Brooklyn Industrial Precinct

Road Dust Assessment 2012

EPA Victoria

July 2012

Report

Report preparation

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Executive Summary

Net Balance Management Group Pty Ltd (Net Balance) was commissioned by EPA Victoria (EPAV) to undertake an air quality dispersion modelling assessment of dust emissions (PM_{10}) from identified high risk roads and road verges within the Brooklyn Industrial Precinct, Victoria. The objectives of the assessment were to examine the quantity of dust generated from the identified roads, and to examine the respective impacts on adjacent residential premises.

The identified roads and verges service a large number of commercial and operational vehicles from the Brooklyn Industrial Precinct. The scope of assessment was confined to the vehicle movements within the identified risk areas on the following roads:

1. Somerville Road (between Paramount Road and Koroit Creek).
2. Paramount Road (between Somerville Road and Indwe Street).
3. McDonald Road.
4. Francis Street (between Cemetery Road and Geelong Road).
5. Cemetery Road.
6. Market Road (between William St and Somerville Road).
7. Old Geelong Road.
8. Jones Road.
9. Bunting Road.

On the basis of the analyses discussed within the body of this report, subject to the limitations listed in Section 8 and relative to the stated objectives, the conclusions of this study were that vehicle-generated PM_{10} emissions from the Brooklyn Industrial precinct are:

- Estimated to be upwards of 308 tonnes per annum from to precinct in general.[1]
- Estimated to be in the order of 257 tonnes per annum from subject roads.
- Primarily associated with Bunting and Somerville Roads, and to a lesser degree with McDonald and Jones Roads.
- Excluding ambient background concentrations and emissions from the remainder of the industrial precinct, predicted to result in peak PM_{10} concentrations that exceed the NEPM air quality standard and SEPP(AQM) intervention levels to the south of the industrial precinct (south of Geelong Road and McDonald Road intersection).

[1] Note the area under examination is significantly larger than in Net Balance's previous investigation which focussed solely on the region serviced by Jones and Bunting Roads, for which annual PM_{10} emissions were calculated to be in excess of 247 tonnes.

1 Introduction

1.1 Overview

Net Balance Management Group Pty Ltd (Net Balance) were commissioned by EPA Victoria (EPA) to undertake an air quality dispersion modelling assessment of PM_{10} dust emissions[2] from identified high risk roads and road verges within the Brooklyn industrial precinct, Victoria.

This project represents an expansion and update of a 2011 assessment of road dust emissions from the Brooklyn industrial precinct undertaken by Net Balance for EPA. Where the previous assessment focussed on Jones and Bunting Roads, this updated assessment encompasses a broader range of identified high risk roads and verges.

Each of the identified roads services a large number of commercial and private vehicles from the Brooklyn industrial precinct. The scope of this assessment is confined to the vehicle movements within the identified risk areas at the following locations:

1. Somerville Road (between Paramount Road and Koroit Creek).
2. Paramount Road (between Somerville Road and Indwe Street).
3. McDonald Road.
4. Francis Street (between Cemetery Road and Geelong Road).
5. Cemetery Road.
6. Market Road (between William St and Somerville Road).
7. Old Geelong Road.
8. Jones Road.
9. Bunting Road.

An aerial photo showing locations of relevance to this study is presented in Figure 1-1.

Particulate emissions in the PM_{10} size fraction were selected as the focus of this study because:

- dust in this size fraction is established as an environmental indicator in the State Environment Protection Policy (Ambient Air Quality) by virtue of its toxicity
- long term monitoring of ambient PM_{10} concentrations has been undertaken by EPA at a number of locations nearby the Brooklyn Industrial Precinct
- PM_{10} was agreed with EPA Victoria as the key indicator for assessment.

The present condition of the roads and verges vary, with areas of degraded bitumen, significant pot holes and poor drainage. Roads within the precinct are typically covered with a layer of dust/mud deposited by vehicles leaving the unsealed industries that use the roads. EPA is currently working with the community and industry to reduce the overall dust burden from the area.

[2] PM_{10} refers to particulates within an equivalent aerodynamic diameter of 10 microns or less.

1.2 Objectives

The objectives of this assessment are:

1. To establish the relative significance of vehicle-generated PM_{10} emissions from the identified high risk roads, as compared to total PM_{10} emissions from the Brooklyn Industrial precinct.
2. To gauge the potential impact of such emissions relative to the intervention levels for PM_{10} in the National Environment Protection Measure (Air) and State Environment Protection Policy (Air Quality Management).
3. To provide a 'base-case' for modelling treatment options under worst case dust (PM_{10}) emission scenarios (the subject of a separate assessment).

1.3 Assessment Methodology

The methodology adopted for the purposes of this assessment can be summarised as follows:

1. Examination of applicable legislation.
2. Analysis of 14 months of ambient PM_{10} monitoring data and concurrent meteorological data from locations in the vicinity of the Brooklyn Industrial Precinct to:
    a. Identify the impact of PM_{10} emission from the Brooklyn Industrial precinct in the data.
    b. Develop a dataset for use in later back-calculations to estimate *total precinct PM_{10} emissions* utilising dispersion modelling. This dataset consists of recorded average PM_{10} concentrations at each EPA monitoring station for each hour of the week (averaged through the year) and only for hours when those stations are downwind of the Brooklyn Industrial Precinct.
3. Monitoring at a total of 11 locations on the 7 focus roads for periods of 14+ days in order to establish the volume and mix of traffic flow on each. Monitoring locations, shown in Figure 1-1, are:
    1. Market Road (south end, near Somerville Road).
    2. Somerville Road (mid-way between Market Road and McDonald Road).
    3. Somerville Road (mid-way between McDonald Road and Paramount Road, close to Paramount).
    4. Paramount Road (south end).
    5. McDonald Road (North of Bunting Road).
    6. McDonald Road (South of Bunting Road).
    7. Bunting Road (near McDonald Road).
    8. Old Geelong Road (west of Jones Road).
    9. Old Geelong Road (east of Jones Road).

10. Francis Street (close to Geelong Road).
11. Cemetery Road. (North End).

4. Development of an inventory of PM_{10} emissions from the identified high risk areas on the basis of:
    a. Recorded traffic data.
    b. USEPA AP42 emission factors for PM_{10} emissions from paved surfaces.
    c. National Pollutant Inventory emission factors for unpaved roads.
5. Dispersion modelling of roadway PM_{10} emissions on the basis of the above-defined inventory utilising the AUSROADS dispersion model.
6. Draw on the results of steps 2, 3, 4 and 5 to estimate the relative significance of vehicle-generated PM_{10} at the identified high risk areas, as compared to total PM_{10} emissions from the Brooklyn Industrial Precinct. This was done via:
    a. The preparation a dispersion model configuration based on 'unity' emission rates, the extraction of predicted ground level PM_{10} concentrations at the location of each EPA monitoring station and processing of this data in the same manner as described in item 2(a), above. The calibration data points from item 2(a) were divided by the model output to establish adjustment factors, which were then applied to the original 'unity' emission factors in order to provide an estimate of total PM_{10} emissions (inclusive of road and other sources) from the precinct.
    b. Dividing the road PM_{10} emissions calculated in item 4 by the total precinct emissions in order to establish the relative significance of vehicle-generated PM_{10}.
7. Preparation of a contour plot showing predicted ground level PM_{10} concentrations (excluding background levels) for comparison against the National Environment Protection Measure (Air) and State Environment Protection Policy (Air Quality Management) PM_{10} intervention levels.

FIGURE 1-1

Site Location

0 0.5 1
km

Traffic Monitoring Locations

1	Market St
2	Somerville Rd (west)
3	Somerville Rd (east)
4	Paramount Rd
5	McDonald Rd (north)
6	McDonald Rd (south)
7	Bunting Rd
8	Old Geelong Rd (west)
9	Old Geelong Rd (east)
10	Francis St
11	Cemetery Rd

Brooklyn Industrial Precinct

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netbalance tomorrow's agenda

2 Regulatory Context

2.1 State Environment Protection Policies

Air quality in Victoria is regulated by two policies:

- State Environment Protection Policy – Ambient Air Quality (SEPP(AAQ)); and
- State Environment Protection Policy – Air Quality Management (SEPP(AQM)).

2.1.1 State Environment Protection Policy – Ambient Air Quality

The SEPP(AAQ) sets air quality objectives and goals for the whole State of Victoria and adopts the requirements of the National Environment Protection (Ambient Air Quality) Measure (NEPM). This NEPM sets standards, goals, monitoring and reporting protocols for six common pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), photochemical oxidants (as ozone), sulphur dioxide (SO_2), lead and particles as PM_{10}. The NEPM list an air quality standard for PM_{10} of 50 µg/m^3 (24-hour average). The SEPP(AAQ) echoes this standard and also includes a separate objective for visibility reducing particles, which is not included in the NEPM.

2.1.2 State Environment Protection Policy – Air Quality Management

The SEPP(AQM) establishes the framework for managing emissions into the air environment in Victoria from all sources of air pollutants, so that the air quality objectives outlined in the SEPP(AAQ) are met and Victoria achieves the cleanest air possible, having regard to the economic and social development of Victoria. The protection of the air environment provided by SEPP(AQM) addresses not only ambient air quality, but also the management of emission sources and local air quality impacts.

Schedule A of the SEPP(AQM) lists design criteria for a range of air quality indicators (air pollutants). These design criteria, applicable to peak predicted in-air pollutant concentrations at ground level, are used in the assessment of emissions to air from new and modified industrial facilities. The SEPP(AQM) design criterion for PM_{10} is 80 µg/m^3 (1-hour average). As noted in Schedule C, Part C 1 of the SEPP(AQM), for design criteria of with averaging periods of 1-hour or less, the maximum predicted ground level concentration is taken to be the 99.9th percentile prediction.

Schedule B of the SEPP(AQM) lists intervention levels for a range of air quality indicators. These intervention levels are to be used in the assessment of local and neighbourhood air quality monitoring data and are applicable in the case of this study. The SEPP(AQM) intervention level for PM_{10} is 60 µg/m^3 (24-hour average) with no allowable exceedances per annum.

Schedule C, Part B – 3 of the SEPP(AQM) requires that regulatory atmospheric dispersion modelling assessments take into account background concentrations of the air quality indicators under investigation.

2.1.3 Relevance to This Assessment

Both the NEPM air quality standard and SEPP(AQM) intervention level for PM_{10} are of relevance to the management of particulate emissions in Victoria:

- NEPM: 50 µg/m^3, 24-hour average standard.
- SEPP(AQM): 60 µg/m^3, 24-hour average intervention level.

This study compares performance against both.

In terms of the inclusion of ambient air quality data, as demonstrated in Section 3.2.2 the effect of PM_{10} emissions from the Brooklyn Industrial Precinct is clear in data recorded at Footscray. Inclusion of this data (from which the 2002 regulatory dataset is derived) as the background concentration in a study of existing sources of PM_{10} may therefore result in double-counting of PM_{10} impact at some locations in the modelling domain.

As such, the incremental increase over background PM_{10} concentrations caused by road dust is instead examined for the closest residence to the Brooklyn Industrial Precinct via the creation of a time series showing predicted ground level PM_{10} concentrations. Because this method focuses on the incremental increase in impact, rather than net impact, the issue of double counting is less significant.

3 Local Meteorology and Air Quality

3.1 Meteorology

3.1.1 Representative Meteorological Data

Atmospheric dispersion modelling requires as an input a set of meteorological data that is representative of conditions at the subject site. Data recorded in 2002 by EPA Victoria in West Footscray, 2.4km east-northeast of site, has been adopted for the purposes of this assessment. This data set is considered to be representative of conditions at site because:

- All of the identified high risk locations, being relatively closely located, would be subject to very similar synoptic and regional scale meteorological factors such as frontal systems and broad-scale terrain effects; and
- The terrain at all locations, as well as the intervening terrain, is relatively flat, meaning local meteorological factors, such as cool air drainage flows and sea breeze systems would have similar impacts.

3.1.2 Meteorological Data Analysis

The data file selected for use in this assessment was prepared by EPA Victoria for regulatory dispersion modelling purposes. The data covers 98% (8,592 hours) of calendar year 2002. The meteorological parameters provided in the file are:

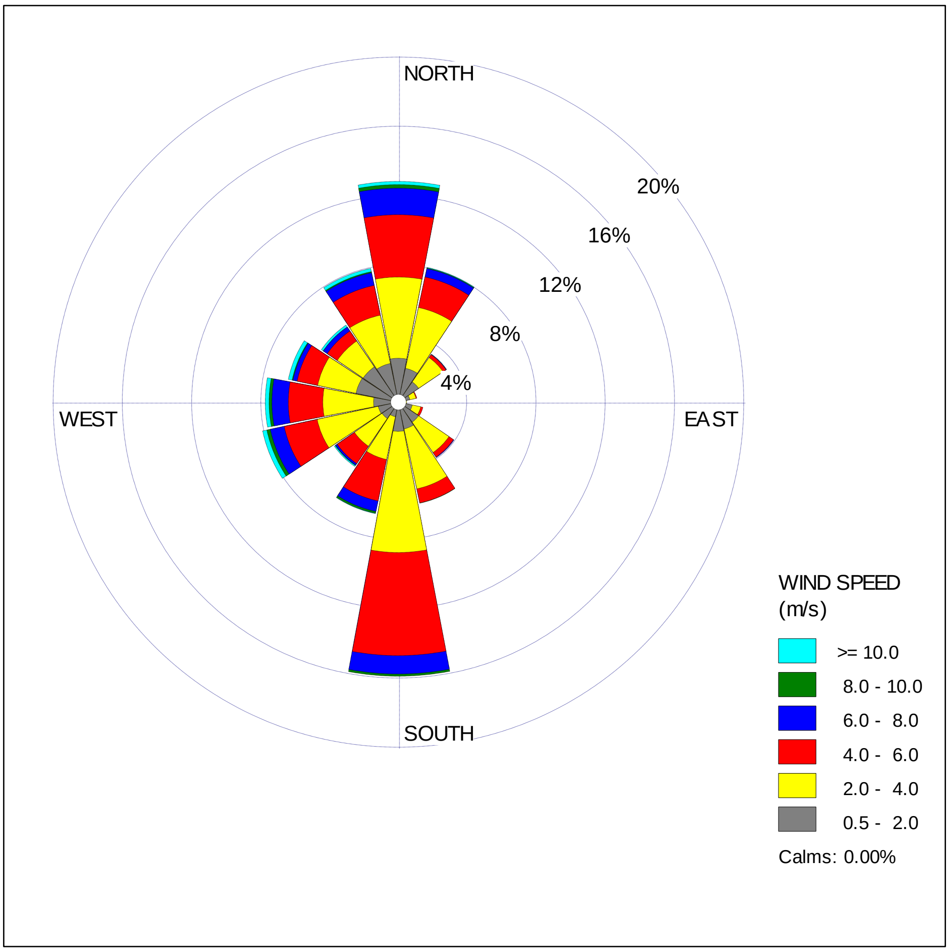
- Temperature (°C).
- Wind speed (m/s).
- Wind direction (degrees).
- Atmospheric stability category (A-F).
- Mixing height (m).
- Sigma theta (degrees).

Wind Distribution

An annual wind rose generated from the data is presented in Figure 2-1. Frequent northerly and southerly winds are evident and are due to the predominance of winds from these directions in winter and summer, respectively. Westerly winds, whilst less dominant than northerlies and southerlies, are associated with broad-scale synoptic flow. Lower wind speeds show a north-westerly predominance which is likely the result of cool air drainage flows along Stony Creek, which runs north west to south east past both the EPA monitoring location and the subject site.

Given that the wind rose in Figure 2-1 demonstrates relatively high incidences of such winds from the north and south, it would be expected that peak ground level impacts would follow a similar pattern.

Figure 2-1 Footscray 2002 Wind Rose



Stability Category Distribution

Atmospheric stability is a term used to describe the propensity for vertical mixing to occur within the atmosphere. The degree of stability is governed by vertical thermal gradients and by the interaction of wind with the earth's surface.

Presented in Table 2-1 is the atmospheric stability category distribution for Footscray in 2002. The count of each stability category for each hour of the 358 days in the data file is shown. The definitions of each atmospheric stability category are:

A. Unstable.

B. Moderately unstable.

C. Slightly unstable.

D. Neutral.

E. Slightly stable

F. Stable.

For emissions sources such as those on-site (i.e. low level mechanically induced sources), peak ground level pollutant concentrations are typically associated with neutral to stable atmospheric conditions as such conditions limit the vertical dimensions of the plume and hence inhibit dispersion.

Table 2-1 Footscray 2002 Stability Category Distribution

Hour	A	B	C	D	E	F	Count
			Atmospheric Stability Category				
1				119	69	170	358
2				115	76	167	358
3				114	73	171	358
4				110	82	166	358
5				141	62	155	358
6				138	72	148	358
7				213	42	103	358
8				326	13	19	358
9	7	30	57	264			358
10	22	73	152	111			358
11	29	83	169	77			358
12	27	83	159	89			358
13	19	78	168	93			358
14	10	80	168	100			358
15		72	174	112			358
16		11	153	194			358
17		2	87	227	16	26	358
18		1	41	218	35	63	358
19			6	237	42	73	358
20				179	83	96	358
21				141	97	120	358
22				141	78	139	358
23				127	86	145	358
24				129	72	157	358
Grand Total	**114**	**513**	**1334**	**3715**	**998**	**1918**	**8592**
	1%	6%	16%	43%	12%	22%	

3.2 Local Air Quality

EPA Victoria provided Net Balance with ambient in-air PM_{10} concentration data and concurrent wind speed data for three locations (Footscray, Brooklyn and Brooklyn School) nearby the Brooklyn Industrial Precinct. Overall 14 months of data, from November 2009 to December 2010 (inclusive) was provided. As displayed in Figure 1-1, the Footscray monitoring station is located 2.4km east-northeast of the site and the Brooklyn and Brooklyn School sites are located approximately 1km southeast of the site.

These datasets were utilised in this study for the following purposes:

- To identify the impact of PM_{10} emission from the Brooklyn Industrial precinct in the data.
- To develop a dataset for use in later back-calculations to estimate total precinct PM_{10} emissions utilising dispersion modelling.

3.2.1 Assessment of Local Air Quality

Table 2-2 shows the number of non-compliances to the NEPM air quality standard for PM_{10} (50 µg/m^3, 24-hour average). Air quality at the Brooklyn School and Brooklyn monitoring stations (located in close proximity to each other), is seen to exceed the NEPM air quality standard a total of 34 times.

Table 2-2 Non-compliances to the NEPM air quality standard for PM_{10}

Data period	Footscray	Brooklyn School	Brooklyn
31/10/2009 - 31/12/2009	2	10	0
01/01/2010 - 31/12/2010	3	ND	ND
01/01/2010 - 28/09/2010	ND	19	ND
02/07/2010 - 31/12/2010	ND	ND	5

Table 2-3 shows the number of non-compliances to the SEPP(AQM) intervention level for PM_{10} (60 µg/m^3, 24-hour average). For the periods of data available, air quality at Footscray is seen to exceed this goal twice in the available datasets. Whereas, air quality at the Brooklyn School and Brooklyn air quality monitoring stations (located in close proximity to each other), 15 exceedances are noted.

Table 2-3 Non-compliances to the SEPP(AQM) Intervention Level for PM_{10}

Data period	Footscray	Brooklyn School	Brooklyn
31/10/2009 - 31/12/2009	1	7	0
01/01/2010 - 31/12/2010	1	ND	ND
01/01/2010 - 28/09/2010	ND	5	ND
02/07/2010 - 31/12/2010	ND	ND	3

3.2.2 *Identification of PM_{10} Signal*

The impact of PM_{10} emission from the Brooklyn Industrial precinct over the ambient PM_{10} concentrations recorded at the monitoring locations was ascertained via the determination of the wind directions associated with the greatest number of SEPP(AQM) design criterion exceedances.

Because this component of the study required consideration of shorter averaging periods than 24-hours (as used in the intervention levels), the 1-hour average design criterion was adopted as a metric rather than the 24-hour average intervention level (see Section 2.1.3). The rationale for this was that over a 1-hour (rather than 24-hour) averaging period, the significance of wind meander is reduced and the PM_{10} impact from a single direction (i.e. from Brooklyn industrial precinct) can be more effectively isolated from the monitoring data.

The results of this analysis are displayed in Figure 2-2 to Figure 2-4.

As displayed in these figures, SEPP(AQM) design criteria exceedances at the three monitoring locations occur most frequently when such locations are directly downwind of the Brooklyn industrial precinct.

Figure 2-2 Footscray – PM_{10} Design Criterion Exceedances vs. Wind Direction

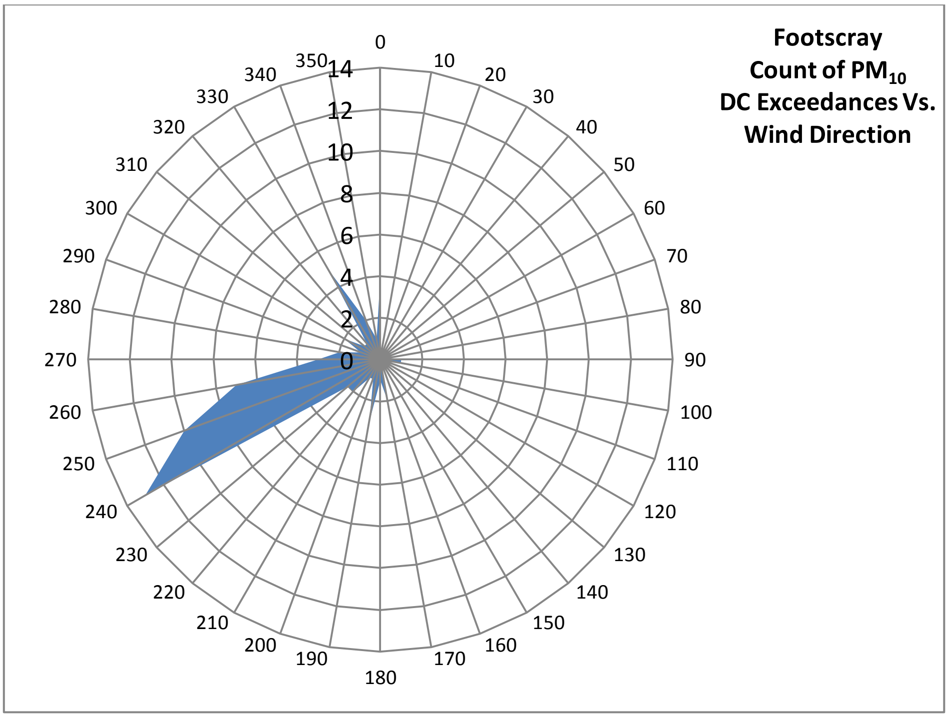


Figure 2-3 Brooklyn School – PM_{10} Design Criterion Exceedances vs. Wind Direction

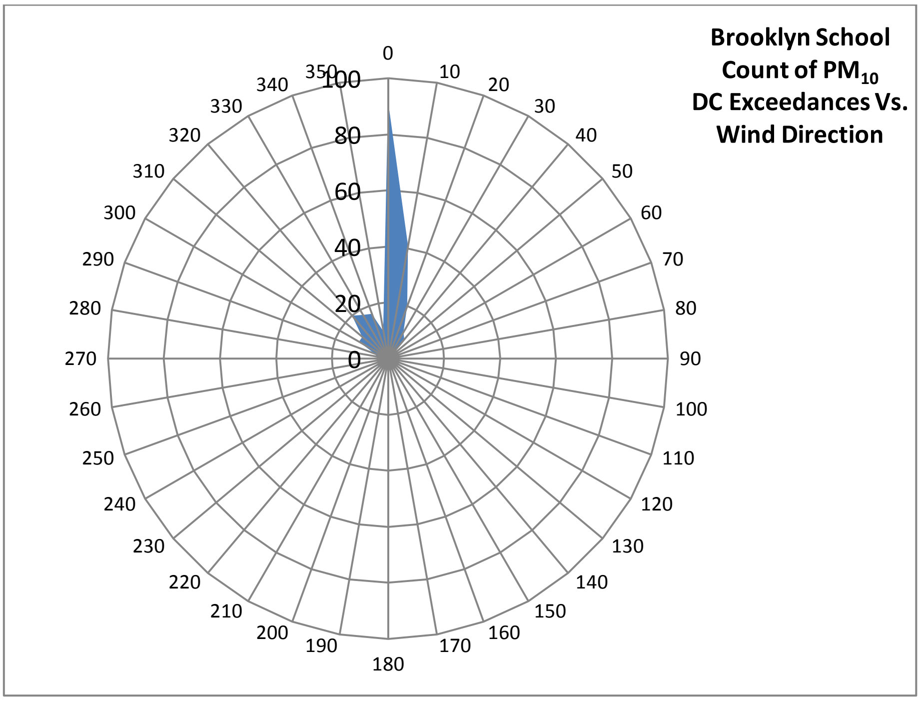
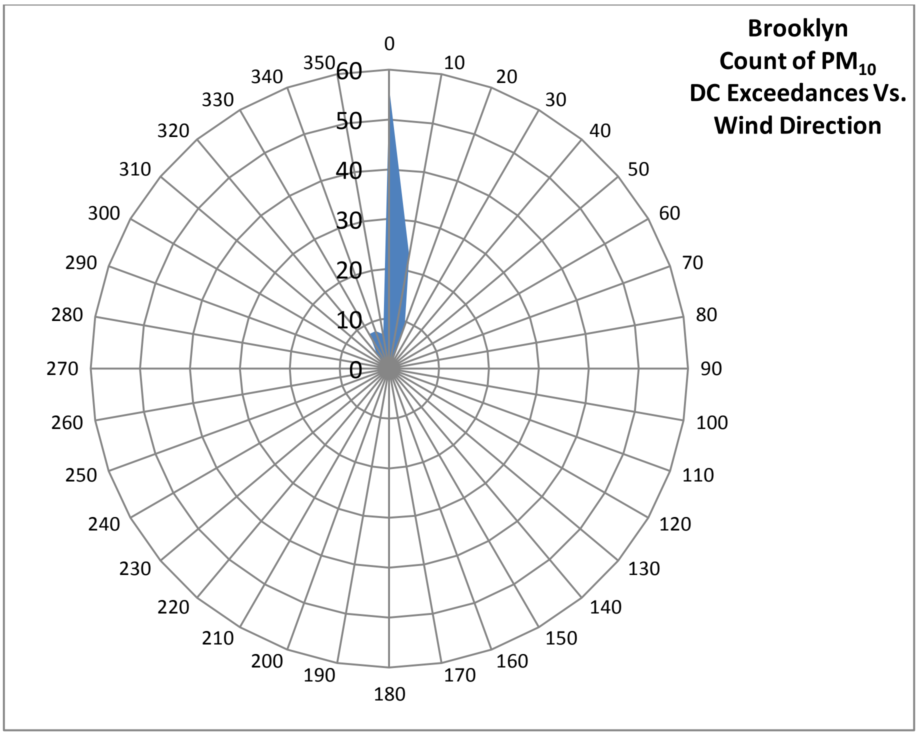


Figure 2-4 Brooklyn – PM_{10} Design Criterion Exceedances vs. Wind Direction



3.2.3 Dataset for Back-Calculation

Further to the above, the provided PM_{10} and wind direction datasets were utilised in estimating total precinct PM_{10} emissions. To facilitate this calculation, it was necessary to produce an estimate of the portion of in-air PM_{10} concentration at each monitor that could be attributed to emissions from the Brooklyn industrial precinct. This process was made possible by the locations of the monitors, relative to the precinct. This arrangement (displayed in Figure 1-1) allows for the following assumptions:

- When the wind direction is between 280° and 30°, the PM_{10} concentration at the Brooklyn School and Brooklyn monitors can be considered to equal background plus the contribution of emissions from the industrial precinct, whereas the concentrations recorded at the Footscray monitor is representative of background only. Under such conditions, the contribution of the industrial precinct to ambient PM_{10} concentration can calculated as the difference between Brooklyn (or Brooklyn School) and Footscray readings.
- The reverse of the above is true for wind directions between 210° and 280°.

On the basis of these assumptions, a data set was produced for each monitoring location that provided an estimate of the average PM_{10} concentration (associated with the industrial precinct) for each hour of the day, for weekdays, Saturdays and Sundays. This data format was selected to allow for comparison against modelled data for other years (i.e. 2002).

4 Emissions Characterisation

PM_{10} emissions were estimated based on:

- Emissions Estimation Techniques detailed in USEPA AP 42 Compilation of Air Pollutant Emission Factors – 13.2.1 Paved Roads.
- Emissions Estimation Techniques detailed in the National Pollutant Inventory Emissions Estimation Technique Manual for Mining V2.3.
- Traffic data for each location recorded for Net Balance by Counters Plus Pty Ltd between 17 April and 16 May 2012.
- A site inspection undertaken by Net Balance on 17 April 2012, the findings from which facilitated the characterisation of the surface of each road and informed the adoption of appropriate emission rates.

4.1 Emission Factors

4.1.1 Paved Roads

The USEPA AP 42 documentation provides the following relationship describing particulate emissions from paved roads:

$$E = k\,(sL)^{0.91} \times (W)^{1.02} \qquad (1)$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest
sL = road surface silt loading (grams per square meter) (g/m^2), and
W = average weight (tons) of the vehicles traveling the road.

Specific parameter values adopted for this study were:

k = 0.62 gPM_{10}/VKT

sL = 3, 12 or 21 g/m2 (based on whether roads were classified as having low, medium or high silt levels during the site visit and with consideration to the values listed in USEPA AP 42 Table 13.2.1-3).

W = Varies from 1 – 40 tonnes, depending on the vehicle classifications provided in the raw traffic data output (converted to imperial tons prior to use in the formula).

4.1.2 Unpaved Roads

Given the present state of the surface of Bunting Road (broken bitumen/gravel/crushed rock), an alternate method of emissions estimation was investigated based on emissions factors for unpaved roads contained in the NPI EETM for Mining V2.3:

$$EF_i = k_i * (s/12)^A * (W/3)^B/(M/0.2)^C \text{ kg/VKT}$$

where:

k_i	=	2.82 for particles less than 30 micrometres aerodynamic diameter
k_i	=	0.733 for particles less than 10 micrometres aerodynamic diameter
s	=	surface material silt content, %
W	=	vehicle gross mass, t
M	=	surface material moisture content, %
A	=	empirical constant: 0.8 (for PM_{10}) & 0.8 (for TSP)
B	=	empirical constant: 0.4 (for PM_{10}) & 0.5 (for TSP)
C	=	empirical constant: 0.3 (for PM_{10}) & 0.4 (for TSP)
(i)	=	particle size category

Specific parameter values appropriate for PM10 were adopted. Other parameter values were:

s = 30%

W = Varies from 1 – 40 tonnes, depending on the vehicle classifications provided in the raw traffic data output.

4.1.3 Adopted Emission Rates

Table 4-1 lists the adopted emission rates for PM_{10} in tonnes per year. The emission rates incorporate an accumulation vehicle data for weekdays, Saturdays and Sundays during the monitoring period, projected as an average over a full year.

The annual emission rates previously outlined in the air quality dispersion modelling prepared for EPA Victoria were 35.4 tonnes/year and 47.6 tonnes/year for Jones Rd and Bunting Rd respectively. The current model differs slightly due to refinements in data resolution through defining vehicle classes.

Table 4-1 Adopted Emission Rates for PM_{10}

Road	Surface and silt content	Length (m)	Weekdays		Saturdays		Sundays		
			Vehicles	g PM_{10}/vkt	Vehicles	g PM_{10}/vkt	Vehicles	g PM_{10}/vkt	t PM_{10}/year
Market Rd	paved_low	730	7,904	10	5,388	7	3,170	5	18
Somerville Rd (West of McDonald)	paved_low	1,293	8,027	14	4,691	8	3,004	6	41
Somerville Rd (East of McDonald)	paved_low	1,118	6,100	17	4,076	10	2,523	7	34
Paramount Rd	paved_low	757	5,708	9	6,081	5	4,571	3	11
McDonald Rd (North of Bunting)	paved_low	334	7,887	14	5,770	7	2,909	5	11
McDonald Rd (South of Bunting)	paved_low	596	7,449	15	4,830	8	2,954	5	19
Bunting Rd	unpaved	957	1,752	121	1,150	113	204	101	60
Old Geelong Rd (West of Jones)	paved_high	286	653	122	708	82	444	33	7
Old Geelong Rd (East of Jones)	paved_low	271	1,342	88	834	79	456	31	9
Francis St	paved_low	789	5,751	18	3,259	10	1,830	7	23
Cemetery Rd	paved_low	365	898	21	485	16	325	19	2
Jones Rd	paved	1,070	689	100	151	171	40	139	21
									257

4.2 Traffic Data

Table 4-2 shows the number of days in the monitoring period (17th April 2012 – 24th May 2012) that data were collected for each location. Data were not collected concurrently due to equipment failures and vandalism. Traffic counts on Jones Road were inferred from the 2 Old Geelong Rd locations (either side of the T-Junction with Jones). Refer to Appendix A: for normalised traffic counts for weekdays, Saturdays and Sundays.

Table 4-2 Number of days of traffic monitoring

	Market Rd	Somerville Rd (West of McDonald)	Somerville Rd (East of McDonald)	Paramount Rd	McDonald Rd (North of Bunting)	McDonald Rd (South of Bunting)	Bunting Rd	Old Geelong Rd (West of Jones)	Old Geelong Rd (East of Jones)	Francis St	Cemetery Rd	Jones Rd
Weekdays	14	14	15	14	14	14	14	14	14	22	14	8
Saturdays	2	2	2	2	2	2	2	2	2	3	2	1
Sundays	2	2	2	2	2	2	2	2	2	3	2	1

5 Atmospheric Dispersion Modelling

Dispersion Modelling was undertaken using the EPA Victoria model – AUSROADS. Default model settings have were adopted except in cases where adjustments have been made to configure the model to reflect specific site and anemometer location characteristics. Table 5-1 summarises the AUSROADS model Configuration and Table 5-2 the geometry of modelled roadways. Further setting details can be found in the attached AUSROADS text output file (see 0).

Two dispersion model configurations were adopted in this study:

1. Utilising discrete receptors located at each of the 3 air quality monitoring stations discussed in Section 3.2 and with emission rates set at unity (i.e. 1 g PM_{10}/VKT), the first model configuration was developed to generate time series' of predicted ground level PM_{10} concentrations. These time series' were then processed into a format matching that described in Section 3.2.3.
2. Utilising multiple receptors and the emission rates detailed in Section 4.1.3, the second model scenario was used to predict ground level PM_{10} concentrations over a broad spatial domain in order to gauge the impact of vehicle-generates PM_{10} emissions from the precinct relative to the NEPM air quality standard and SEPP(AQM) intervention level.

The 2002 EPA regulatory dispersion modelling datasets contain a set of background PM_{10} concentration data for use in regulatory assessments. This dataset demonstrates frequent elevated PM_{10} levels (although no exceedances of either the NEPM air quality standard or SEPP(AQM) intervention level). As the direct inclusion of such data in the dispersion model configurations would obscure the detail of impacts from individual sources (i.e. the subjects of this study), it was instead included indirectly, via the use of the third model configuration, described above.

It is noted that the lack of intervention level exceedances in the 2002 EPA regulatory dataset contrasts with the more recent data discussed in Section 3.2, which demonstrates numerous exceedances.

The AUSROADS model was configured as per the details shown in Table 5-1. Easting and Northing data were recorded at discrete locations either end of each road, and then geometry was used to calculate respective lengths for each roadway, shown in Table 5-2.

Table 5-1 AUSROADS model configuration

Parameter	Setting
Meteorological Dataset	2002 Footscray EPA Regulatory dataset.
Link Types	At Grade
Lanes	2
Lane Width (metres)	4
Background Concentration	0
Anemometer Height	12m
Sigma Theta Averaging Period	60 mins
Met. Site Roughness Height	0.5m
Horizontal Dispersion	Sigma Theta
Wind Profile Exponents	Irwin Urban
Averaging Times	24 hour
Terrain Effects	Ignored (due to relatively flat regional terrain).
Surface Roughness	Residential (0.4m)

Table 5-2 Roadway geometry

Road	X1	Y1	X2	Y2	Length
Market Rd	309,666	5,813,314	309,769	5,814,037	730
Somerville Rd (West of McDonald)	309,302	5,813,362	310,583	5,813,184	1,293
Somerville Rd (East of McDonald)	310,583	5,813,184	311,691	5,813,035	1,118
Paramount Rd	311,691	5,813,035	311,785	5,813,786	757
McDonald Rd (North of Bunting)	310,536	5,812,853	310,583	5,813,184	334
McDonald Rd (South of Bunting)	310,448	5,812,264	310,536	5,812,853	596
Bunting Rd	309,589	5,812,992	310,536	5,812,853	957
Old Geelong Rd (West of Jones)	308,881	5,811,993	309,165	5,811,957	286
Old Geelong Rd (East of Jones)	309,165	5,811,957	309,434	5,811,921	271
Francis St	310,764	5,812,323	311,546	5,812,215	789
Cemetery Rd	311,546	5,812,215	311,597	5,812,576	365
Jones Rd	309,165	5,811,957	309,314	5,813,017	1,070

6 Results

6.1 Estimated total Brooklyn Industrial Precinct PM_{10} emissions

Total PM_{10} emissions from the Brooklyn Industrial Precinct were estimated by dividing the formatted ambient air quality dataset from Section 3.2.3 by the formatted output from the discrete receptor model configuration. For each monitoring location, this generated hourly difference factors for weekdays, Saturdays and Sundays. These factors were then averaged across the three monitoring locations and were applied to the original 'unity' emission inventory used in the model configuration. The resulting inventory was then used in combination with the recorded traffic data (Section 4.2) to generate an estimate of total PM_{10} emissions from the precinct.

It is noted that this method may underestimate total emissions given that dust is emitted from a larger area within the precinct than just the footprints of the roadways. In reality, initial dispersion would be greater than assumed in this method, meaning that a greater mass emission of particulates would be required to generate similar downwind results. Nevertheless, on the basis of the adopted method, total PM_{10} emissions from the Brooklyn industrial precinct are estimated to be **308 tonnes per annum**.

6.2 Estimated total PM_{10} emissions from assessed roads

Combining the PM_{10} emission rate estimates presented in Section 4.1 with the traffic data presented in Section 4.2 yields a total road dust estimate of **257 tonnes per annum** from subject roads. This represents 83% of the back-calculated total for precinct emissions.

It is noted that this is likely an over-estimate of the contribution of road dust to total precinct emissions due to the conservative nature of emissions estimate methodologies, as well as the methodological limitations discussed in Section 6.1.

It is therefore considered that these results are consistent with previous studies and assumptions by EPA Victoria that approximately 50% of PM_{10} emissions from the precinct are due to road dust.

In terms of the significance of each assessed road, Table 6-1 presents the approximate relative significance of each road to total road dust emissions from the precinct.

Table 6-1 Relative significance of road dust emissions

Road	% of total road dust emissions
Bunting Rd	23%
Somerville Rd (West of McDonald)	16%
Somerville Rd (East of McDonald)	13%
Francis St	9%
Jones Rd	8%
McDonald Rd (South of Bunting)	7%
Market Rd	7%
Paramount Rd	4%
McDonald Rd (North of Bunting)	4%
Old Geelong Rd (East of Jones)	4%
Old Geelong Rd (West of Jones)	3%
Cemetery Rd	1%

6.3 Assessment of road dust emissions against NEPM air quality standard and SEPP(AQM) intervention level

A contour plot of the predicted 24-hour average ground level PM_{10} concentration associated with road dust emissions, excluding the influence of background PM_{10} levels and emission from other sources within the industrial precinct, is provided in Figure 6-1. The 50 µg/m^3 NEPM air quality standard and 60 µg/m^3 SEPP(AQM) intervention level for PM_{10} are exceeded in the residential area to the south of Geelong Road / McDonald Road intersection. Properties with SEPP intervention level exceedances are situated along Corrigan Ave and Stenhouse Ave. NEPM exceedances are shown to extend approximately to Nolan Ave.

FIGURE 6-1

PM10 Emissions from Roads

0 0.5 1
km

Contours:
PM10 Concentration (ug/m3)
Predicted Peak
24-hour Average
No Background

SEPP(AQM) Intervention Level

60 ug/m3
24- hour average

NEPM Air Quality Standard

50 ug/m3
24- hour average
Goal: Less than 5
exceedances per year

Brooklyn Industrial Precinct

MMPJ12EPA037 Brooklyn Dust 12

Date: 20/06/2012
Revision: A
Checked:BPS
Approved:GE

netbalance tomorrow's agenda

7 Conclusions

On the basis of the analyses discussed within the body of this report, subject to the limitations listed in Section 8 and relative to the stated objectives, the conclusions of this study were that vehicle-generated PM_{10} emissions from the Brooklyn Industrial precinct are:

- Estimated to be upwards of 308 tonnes per annum from to precinct in general.
- Estimated to be in the order of 257 tonnes per annum from subject roads.
- Primarily associated with Bunting and Somerville Roads, and to a lesser degree with McDonald and Jones Roads.
- Excluding ambient background concentrations and emissions from the remainder of the industrial precinct, predicted to result in peak PM_{10} concentrations that exceed the NEPM air quality standard and SEPP(AQM) intervention levels to the south of the industrial precinct (south of Geelong Road and McDonald Road intersection).

8 Limitations

Net Balance Management Group Pty Ltd (Net Balance) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for use by EPA Victoria and only those third parties who have been authorised in writing by Net Balance. The report is based on Net Balance's interpretation of the State Environment Protection Policies and generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the project brief.

The methodology adopted and sources of information used by Net Balance are outlined in this report. All data used in the assessment was supplied through verified means, and Net Balance has assumed that all data supplied is accurate and complete unless otherwise indicated. Net Balance has made no independent verification of this information beyond the agreed scope of works and Net Balance assumes no responsibility for any inaccuracies or omissions.

This report was prepared through May to June 2012 and is based on the conditions encountered and information reviewed at the time of preparation. Net Balance disclaims responsibility for any changes that may have occurred after this time.

The outputs of dispersion modelling are highly dependent on the quality of input data. Therefore, Net Balance and EPA Victoria are of the opinion that the results of modelling can only be used for broad guidance as to potential environmental impacts.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Appendix A: **Average Daily Vehicle Counts**

Table A-1 Average Daily Vehicle Counts - Weekdays

Hour	Market Rd.	Somerville Rd (location 1)	Somerville Rd (location2)	Paramount Rd	McDonald Rd (location 1)	McDonald Rd (location 2)	Bunting Rd	Old Geelong Rd (location 1)	Old Geelong Rd (location 2)	Francis St	Cemetery Rd	Jones Road (inferred)
0:00-1:00	34	41	46	34	37	33	2	2	8	11	10	6
1:00-2:00	29	39	42	26	26	22	3	2	4	9	8	2
2:00-3:00	30	42	37	37	46	51	4	2	4	13	7	2
3:00-4:00	51	64	43	33	56	53	5	2	6	14	4	4
4:00-5:00	121	154	75	74	141	92	6	4	17	36	7	13
5:00-6:00	197	254	156	145	199	213	35	22	41	166	18	19
6:00-7:00	420	500	365	277	383	406	96	32	70	400	48	38
7:00-8:00	527	577	438	293	478	508	113	39	81	533	67	42
8:00-9:00	603	639	484	371	568	587	134	46	97	538	74	51
9:00-10:00	536	542	419	352	516	544	155	55	105	460	65	50
10:00-11:00	517	521	404	333	503	496	171	61	118	400	58	57
11:00-12:00	535	530	415	353	557	560	178	66	134	400	61	68
12:00-13:00	565	564	433	364	560	543	184	62	131	412	63	69
13:00-14:00	584	583	429	372	587	587	173	63	132	399	61	69
14:00-15:00	610	603	443	412	613	562	166	71	126	403	64	55
15:00-16:00	711	630	479	495	716	647	161	60	121	419	80	61
16:00-17:00	609	570	426	457	620	504	82	29	64	387	72	35
17:00-18:00	471	460	362	421	508	363	40	12	32	318	50	20
18:00-19:00	266	250	212	280	271	233	17	9	15	187	23	6
19:00-20:00	139	139	120	176	148	128	7	5	12	88	9	7
20:00-21:00	109	102	82	126	114	98	6	3	8	63	10	5
21:00-22:00	89	87	72	113	93	83	5	1	4	43	12	3
22:00-23:00	79	70	60	95	78	75	4	3	7	31	13	4
23:00-24:00	72	66	58	69	69	61	5	2	5	21	14	3
TOTAL	**7904**	**8027**	**6100**	**5708**	**7887**	**7449**	**1752**	**653**	**1342**	**5751**	**898**	**689**

Table 8-2 Average Daily Vehicle Counts - Saturday

Hour	Market Rd.	Somerville Rd (location 1)	Somerville Rd (location2)	Paramount Rd	McDonald Rd (location 1)	McDonald Rd (location 2)	Bunting Rd	Old Geelong Rd (location 1)	Old Geelong Rd (location 2)	Francis St	Cemetery Rd	Jones Road (inferred)
0:00-1:00	63	65	65	71	77	55	3	0	4	17	9	4
1:00-2:00	49	58	41	55	50	36	4	3	5	17	4	2
2:00-3:00	45	50	37	57	51	31	0	2	2	13	6	0
3:00-4:00	51	43	45	38	52	38	3	3	9	9	2	6
4:00-5:00	91	101	59	69	129	64	5	4	23	30	6	19
5:00-6:00	100	115	104	117	100	84	23	11	21	95	18	10
6:00-7:00	189	174	140	148	185	179	96	14	33	159	18	19
7:00-8:00	217	187	168	159	204	197	140	34	47	168	20	13
8:00-9:00	295	241	219	250	311	278	162	63	79	209	32	16
9:00-10:00	369	317	299	382	423	357	183	67	76	252	40	9
10:00-11:00	416	354	356	459	486	452	148	98	84	328	40	0
11:00-12:00	477	396	397	549	572	502	151	104	113	309	39	9
12:00-13:00	457	375	355	519	520	421	79	96	120	358	48	24
13:00-14:00	400	333	295	524	489	370	46	82	91	294	41	9
14:00-15:00	365	315	251	483	443	347	25	53	52	220	35	0
15:00-16:00	343	289	232	458	390	297	23	34	27	186	33	0
16:00-17:00	296	256	205	401	332	238	20	11	15	141	28	4
17:00-18:00	286	247	210	382	273	234	6	6	8	143	23	2
18:00-19:00	268	201	166	278	222	203	10	5	4	112	13	0
19:00-20:00	153	149	111	174	121	125	14	6	8	59	9	2
20:00-21:00	115	109	85	125	93	93	4	4	7	50	6	3
21:00-22:00	113	106	82	128	92	83	0	1	0	27	6	0
22:00-23:00	115	107	89	136	85	78	4	3	3	32	4	0
23:00-24:00	115	103	65	119	70	68	1	4	3	31	5	0
TOTAL	**5388**	**4691**	**4076**	**6081**	**5770**	**4830**	**1150**	**708**	**834**	**3259**	**485**	**151**

Table 8-3 Average Daily Vehicle Counts - Sunday

Hour	Market Rd.	Somerville Rd (location 1)	Somerville Rd (location2)	Paramount Rd	McDonald Rd (location 1)	McDonald Rd (location 2)	Bunting Rd	Old Geelong Rd (location 1)	Old Geelong Rd (location 2)	Francis St	Cemetery Rd	Jones Road (inferred)
0:00-1:00	112	92	59	83	64	59	1	7	5	16	1	0
1:00-2:00	53	52	32	55	38	36	1	0	2	10	2	2
2:00-3:00	31	38	30	33	20	27	1	3	4	6	3	1
3:00-4:00	13	21	19	26	12	19	4	0	2	1	1	2
4:00-5:00	26	32	21	28	23	21	0	1	1	9	1	0
5:00-6:00	35	31	24	52	29	26	3	1	2	21	6	1
6:00-7:00	44	55	37	65	32	35	2	1	4	22	7	3
7:00-8:00	70	64	48	87	52	55	11	15	17	22	16	2
8:00-9:00	111	95	81	134	93	89	8	33	33	71	19	0
9:00-10:00	156	154	102	203	152	155	13	45	41	116	24	0
10:00-11:00	234	210	147	320	210	215	13	62	59	180	32	0
11:00-12:00	242	235	191	380	257	265	17	74	63	198	30	0
12:00-13:00	281	275	207	394	262	281	15	58	52	201	26	0
13:00-14:00	304	277	209	444	257	263	29	59	59	175	14	0
14:00-15:00	248	231	198	376	242	233	7	34	34	161	25	0
15:00-16:00	215	199	164	387	226	225	16	19	18	129	18	0
16:00-17:00	237	210	199	352	221	226	14	3	2	143	11	0
17:00-18:00	199	171	175	332	177	187	23	6	11	121	10	5
18:00-19:00	161	141	145	227	145	141	11	5	13	86	15	8
19:00-20:00	123	117	120	160	109	111	5	3	8	50	21	5
20:00-21:00	89	89	95	149	105	100	6	4	8	32	17	4
21:00-22:00	79	87	89	128	86	88	0	3	5	33	13	2
22:00-23:00	53	69	74	103	62	63	3	4	8	15	7	4
23:00-24:00	54	59	57	53	35	34	1	4	5	12	6	1
TOTAL	**3170**	**3004**	**2523**	**4571**	**2909**	**2954**	**204**	**444**	**456**	**1830**	**325**	**40**