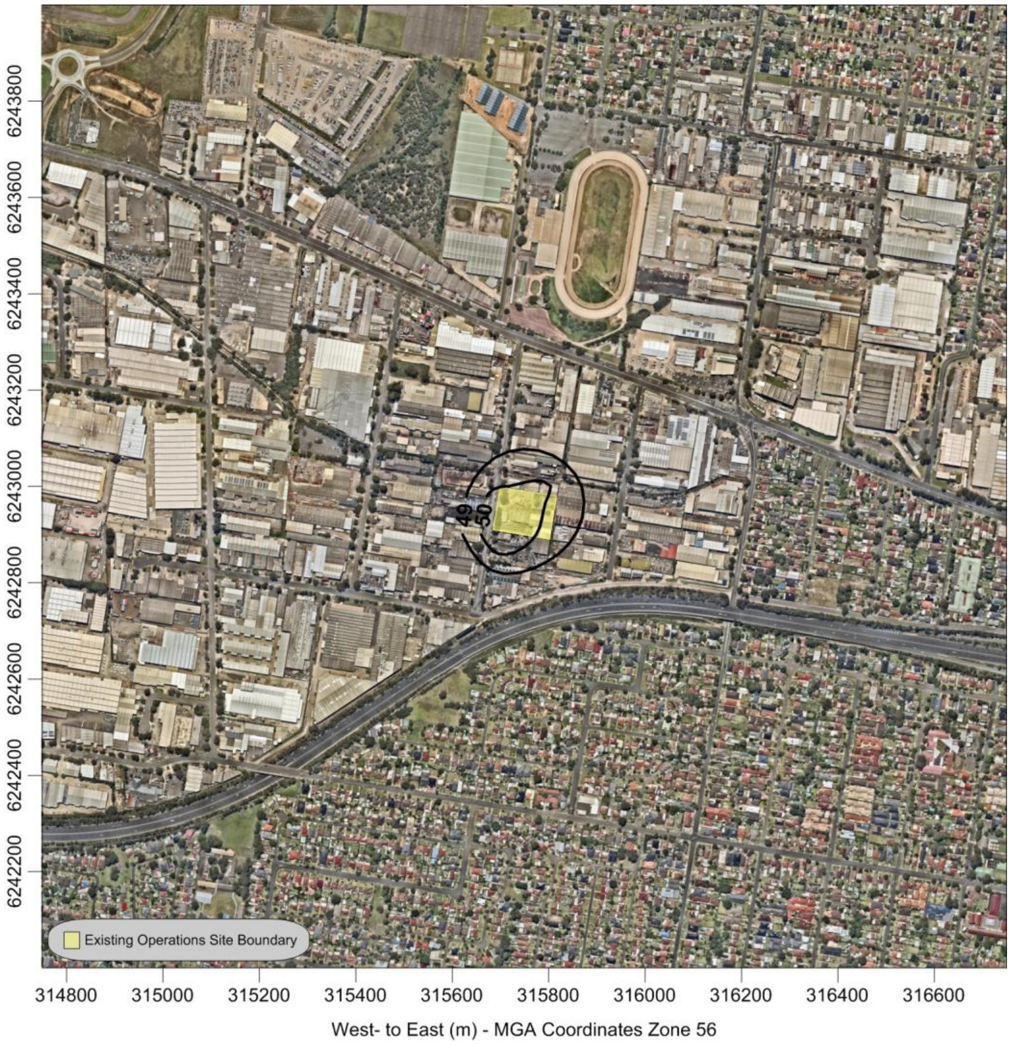
Species: PM10	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Existing – Project and Background	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** 30 µg/m³	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.3: Predicted annual average PM_{10} concentrations (µg/m³) from the Project and background – Existing Operations



Species: PM2.5	Averaging Time: Annual	Percentile: N/A	Scenario: Existing – Project and Background	Location: Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** 8 µg/m³	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.4: Predicted annual average $PM_{2.5}$ concentrations (µg/m³) from the Project and background – Existing Operations



Species: TSP	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Existing – Project and Background	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** 90 µg/m³	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.5: Predicted annual average TSP concentrations (µg/m³) from the Project and background – Existing Operations

Species: Dust Deposition	Averaging Time: Annual	Percentile: N/A	Scenario: Existing – Project only	Location: Revesby
Model Used: CALPUFF v6.42	**Units:** g/m²/month	**Criterion:** 2 g/m²/month	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.6: Predicted annual average dust deposition levels (g/m²/month) from the Project only – Existing Operations

Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Existing – Project and background	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** g/m²/month	**Criterion:** 4 g/m²/month	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.7: Predicted annual average dust deposition levels (g/m²/month) from the Project and background – Existing Operations

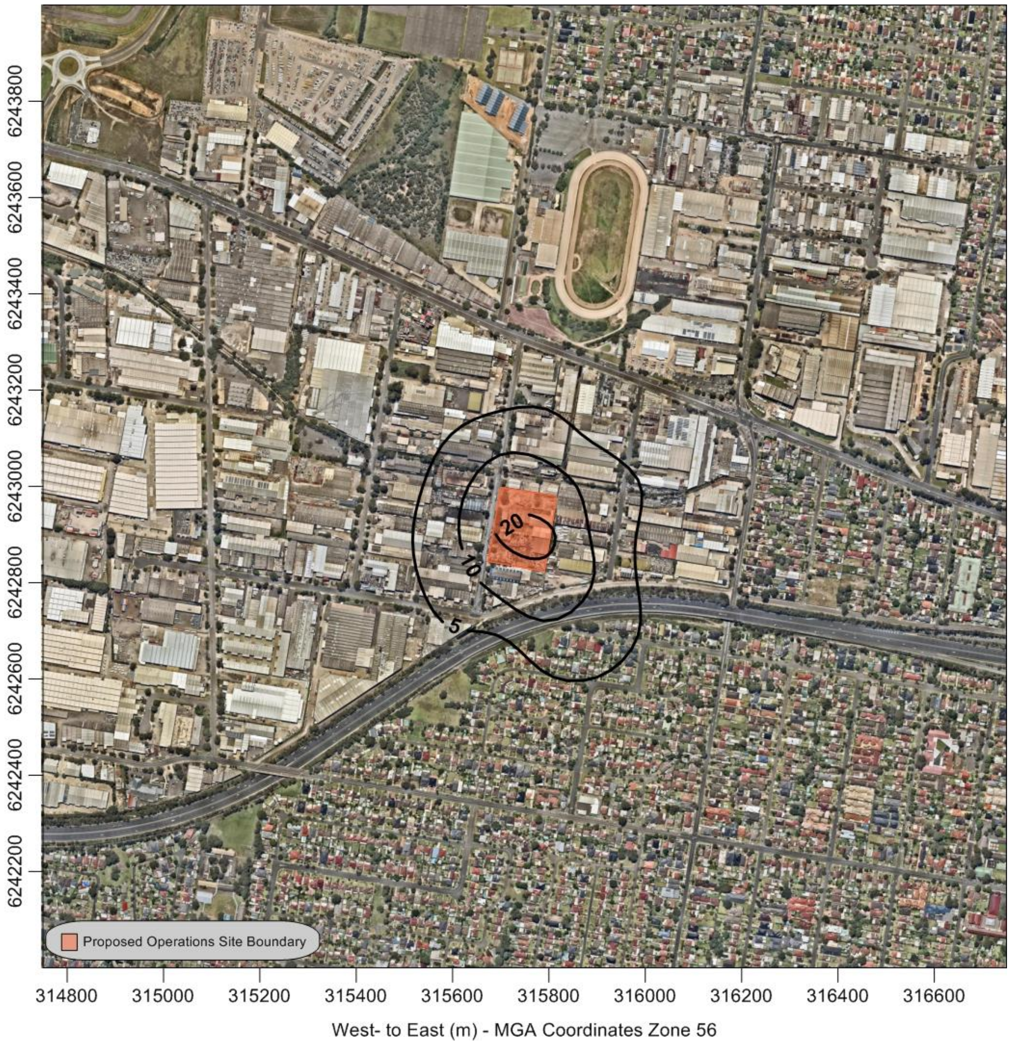
7.2 Proposed Operations

Figure 7.8 to **Figure 7.14** present the contour plots for PM_{10}, $PM_{2.5}$, TSP and dust deposition for proposed Project operations.

Maximum 24-hour PM_{10} concentrations from site operations are expected to be higher than in the existing operations case but again less than 10 µg/m^3 at residential areas around the proposed Project site. Maximum cumulative 24-hour PM_{10} concentration, taking existing air quality into account, are expected to be less than 30 µg/m^3.

No exceedances of the 24-hour average of 50 µg/m^3 are anticipated as a result of proposed operations at the site.

Predicted concentrations and levels of annual PM_{10}, $PM_{2.5}$, TSP and dust deposition levels are also predicted to be well below the impact assessment criterion/advisory reporting standard as a result of existing Project operations at all nearby residences.

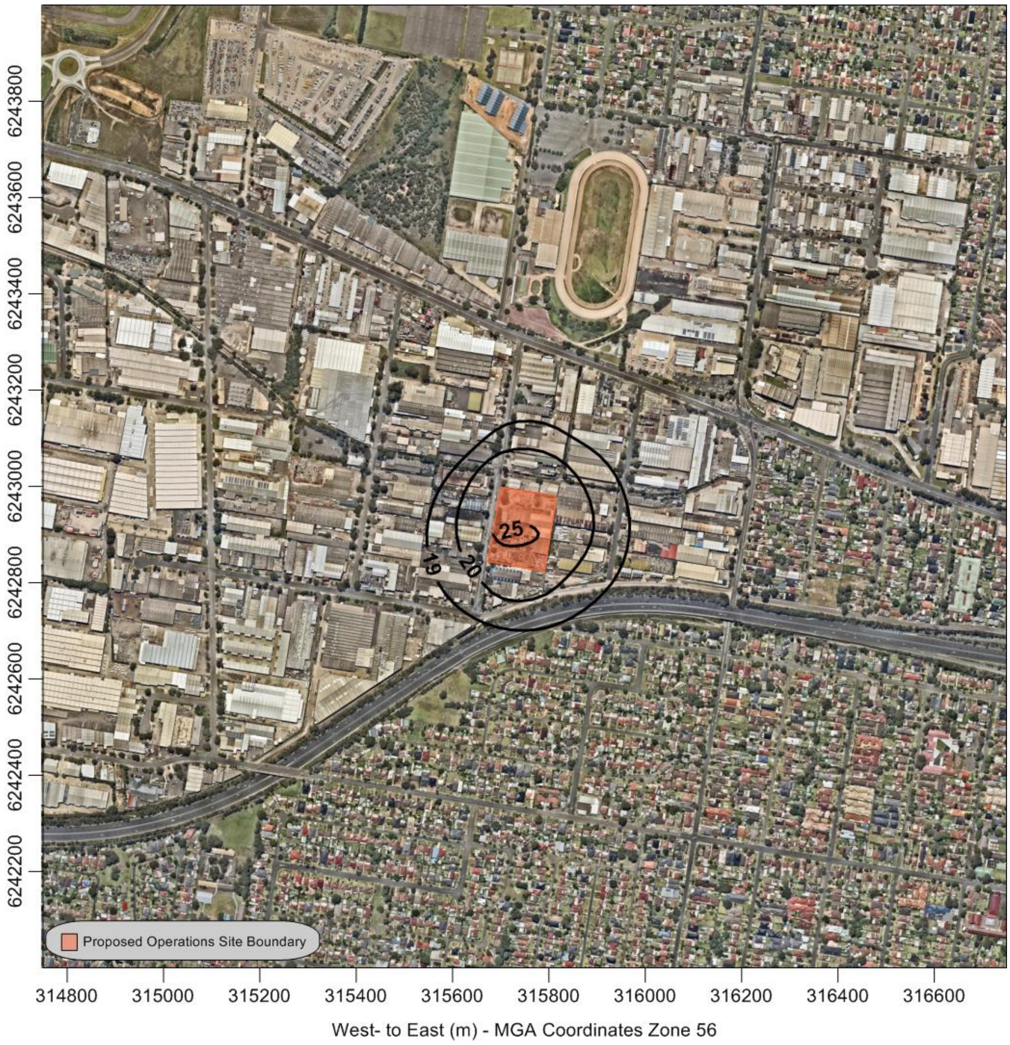


Species: PM10	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Proposed – Project Only	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** N/A	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.8: Predicted maximum 24-hour average PM_{10} concentrations (µg/m³) from the Project only – Proposed Operations

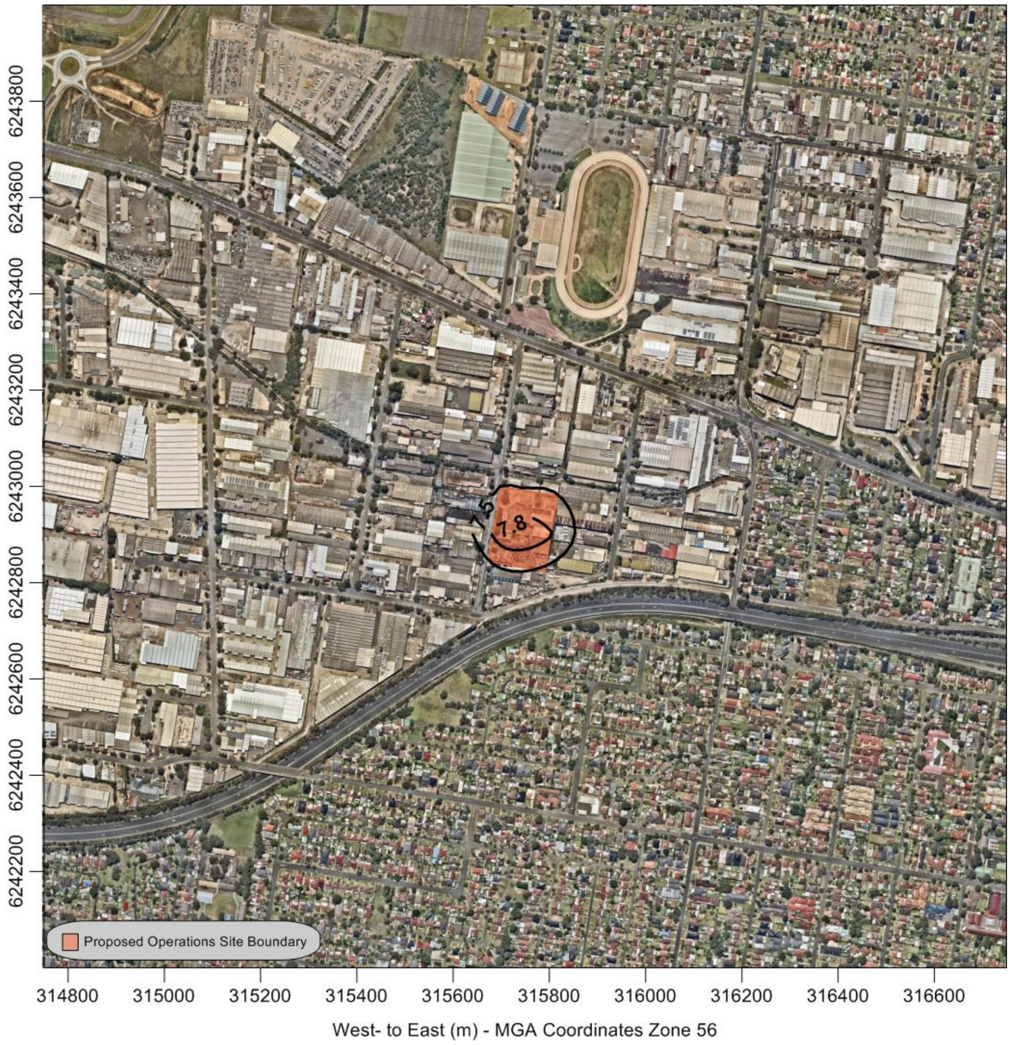
Species: PM2.5	**Averaging Time:** 24-hour	**Percentile:** Maximum	**Scenario:** Proposed – Project Only	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** N/A	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.9: Predicted maximum 24-hour average $PM_{2.5}$ concentrations (µg/m³) from the Project only – Proposed Operations



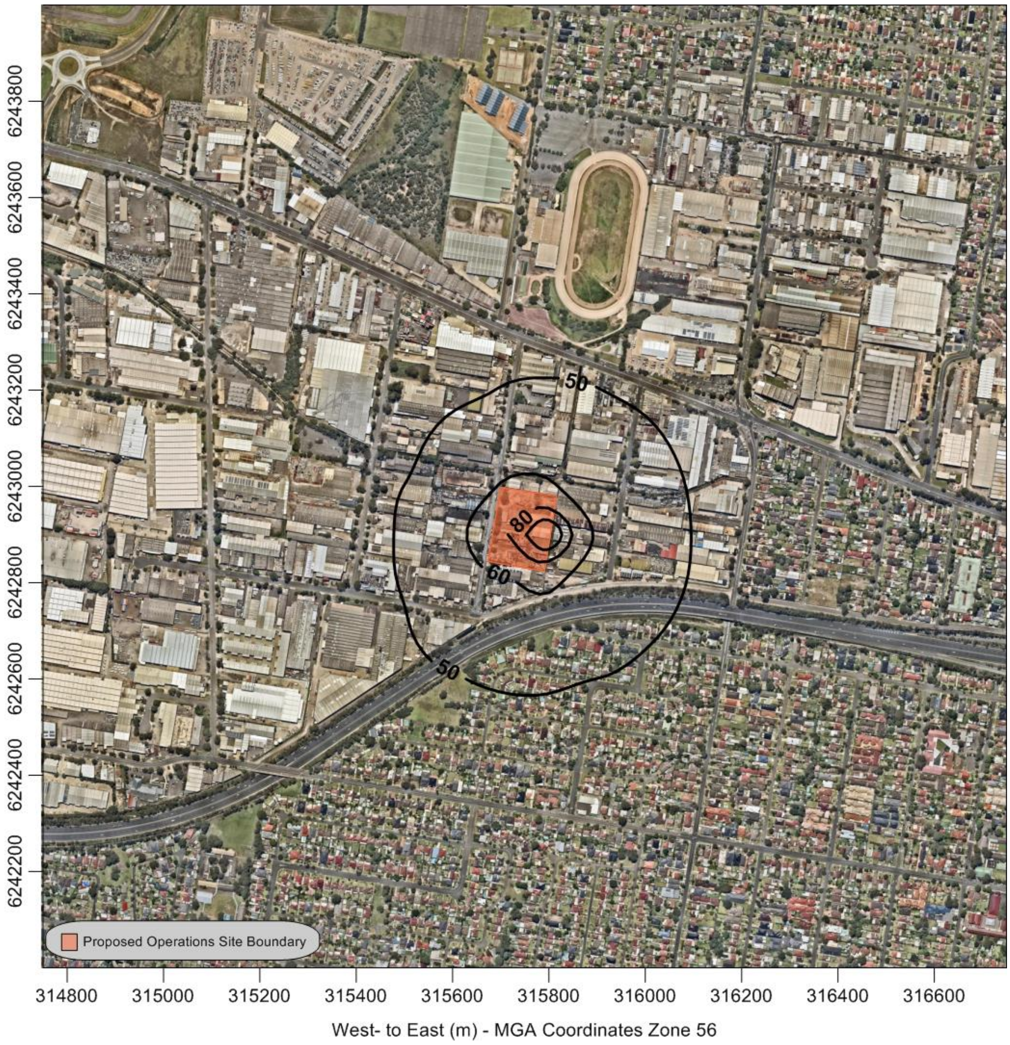
Species: PM10	Averaging Time: Annual	Percentile: N/A	Scenario: Proposed – Project and Background	Location: Revesby
Model Used: CALPUFF v6.42	Units: µg/m³	Criterion: 30 µg/m³	Met Data: 2014 (CALMET)	Plot: F Manansala

Figure 7.10: Predicted annual average PM_{10} concentrations (µg/m³) from the Project and background – Proposed Operations



Species: PM2.5	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Proposed – Project and Background	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** 8 µg/m³	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.11: Predicted annual average $PM_{2.5}$ concentrations (µg/m³) from the Project and background – Proposed Operations



Species: TSP	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Proposed – Project and Background	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** µg/m³	**Criterion:** 90 µg/m³	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.12: Predicted annual average TSP concentrations (µg/m³) from the Project and background – Proposed Operations

Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Proposed – Project only	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** g/m²/month	**Criterion:** 2 g/m²/month	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.13: Predicted annual average dust deposition levels (g/m²/month) from the Project only – Proposed Operations

Species: Dust Deposition	**Averaging Time:** Annual	**Percentile:** N/A	**Scenario:** Proposed – Project and background	**Location:** Revesby
Model Used: CALPUFF v6.42	**Units:** g/m²/month	**Criterion:** 4 g/m²/month	**Met Data:** 2014 (CALMET)	**Plot:** F Manansala

Figure 7.14: Predicted annual average dust deposition levels (g/m²/month) from the Project and background – Proposed Operations

8 GREENHOUSE GAS (GHG) ASSESSMENT

8.1 Introduction

GHG emissions have been estimated based on the methods outlined in the following documents:

- World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition (**WRI/WBCSD, 2004**)
- National Greenhouse and Energy Reporting (Measurement) Determination 2008, and
- Commonwealth Department of Climate Change and Energy Efficiency (DCCEE) National Greenhouse Accounts (NGA) Factors 2012 (**DCCEE, 2012**).

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes.

Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for GHG accounting and reporting purposes, as described below. This terminology has been adopted in Australian GHG reporting and measurement methods and has been employed in this assessment. The 'scope' of an emission is relative to the reporting entity. Indirect scope 2 and scope 3 emissions will be reportable as direct scope 1 emissions from another facility.

1) Scope 1: Direct Greenhouse Gas Emissions

Direct GHG emissions are defined as those emissions that occur from sources that are owned or controlled by the reporting entity. Direct GHG emissions are those emissions that are principally the result of the following types of activities undertaken by an entity and include the following:

- Generation of electricity, heat or steam. These emissions result from combustion of fuels in stationary sources.
- Physical or chemical processing. Most of these emissions result from manufacture or processing of chemicals and materials (e.g. the manufacture of cement, aluminium, etc.).
- Transportation of materials, products, waste and employees. These emissions result from the combustion of fuels in entity owned/controlled mobile combustion sources (e.g. trucks, trains, ships, airplanes, buses and cars).
- Fugitive emissions that result from intentional or unintentional releases (e.g. equipment leaks from joints, seals, packing, and gaskets, and venting); hydroflurocarbon emissions during the use of refrigeration and air conditioning equipment; and methane (CH_4) leakages from gas transport.

2) Scope 2: Energy Product Use Indirect Greenhouse Gas Emissions

Scope 2 emissions are a category of indirect emissions that account for GHG emissions from the generation of purchased energy products (principally, electricity, steam/heat and reduction materials used for smelting) by the entity.

Scope 2 typically covers purchased electricity, defined as electricity that is purchased or otherwise brought into the organisational boundary of the entity.

3) Scope 3: Other Indirect Greenhouse Gas Emissions (Optional)

Scope 3 emissions are defined as those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by that entity. Some examples of scope 3 activities provided in the GHG Protocol are extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

The GHG Protocol provides that reporting scope 3 emissions is optional as the GHG Protocol notes that reporting scope 3 emissions can result in double counting of emissions and can also make comparisons between organisations and/or products difficult because reporting is voluntary. Double counting needs to be avoided when compiling national (country) inventories under the Kyoto Protocol. The GHG Protocol also recognises that compliance regimes are more likely to focus on the "point of release" of emissions (i.e. direct emissions) and/or indirect emissions from the purchase of electricity. Scope 3 emissions are not reported here.

8.2 Greenhouse Gas Emission Estimates

Emissions of carbon dioxide (CO_2) and methane (CH_4) would be the most relevant GHGs for the facility. These gases are formed and released during the combustion of fuels used on-site.

Inventories of GHG emissions can be calculated using published emission factors. Different gases have different greenhouse warming effects (referred to as global warming potentials) and emission factors take into account the global warming potentials of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide equivalent (CO_2-e) emissions by applying the relevant global warming potential. The GHG assessment has been conducted using the NGA Factors, published by the **DoE (2015)**.

Relevant sources included in the assessment are as follows:

- Fuel consumption (diesel and LGP) – scope 1, and
- Indirect emissions associated with on-site electricity use – scope 2.

A summary of the annual GHG emissions for current and proposed operations are provided in **Table 8.1**.

Table 8.1: Summary of Estimated CO_2-e (tonnes/year) – Proposed operations

		Emission factor	Quantity	Units
Energy inputs				
Diesel used (scaled for increased production from 30,000 – 250,000 t/y)			2,757,300	l/y
LPG used (scaled for increased production from 30,000 – 250,000 t/y)			2,375	l/y
Electrical energy used			763,270	kWh/y
Calculation of greenhouse gas emissions				
CO_2-e from diesel usage	Scope 1	2.72 kg CO_2-e/litre diesel [1]	7,500	t/y
CO_2-e from LPG usage	Scope 1	1.56 kg CO_2-e/litre LPG [2]	4	t/y
CO_2-e from electrical energy	Scope 2	0.84 kg CO_2-e/kWh electricity [3]	641	t/y
Total CO_2-e			**8,145**	**t/y**

[1] DoE (2015), Table 4
[2] DoE (2015), Table 3
[3] DoE (2015), Table 5

8.3 Impact on the Environment

According to the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report, global surface temperature has increased by 0.89°C ± 0.2°C during the 100 years ending 2012 (**IPCC, 2013**). The IPCC has determined "most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations". "Very likely" is defined by the IPCC as greater than 90% probability of occurrence (**IPCC, 2013**).

The Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Average annual emissions from the Project (0.008 Mt CO_2-e) would represent approximately 0.0014% of Australia's commitment under the original

Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global GHG emissions, given that Australia contributed approximately 1.12% of global GHG emissions in 2012 (**PBL Netherlands Environmental Assessment Agency, 2015**).

9 MITIGATION MEASURES

9.1 Dust Emissions

There are a number of mitigation measures proposed in relation to reducing fugitive dust emissions on-site, and these are listed below.

- Water sprays on truck haulage areas within the site.
- Misting sprays in crushing/screening area.
- Watering of storage bays and exposed stockpile areas, particularly during periods of high winds.
- Use of a street sweeper and water cart to keep internal trafficked areas and Violet Street clean.

9.2 Odour emissions

- Separation and timely removal of organic matter found within general construction and demolition waste received.

9.3 Greenhouse Gas Emissions

The proposed measures to reduce greenhouse gas emissions are listed below:

- Consideration of energy efficiency in plant and equipment selection/purchase, including such things as the installation of timers on lighting.
- Investigation of the use of solar power on-site.

10 CONCLUSIONS

Pacific Environment has completed an air quality and greenhouse gas assessment for the proposed upgrade to the Revesby Waste Recycling Facility.

The assessment modelled both the current operations and the proposed future operations at the site to represent the potential dust impacts the facility would have on the nearest sensitive receptors (e.g. residences) in the vicinity. Dispersion modelling was conducted to predict the ground level concentrations for all relevant dust anticipated emission sources.

The dispersion modelling indicates that there are not predicted to be any exceedances of the dust assessment criterion at nearby sensitive receptors for future operations. There is also not anticipated to be a measureable or discernible change in odour levels experienced at nearby receptors.

A GHG assessment for the Project indicates that average annual emissions from the proposed Project (0.008 Mt CO_2-e) would represent less than 0.0014% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse gas emissions.

11 REFERENCES

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Appendix A INTERPRETATION OF A WIND ROSE

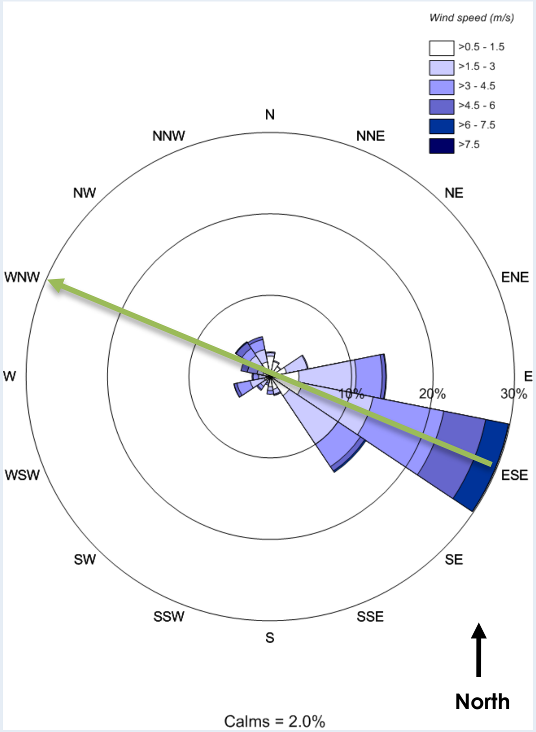
How to read a wind rose

A wind rose shows the frequency of occurrence of winds by direction and strength, presented as 16 bars that correspond to the compass points (N, NNE, NE, etc). The length of each bar represents the frequency of occurrence of winds from that direction, and the colours of the bar sections correspond to wind speed categories, the darker colours representing stronger winds.

In this example, 30% of winds are from the ESE direction, and the winds from this direction have the following speed distribution:

- 10% between 1.5 m/s and 3 m/s
- 10% between 3 m/s and 4.5 m/s
- 7% between 4.5 m/s and 6 m/s
- 3% between 6 m/s and 7.5 m/s

Predominant wind direction



Appendix B EMISSIONS ESTIMATES

B.1 EMISSION FACTOR EQUATIONS

The most significant sources of dust for both the existing and proposed WRF will be:

- Dust emissions from vehicle movements
- Unloading and loading materials to stockpiles
- Wind erosion from exposed areas

Estimates of dust emissions from these sources for the existing and proposed Project operations have been estimated using operations information supplied by the proponent and emission factors from the US EPA's AP-42 document.

Hauling material on unsealed surfaces

The emission estimate of wheel generated dust associated with hauling materials on-site is based the US EPA AP42 emission equation for unpaved surfaces at industrial sites (**US EPA, 1985 and updates**) shown below. As discussed previously, although the roads on-site will be paved, there will be some residual dust on these surfaces and these equations have been used for conservatism.

$$E_{TSP}\ (kg/VKT) = 0.2819 \times 4.9 \times [\times (s/12)\hat{}0.7 \times ((W \times 1.1023)/3)\hat{}0.45]$$

$$E_{PM_{10}}\ (kg/VKT) = 0.2819 \times 1.5 \times [\times (s/12)\hat{}0.9 \times ((W \times 1.1023)/3)\hat{}0.45]$$

$$E_{PM_{2.5}}\ (kg/VKT) = 0.2819 \times 0.15 \times [\times (s/12)\hat{}0.9 \times ((W \times 1.1023)/3)\hat{}0.45]$$

Where,

s = silt content of road surface
W = mean vehicle weight (average weight between loading and unloaded)

The mean vehicle weight used in the emissions estimates is an average of the loaded and unloaded gross vehicle mass, to account for one empty trip and one loaded trip. The average vehicle mass assumed for the modelling was 32.5 t.

Loading/unloading materials

The **US EPA** (**1985 and updates**) emission factor equation has been used.

$$E_{TSP}\left({}^{kg}/_{t}\right) = \frac{5.8}{M^{1.2}}$$

$$E_{PM_{10}}\left({}^{kg}/_{t}\right) = \frac{0.0447}{M^{0.9}}$$

$$E_{PM_{2.5}}\left({}^{kg}/_{t}\right) = 0.019 \times E_{TSP}$$

Where,

M = moisture (%)
A moisture content of 2% has been assumed based on similar studies.

Crushing and screening

The emission factors used for crushing have been taken from the US EPA emission factors (**US EPA, 1985 and updates**), which are shown in the table below.

Activity	TSP	PM_{10}	$PM_{2.5}$
Crushing (controlled)	0.0006	0.00027	0.00005
Screening (controlled)	0.0011	0.00037	0.000025

Wind Erosion

The emission factor used for wind erosion has been taken as 0.1 kg/ha for TSP, 0.5 kg/ha for PM_{10} and 0.075 for $PM_{2.5}$ **US EPA (1985 and updates)**.

B.2 EMISSION INVENTORIES

Table B.1: Existing Operations TSP Emissions

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Revesby Enviro Recycling - CURRENT OPERATIONS																	
Hauling waste on site	171	30,000	t/y	0.02284	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	2.284	kg/VKT	5	% silt content	75	% control
Unloading to stockpiles	68	30,000	t/y	0.00226	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading concrete to crusher	1	30,000	t/y	0.00226	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							99	% control
Crushing	1	30,000	t/y	0.00270	kg/t											99	% control
Screening	4	30,000	t/y	0.01250	kg/t											99	% control
Loading crushed concrete to storage bays	68	30,000	t/y	0.00226	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading material to trucks for transport off site	68	30,000	t/y	0.00226	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Hauling material off site	171	30,000	t/y	0.02284	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	2.284	kg/VKT	5	% silt content	75	% control
Wind erosion from storage bays	30	0.07	ha	0.1	kg/ha/h	8760	h/y									50	% control
Wind erosion from the general site	432	0.49	ha	0.1	kg/ha/h	8760	h/y										
Total Emissions	**1,013**																

Table B.2: Existing Operations PM_{10} Emissions

ACTIVITY	PM_{10} emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Revesby Enviro Recycling - CURRENT OPERATIONS																	
Hauling waste on site	52	30,000	t/y	0.0070	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	0.699	kg/VKT	5	% silt content	75	% control
Unloading to stockpiles	32	30,000	t/y	0.0011	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading concrete to crusher	0.3	30,000	t/y	0.0011	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							99	% control
Crushing	0.4	30,000	t/y	0.0012	kg/t											99	% control
Screening	1	30,000	t/y	0.0043	kg/t											99	% control
Loading crushed concrete to storage bays	32	30,000	t/y	0.0011	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading material to trucks for transport off site	32	30,000	t/y	0.0011	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Hauling material off site	52	30,000	t/y	0.0070	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	0.699	kg/VKT	5	% silt content	75	% control
Wind erosion from storage bays	15	0.07	ha	0.05	kg/ha/h	8760	h/y									50	% control
Wind erosion from the general site	216	0.49	ha	0.05	kg/ha/h	8760	h/y										
Total Emissions	**434**																

Table B.3: Existing Operations $PM_{2.5}$ Emissions

ACTIVITY	$PM_{2.5}$ emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Rev esby Env iro Recycling - CURRENT OPERATIONS																	
Hauling waste on site	5.2	30,000	t/y	0.00070	kg/t	15	payload (tonnes)	32.5	Av erage v ehicle mass (tonnes)	0.15	km/return trip	0.070	kg/VKT	5	% silt content	75	% control
Unloading to stockpiles	4.8	30,000	t/y	0.00016	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading concrete to crusher	0.05	30,000	t/y	0.00016	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %							99	% control
Crushing	0.4	30,000	t/y	0.00120	kg/t											99	% control
Screening	1.3	30,000	t/y	0.00430	kg/t											99	% control
Loading crushed concrete to storage bays	4.8	30,000	t/y	0.00016	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading material to trucks for transport off site	4.8	30,000	t/y	0.00016	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Hauling material off site	5.2	30,000	t/y	0.00070	kg/t	15	payload (tonnes)	32.5	Av erage v ehicle mass (tonnes)	0.15	km/return trip	0.070	kg/VKT	5	% silt content	75	% control
Wind erosion from storage bays	2.2	0.07	ha	0.0075	kg/ha/h	8760	h/y									50	% control
Wind erosion from the general site	32.4	0.49	ha	0.0075	kg/ha/h	8760	h/y										
Total Emissions	**61**																

Table B.4: Proposed Operations TSP Emissions

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Rev esby Env iro Recycling - PROPOSED OPERATIONS																	
Hauling waste on site	1,428	250,000	t/y	0.02284	kg/t	15	payload (tonnes)	32.5	Av erage v ehicle mass (tonnes)	0.15	km/return trip	2.284	kg/VKT	5	% silt content	75	% control
Unloading to stockpiles	564	250,000	t/y	0.00226	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading concrete to crusher	564	250,000	t/y	0.00226	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Crushing	150	250,000	t/y	0.00060	kg/t												
Screening	275	250,000	t/y	0.00110	kg/t												
Unloading sorted materials to stockpiles	282	125,000	t/y	0.00226	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading crushed concrete to storage bays	282	125,000	t/y	0.00226	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading material to trucks for transport off site	564	250,000	t/y	0.00226	kg/t	1.906	av erage of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Hauling material off site	1,428	250,000	t/y	0.02284	kg/t	15	payload (tonnes)	32.5	Av erage v ehicle mass (tonnes)	0.15	km/return trip	2.284	kg/VKT	5	% silt content	75	% control
Wind erosion from storage bays	48	0.11	ha	0.1	kg/ha/h	8760	h/y									50	% control
Wind erosion from the general site	918	1.05	ha	0.1	kg/ha/h	8760	h/y										
Total Emissions	**6,504**																

Table B.5: Proposed Operations PM_{10} Emissions

ACTIVITY	PM_{10} emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Revesby Enviro Recycling - PROPOSED OPERATIONS																	
Hauling waste on site	437	250,000	t/y	0.00699	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	0.699	kg/VKT	5	% silt content	75	% control
Unloading to stockpiles	267	250,000	t/y	0.00107	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading concrete to crusher	267	250,000	t/y	0.00107	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Crushing	68	250,000	t/y	0.00027	kg/t												
Screening	93	250,000	t/y	0.00037	kg/t												
Unloading sorted materials to stockpiles	133	125,000	t/y	0.00107	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading crushed concrete to storage bays	133	125,000	t/y	0.00107	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading material to trucks for transport off site	267	250,000	t/y	0.00107	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Hauling material off site	437	250,000	t/y	0.00699	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	0.699	kg/VKT	5	% silt content	75	% control
Wind erosion from storage bays	24	0.11	ha	0.05	kg/ha/h	8760	h/y									50	% control
Wind erosion from the general site	459	1.05	ha	0.05	kg/ha/h	8760	h/y										
Total Emissions	**2,585**																

Table B.6: Proposed Operations $PM_{2.5}$ Emissions

ACTIVITY	$PM_{2.5}$ emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
Revesby Enviro Recycling - PROPOSED OPERATIONS																	
Hauling waste on site	44	250,000	t/y	0.00070	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	0.070	kg/VKT	5	% silt content	75	% control
Unloading to stockpiles	40	250,000	t/y	0.00016	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading concrete to crusher	40.0	250,000	t/y	0.00016	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Crushing	13	250,000	t/y	0.00120	kg/t												
Screening	6	250,000	t/y	0.00430	kg/t												
Unloading sorted materials to stockpiles	20	125,000	t/y	0.00016	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading crushed concrete to storage bays	20	125,000	t/y	0.00016	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Loading material to trucks for transport off site	40	250,000	t/y	0.00016	kg/t	1.906	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
Hauling material off site	44	250,000	t/y	0.00070	kg/t	15	payload (tonnes)	32.5	Average vehicle mass (tonnes)	0.15	km/return trip	0.070	kg/VKT	5	% silt content	75	% control
Wind erosion from storage bays	4	0.11	ha	0.0075	kg/ha/h	8760	h/y									50	% control
Wind erosion from the general site	69	1.0481	ha	0.0075	kg/ha/h	8760	h/y										
Total Emissions	**340**																