Air Emissions Calculation from Road Transport in Melbourne Metropolitan Area

Automated and Zero Emissions Vehicles
Infrastructure Victoria Project

Aurecon Australia Pty Ltd

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Automated and Zero Emissions Vehicles Infrastructure Victoria Project

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1 INTRODUCTION

The Victorian Government is considering how to:

- Best support the development of new vehicle technologies;
- Minimise barriers to efficient implementation and widespread uptake; and
- Ensure the value of the vehicle technologies to the community is maximised.

The population health and environmental impacts are a key contributor to the value that automated vehicles (AV) and zero emission vehicles (ZEV) can deliver to the community. These benefits include the potential for improved air quality and reduced greenhouse gas (GHG) emissions.

Infrastructure Victoria has been directed by the Special Minister to provide advice on the infrastructure required to enable the implementation of AV and ZEV in Victoria. To provide a response to this request for advice, Infrastructure Victoria has developed a number of packages of work. One of the packages considers:

- Potential for improvements in population health (reduced risk of premature mortality and morbidity) due to reduced exposure to pollutants including:
  - Sulphur dioxide (SO_2);
  - Nitrogen dioxide (NO_2);
  - Black carbon (BC);
  - Particulate matter in two size fractions less than 10 μm and 2.5 μm (PM_{10} and $PM_{2.5}$);
  - Volatile organic compounds (VOCs); and
  - Oxides of carbon including carbon monoxide and carbon dioxide (CO and CO_2).
- How those impacts will vary by socioeconomic and demographic groups across Victoria.

Evaluation of the improvements in population health and variance of impacts across socioeconomic and demographic groups requires data on the road emissions and projected contribution of those emissions to ambient air quality. Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Aurecon Australia Pty Ltd (Aurecon) (the main contract holder with Infrastructure Victoria for this package of work) to undertake air emission estimation for traffic modelling results for Melbourne Metropolitan Area provided to Infrastructure Victoria for the considered scenarios by KPMG.

2 CONSIDERED SCENARIOS

To provide a response to the request for advice by the Special Minister, Infrastructure Victoria has developed the following scenarios:

- Dead End (base case);
- Slow lane;
- Electric Avenue;
- Fleet street;
- Hydrogen Highway;
- Private Drive; and
- High speed.

Table 2-1 provides a summary of the developed scenarios.

Table 2-1 Summary of scenarios developed by Infrastructure Victoria

Scenario	Year	Driving mode	Power Source	Ownership / Market model	Occupancy Level
Dead End	2046	Non-driverless	Petrol/ diesel	Private ownership	Multiple occupancy and single occupancy
Slow Lane	2046	Non-driverless and driverless	Electric and petrol/ diesel	Shared, on-demand services and private ownership	Multiple occupancy and single occupancy
Electric Avenue	2046	Non-driverless	Electric	Private ownership	Single occupancy
Fleet Street	2046	Driverless	Electric	Shared, on-demand services	Multiple occupancy
Hydrogen Highway	2046	Driverless	Hydrogen	Private ownership	Single occupancy
Private Drive	2046	Driverless	Electric	Private ownership	Single occupancy
High speed	2031	Driverless	Electric	Shared, on-demand services	Multiple occupancy

All scenarios, except for High Speed, have been run by KPMG to produce detailed traffic modelling statistics and link by link data. The link by link data was then provided to ERM to enable air emission estimation.

No detailed traffic modelling statistics or link by link data have been produced by KPMG for the High Speed scenario. Summary statistics for this scenario was derived by KPMG by interpolation of 2046 model runs. The summary statistics did not contain sufficient detail for air emission estimation and therefore this scenario has been excluded from further consideration in this assessment.

Moreover, traffic modelling results produced by KMPG included both Private Drive and Private Drive Empty Running scenarios. ERM was instructed by

Infrastructure Victoria to consider both of these scenarios within the air emission estimation (email dated 16 May 2018). ERM understands that the Private Drive Empty Running scenario considered the return of empty vehicles back to their base after dropping the passenger off, whilst the Private Drive scenario did not consider these additional empty vehicle movements. ERM therefore understands that Private Drive Empty Running scenario is in fact a correction of Private Drive scenario. This assessment however considered both Private Drive and Private Drive Empty Running scenarios as instructed on 16 May 2018.

Table 2-2 provides the summary of scenarios considered in this assessment.

Table 2-2 Summary of scenarios considered in this assessment

Scenario	Driving mode	Power Source	Ownership / Market model	Occupancy Level
Dead End	Non-driverless	Petrol/diesel	Shared, on-demand services and private ownership	Multiple occupancy and single occupancy
Slow Lane	Non-driverless and driverless	Electric and petrol/diesel	Shared, on-demand services and private ownership	Multiple occupancy and single occupancy
Electric Avenue	Non-driverless	Electric	Private ownership	Single occupancy
Private Drive	Driverless	Electric	Private ownership	Single occupancy
Private Drive Empty Running	Driverless	Electric	Private ownership but vehicles return to base empty	Single occupancy
Fleet Street	Driverless	Electric	Shared, on-demand services	Multiple occupancy
Hydrogen Highway	Driverless	Hydrogen	Private ownership	Single occupancy

The Dead End scenario forms the base case as this assumes that the move to AV / ZEV does not occur and that improvements in combustion engine technology continue to the assessment year. The Dead End scenario therefore forms the closest approximation of the current use of vehicles within the assessment year. Changes resulting from the other scenarios are therefore made in comparison to Dead End.

It should be also noted that at the time of emission estimation, ERM was only provided with the spatial information for Melbourne metropolitan road links and therefore emission estimation has been limited to Melbourne metropolitan areas.

The extent of the data provided by KPMG did not include current traffic flows, consequently it was not possible to provide a direct comparison of the estimated emissions for the Dead End scenario to current impact.

3 EMISSION ESTIMATION

ERM was provided with traffic statistics for each road link (local, arterial and freeway) for the scenarios described in *Table 2-1*.

Emission estimation for each scenario was undertaken using the following excel workbooks provided to ERM by Infrastructure Victoria:

- IV AZEVIA Dashboard 20180515 PRELIMINARY DRAFT v8.xlsb; and
- Metro Melb modelling = link_stats_20180504.

Dead End and Slow Lane scenario projections for 2046 included traditional fleet, which comprised combustion vehicles. Emissions from these scenarios therefore comprised both exhaust and non-exhaust emissions.

Electric Avenue, Fleet Street, Private Drive and Private Drive Empty Running scenario projections for 2046 included electric vehicles only, some of which are automated (robotaxi). Emissions from these scenarios therefore comprised only non-exhaust emissions.

Hydrogen Highway scenario projection for 2046 included hydrogen vehicles only. Hydrogen vehicles are associated with the following emissions:

- Non-exhaust; and
- Water vapour.

Water vapour is not directly linked to human health impacts, as such emission estimation for this scenario only considered non-exhaust emissions.

3.1 EXHAUST EMISSIONS

Exhaust emissions for all scenarios were calculated using COPERT Australia software. *COPERT Australia* is a MS Windows software, designed by EMISIA SA (a spin-off company of the Aristotle University of Thessaloniki) and the Queensland Department of Science, Information Technology, Innovation and the Arts, to calculate air emissions from road transport in Australia. The COPERT Australia model's algorithms were developed from data collected in Australian test programs designed to reflect the Australian fleet and activity data (EMISIA SA, 2014). The *COPERT Australia* model accounts for various types of emissions including hot running, cold-start and evaporative emissions and covers 226 different vehicles classes and 116 species.

In order to calculate emissions, COPERT Australia software requires the following inputs:

- Region and fuel information;

- Fleet configuration; and
- Activity data.

3.1.1 Region and Fuel Information

Table 3-1 provides region information used in all *COPERT Australia* software runs. *Table 3-2* and *Table 3-3* provide fuel information used in all *COPERT Australia* software runs. It should be noted that all the scenarios adopted default fuel information contained in COPERT Australia database, unless alternative information was available.

Table 3-1 Region Information adopted in COPERT Australia software runs

	Minimum temperature (°C)[1]	Maximum temperature (°C) [1]	Relative Humidity (percent) [1,2]	Reid Vapour Pressure (kPa)[3]	Beta[4]
January	13.8	26.5	54.5	64	0.43
February	14.2	26.6	56.5	64	0.43
March	12.7	24.2	58.5	64	0.45
April	10.2	20.3	62	71	0.48
May	8.3	16.7	69.5	71	0.50
June	6.2	13.7	75	71	0.53
July	5.4	13.1	73	71	0.54
August	5.9	14.4	68	71	0.53
September	7.1	16.7	64	71	0.51
October	8.5	19.4	59	71	0.49
November	10.4	22.1	58	64	0.47
December	12.1	24.6	54.5	64	0.45

1. (Bureau of Meteorology, 2018)
2. Average of 9am and 3pm relative humidity (percent)
3. As adopted in (Pacific Environment Limited, 2016)
4. Calculated using COPERT Australia software

Table 3-2 Fuel information adopted in COPERT Australia software runs

Fuel	Sulphur Content (%wt)	Lead content (g/l)	H:C Ratio	O:C Ratio	Cadmium Content (mg/kg)	Copper Content (mg/kg)	Chromium Content (mg/kg)	Nickel Content (mg/kg)	Selenium Content (mg/kg)	Zinc Content (mg/kg)
ULP	0.00661[1]	0.0025[1]	1.92	0.039[2]	0.0108	0.0418	0.0159	0.013	0.0002	2.164
PULP	0.00305[1]	0.0025[1]	1.85	0.039[2]	0.0108	0.0418	0.0159	0.013	0.0002	2.164
Diesel	0.00072[1]	4.35E-05	1.86	0.005	0.0087	0.0212	0.03	0.0088	0.0001	1.738
Autogas	0.005[2]	2.64E-05	2.525	0	0.0106	0.0373	0.0093	0.0107	0	2.13
CNG	0.005[2]	2.45E-05	3.9	0	0.0106	0.0373	0.0093	0.0107	0	2.13
Biodiesel	0.001[3]	4.53E-05	1.94	0.11	0.0087	0.0212	0.03	0.0088	0.0001	1.738
Bioethanol	0.003[4]	2.49E-05	3	0.5	0.0108	0.0418	0.0159	0.013	0.0002	2.164

1. (Australian Government Department of the Environment and Energy, 2012)
2. (Australian Government, 2014)
3. (Australian Government, 2009)
4. (Australian Government, 2008)

Table 3-3 Improved Fuel Quality Specifications as adopted in COPERT Australia software runs

Fuel Year	Gasoline E100 (percent volume)	Gasoline E150 (percent volume)	Gasoline Aromatics (percent volume)	Gasoline Olefins (percent volume)	Gasoline Benzene (percent volume)	Diesel Density (kg/m³)	Diesel PCA (percent volume)	Diesel CN	Diesel T95 (°C)
2009	46[1]	84[1]	25.8[2]	13.3[2]	0.68[2]	838.7[2]	3.9[2]	54[2]	347.3[2]

1. Adopted from (Smit, 2014)
2. (Australian Government Department of the Environment and Energy, 2012)

3.1.2 *Fleet Configuration*

All of the scenarios considered in this assessment (*Table 2-2*) contain traffic projections for year 2046. It was considered that by 2046 the traditional fleet will undergo a number of fleet replacements and therefore is likely to comprise the vehicles at a minimum containing the best available current engine and emissions control technology. *Table 3-4* provides the technology for each vehicle class adopted in all *COPERT Australia* software runs. It should be noted that, whilst public transport and motorcycle data was provided on a regional basis, the methodology adopted required detailed information on a road link basis. As public transport and motorcycle data was not available for individual road links, emissions from these vehicle classes could not be estimated within the adopted approach. It is considered that contributions from these vehicle classes would not be significant, and therefore not including these vehicles classes would not result in a significant under-estimation of contribution to ambient air quality from road sources within the considered scenarios.

Table 3-4 Vehicle technologies adopted in COPERT Australia model

Sector	Subsector	Technology
Passenger Cars	PC-S-petrol	ADR79-05
Passenger Cars	PC-M-petrol	ADR79-05
Passenger Cars	PC-L-petrol	ADR79-05
Passenger Cars	PC-S-diesel	ADR79-05
Passenger Cars	PC-ML-diesel	ADR79-05
Passenger Cars	PC-S-E10	ADR79-05
Passenger Cars	PC-M-E10	ADR79-05
Passenger Cars	PC-L-E10	ADR79-05
Passenger Cars	PC-LPG	ADR79-05
SUV	SUV-C-petrol	ADR79-05
SUV	SUV-L-petrol	ADR79-05
SUV	SUV-diesel	ADR79-05
SUV	SUV-C-E10	ADR79-05
SUV	SUV-L-E10	ADR79-05
Light Commercial Vehicles	LCV-petrol	ADR79-05
Light Commercial Vehicles	LCV-diesel	ADR79-05
Heavy Duty Trucks	MCV-petrol	ADR00-UNC
Heavy Duty Trucks	MCV-diesel	ADR80-05
Heavy Duty Trucks	HCV-diesel	ADR80-05
Heavy Duty Trucks	AT-diesel	ADR80-05
Heavy Duty Trucks	Autogas Trucks	ADR80-05

3.1.3 *Activity Data*

Activity data inputs within *COPERT Australia* software runs require the following information for each vehicle technology class:

- Input fleet data:

- Population (number of vehicles);
- Mileage (km/year); and
- Mean fleet mileage (km);

- Input Circulation Data:
  - Speed (km/hr) on each type of road (urban, rural, highway); and
  - Driving share (percentage) for each type of road (urban, rural, highway); and

- Input Evaporation Data.

Given the number of road links included in each scenario, rather than use COPERT to model every link within the dataset, COPERT was used to estimate emissions on a nominal number of vehicles (1,000,000 vehicles) and a 1 km per year mileage basis and use the calculated emission rates to scale the emissions for each road link in Excel spreadsheet. This approach using emission factors in spreadsheets is an industry standard which has been used on road projects throughout Australia. All scenarios adopted default mean fleet mileage[1] contained in the COPERT Australia software.

Within the provided traffic movement dataset, there are three different types of roads (local, arterial and freeways). Each road type is allocated, within the provided KPMG dataset, with a specific average speed under each scenario. ERM therefore used the COPERT Australia model to develop three runs for each scenario, each specific to each road type and the associated average speed. *Table 3-5* provides input circulation data parameters for each run undertaken for Dead End scenario and *Table 3-6* provides input circulation data parameters for each run undertaken for Slow Lane scenario. It should be noted that passenger cars (PCs), SUVs and light commercial vehicles (LCVs) adopted speeds provided for private vehicles, while heavy duty trucks (HDT) adopted speeds provided for freight. It should be noted that COPERT was not used for the remaining five scenarios as there are no tailpipe emissions from ZEV.

[1] The mean fleet milage describes the number of kilometres that each vehicle class has typically travelled thus describing the age of the vehicle fleet, and any deterioration in engines and mitigation technology since introduction of the vehicle to the fleet.

Table 3-5 Circulation data parameters adopted for each Dead End COPERT Australia run

Sector	Speed (km/hr)	Driving share
Local roads run		
PC[1], SUV and LCV[2]	29.5	Urban 100%
HDT[3]	34.2	Urban 100%
Arterial roads run		
PC, SUV and LCV	32.5	Urban 100%
HDT	33.2	Urban 100%
Freeways roads run		
PC, SUV and LCV	56.1	Highway 100%
HDT	58.2	Highway 100%

1. PC stands for passenger cars of all classes
2. LCV stands for light commercial vehicle
3. HDT stands for heavy duty truck

Table 3-6 Circulation data parameters adopted for each Slow Lane COPERT Australia run

Sector	Speed (km/hr)	Driving share
Local roads run		
PC[1], SUV and LCV[2]	36	Urban 100%
HDT[3]	41	Urban 100%
Arterial roads run		
PC, SUV and LCV	46	Urban 100%
HDT	44	Urban 100%
Freeways roads run		
PC, SUV and LCV	78	Highway 100%
HDT	81	Highway 100%

1. PC stands for passenger cars of all classes
2. LCV stands for light commercial vehicle
3. HDT stands for heavy duty truck

It should be noted that no evaporative emissions were considered in this assessment for any scenario. COPERT Australia runs were calculated on a road link by road link basis, while evaporative emissions are not necessarily linked to traffic on the roads as they include:

- Diurnal emissions due to thermal expansion and emission of vapour from the fuel tank of stationary vehicle due to diurnal changes in ambient temperature;
- Hot soak losses – emissions from a warmed-up vehicle after the vehicle and engine stopped;
- Evaporative emissions during idling; and
- Refuelling losses.

It was therefore considered incorrect to include evaporative emissions in this assessment.

Air emission Inventory for the Greater Metropolitan Region in New South Wales projection data for Sydney, derived from 2008 data, suggests that in 2016 the evaporative emissions contributed approximately 59 percent of total vehicle-related VOCs emissions. It is therefore considered that a similar magnitude of change would be expected for total VOCs emissions in Melbourne metropolitan area.

Table 3-7 Breakdown of total vehicle-related VOCs emissions for Sydney

Source of VOCs emissions	Emissions (tonnes/year)	Percent of total (%)
Evaporative (all)	10,057	59
Non-exhaust (all)	0	0
Heavy Duty Vehicles exhaust	320	2
Light Duty Vehicles (LDV) petrol exhaust	1,586	9
LDV diesel exhaust	200	1
Other exhaust	243	1
Car petrol exhaust	4,629	27
Grand Total	**17,035**	**100**

1. (New South Wales Environment Protection Authority, 2008)

3.1.4 COPERT Australia Outputs for non-BTEX Species

Table 3-7, *Table 3-8* and *Table 3-9* provide air emissions in tonnes per year estimated using COPERT Australia for each vehicle technology class for local, arterial and freeway road runs respectively for Dead End and Slow Lane scenarios for the following species:

- Carbon Monoxide (CO);
- Volatile Organic Compounds (VOCs);
- Nitrogen oxides (NO_X);
- Particulate matter of aerodynamic diameter of 2.5 microns ($PM_{2.5}$);
- Particulate matter of aerodynamic diameter of 10 microns (PM_{10}); and
- Sulphur dioxide (SO_2).

As previously discussed, the air emissions in tonnes per year provided in *Table 3-7*, *Table 3-8* and *Table 3-9* are based on 1,000,000 vehicles in each vehicle technology class and a 1 km per year mileage. The estimates were also based on the vehicle speeds provided in IV AZEVIA Dashboard 20180515 PRELIMINARY DRAFT v8.xlsb spreadsheet (*Table 3-5* and *Table 3-6*).

Table 3-8 COPERT Australia outputs for Dead End Scenario Local Roads Run

Sector	Subsector	Technology	Dead End Scenario Emissions (tonnes/year)						Slow Lane Scenario Emissions (tonnes/year)					
			CO	VOCs	NO_X	$PM_{2.5}$	PM_{10}	SO_2	CO	VOCs	NO_X	$PM_{2.5}$	PM_{10}	SO_2
Passenger Cars	PC-S-petrol	ADR79-05	0.914	0.116	0.089	0.012	0.022	0.004	1.174	0.125	0.089	0.012	0.022	0.004
Passenger Cars	PC-M-petrol	ADR79-05	0.814	0.138	0.089	0.012	0.022	0.006	0.936	0.139	0.088	0.012	0.022	0.005
Passenger Cars	PC-L-petrol	ADR79-05	0.619	0.104	0.079	0.012	0.022	0.007	0.697	0.098	0.077	0.012	0.022	0.006
Passenger Cars	PC-S-diesel	ADR79-05	0.153	0.022	0.291	0.013	0.023	0.001	0.119	0.017	0.261	0.013	0.023	0.001
Passenger Cars	PC-ML-diesel	ADR79-05	0.153	0.022	0.291	0.013	0.023	0.001	0.119	0.017	0.261	0.013	0.023	0.001
Passenger Cars	PC-S-E10	ADR79-05	0.914	0.116	0.089	0.012	0.022	0.005	1.174	0.125	0.089	0.012	0.022	0.004
Passenger Cars	PC-M-E10	ADR79-05	0.814	0.138	0.089	0.012	0.022	0.006	0.936	0.139	0.088	0.012	0.022	0.005
Passenger Cars	PC-L-E10	ADR79-05	0.619	0.104	0.079	0.012	0.022	0.007	0.697	0.098	0.077	0.012	0.022	0.006
Passenger Cars	PC-LPG	ADR79-05	0.814	0.138	0.089	0.012	0.022	0.006	0.936	0.139	0.088	0.012	0.022	0.006
SUV	SUV-C-petrol	ADR79-05	0.619	0.104	0.079	0.019	0.035	0.007	0.697	0.098	0.077	0.019	0.035	0.006
SUV	SUV-L-petrol	ADR79-05	0.619	0.104	0.079	0.019	0.035	0.008	0.697	0.098	0.077	0.019	0.035	0.007
SUV	SUV-diesel	ADR79-05	0.153	0.022	0.291	0.020	0.035	0.002	0.119	0.017	0.261	0.019	0.035	0.002
SUV	SUV-C-E10	ADR79-05	0.619	0.104	0.079	0.019	0.035	0.007	0.697	0.098	0.077	0.019	0.035	0.006
SUV	SUV-L-E10	ADR79-05	0.619	0.104	0.079	0.019	0.035	0.008	0.697	0.098	0.077	0.019	0.035	0.007
Light Commercial Vehicles	LCV-petrol	ADR79-05	0.619	0.104	0.079	0.019	0.035	0.008	0.697	0.098	0.077	0.019	0.035	0.007
Light Commercial Vehicles	LCV-diesel	ADR79-05	0.401	0.047	0.301	0.020	0.036	0.002	0.342	0.044	0.276	0.019	0.035	0.002
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	3.408	3.855	3.764	0.034	0.072	0.022	3.035	3.299	3.642	0.034	0.071	0.020
Heavy Duty Trucks	MCV-diesel	ADR80-05	0.349	0.011	0.242	0.036	0.074	0.003	0.315	0.010	0.182	0.035	0.073	0.003
Heavy Duty Trucks	HCV-diesel	ADR80-05	0.856	0.024	0.723	0.038	0.075	0.004	0.760	0.021	0.538	0.037	0.074	0.004
Heavy Duty Trucks	AT-diesel	ADR80-05	1.017	0.029	0.551	0.039	0.077	0.012	0.902	0.026	0.422	0.038	0.075	0.011
Heavy Duty Trucks	Autogas Trucks	ADR80-05	4.328	4.454	4.405	0.034	0.072	0.016	3.854	3.812	4.262	0.034	0.071	0.015

Note: Emission estimates are based on 1,000,000 vehicles in each vehicle technology class and a 1 km per year mileage

Table 3-9 COPERT Australia outputs for Dead End Scenario Arterial Roads Run

Sector	Subsector	Technology	Dead End Scenario Emissions (tonnes/year)						Slow Lane Scenario Emissions (tonnes/year)					
			CO	VOCs	NO_X	$PM_{2.5}$	PM_{10}	SO_2	CO	VOCs	NO_X	$PM_{2.5}$	PM_{10}	SO_2
Passenger Cars	PC-S-petrol	ADR79-05	1.042	0.120	0.089	0.012	0.022	0.004	0.208	0.012	0.036	0.012	0.021	0.003
Passenger Cars	PC-M-petrol	ADR79-05	0.873	0.139	0.088	0.012	0.022	0.005	0.208	0.012	0.036	0.012	0.021	0.004
Passenger Cars	PC-L-petrol	ADR79-05	0.656	0.101	0.078	0.012	0.022	0.006	0.208	0.012	0.036	0.012	0.021	0.005
Passenger Cars	PC-S-diesel	ADR79-05	0.136	0.020	0.276	0.013	0.023	0.001	0.083	0.013	0.224	0.012	0.021	0.001
Passenger Cars	PC-ML-diesel	ADR79-05	0.136	0.020	0.276	0.013	0.023	0.001	0.083	0.013	0.224	0.012	0.021	0.001
Passenger Cars	PC-S-E10	ADR79-05	1.042	0.120	0.089	0.012	0.022	0.004	0.208	0.012	0.036	0.012	0.021	0.004
Passenger Cars	PC-M-E10	ADR79-05	0.873	0.139	0.088	0.012	0.022	0.005	0.208	0.012	0.036	0.012	0.021	0.005
Passenger Cars	PC-L-E10	ADR79-05	0.656	0.101	0.078	0.012	0.022	0.007	0.208	0.012	0.036	0.012	0.021	0.005
Passenger Cars	PC-LPG	ADR79-05	0.873	0.139	0.088	0.012	0.022	0.006	0.208	0.012	0.036	0.012	0.021	0.006
SUV	SUV-C-petrol	ADR79-05	0.656	0.101	0.078	0.019	0.035	0.006	0.208	0.012	0.036	0.018	0.032	0.005
SUV	SUV-L-petrol	ADR79-05	0.656	0.101	0.078	0.019	0.035	0.007	0.208	0.012	0.036	0.018	0.032	0.006
SUV	SUV-diesel	ADR79-05	0.136	0.020	0.276	0.020	0.035	0.002	0.083	0.013	0.224	0.018	0.033	0.001
SUV	SUV-C-E10	ADR79-05	0.656	0.101	0.078	0.019	0.035	0.006	0.208	0.012	0.036	0.018	0.032	0.005
SUV	SUV-L-E10	ADR79-05	0.656	0.101	0.078	0.019	0.035	0.008	0.208	0.012	0.036	0.018	0.032	0.006
Light Commercial Vehicles	LCV-petrol	ADR79-05	0.656	0.101	0.078	0.019	0.035	0.007	0.208	0.012	0.036	0.018	0.032	0.005
Light Commercial Vehicles	LCV-diesel	ADR79-05	0.372	0.045	0.289	0.020	0.035	0.002	0.280	0.039	0.249	0.018	0.032	0.001
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	3.475	3.951	3.791	0.034	0.072	0.022	2.907	3.097	3.614	0.033	0.068	0.020
Heavy Duty Trucks	MCV-diesel	ADR80-05	0.356	0.011	0.254	0.036	0.074	0.003	0.303	0.009	0.163	0.034	0.070	0.003
Heavy Duty Trucks	HCV-diesel	ADR80-05	0.873	0.024	0.756	0.038	0.075	0.004	0.727	0.020	0.476	0.035	0.071	0.003
Heavy Duty Trucks	AT-diesel	ADR80-05	1.038	0.030	0.576	0.039	0.077	0.012	0.862	0.025	0.381	0.036	0.072	0.010
Heavy Duty Trucks	Autogas Trucks	ADR80-05	4.413	4.565	4.436	0.034	0.072	0.017	3.692	3.579	4.230	0.033	0.068	0.015

Note: Emission estimates are based on 1,000,000 vehicles in each vehicle technology class and a 1 km per year mileage

Table 3-10 COPERT Australia outputs for Dead End Scenario Freeway Roads Run

Sector	Subsector	Technology	Dead End Scenario Emissions (tonnes/year)						Slow Lane Scenario Emissions (tonnes/year)					
			CO	VOCs	NO_X	$PM_{2.5}$	PM_{10}	SO_2	CO	VOCs	NO_X	$PM_{2.5}$	PM_{10}	SO_2
Passenger Cars	PC-S-petrol	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.003	0.328	0.014	0.020	0.008	0.012	0.002
Passenger Cars	PC-M-petrol	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.003	0.328	0.014	0.020	0.008	0.012	0.003
Passenger Cars	PC-L-petrol	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.004	0.328	0.014	0.020	0.008	0.012	0.003
Passenger Cars	PC-S-diesel	ADR79-05	0.049	0.008	0.191	0.010	0.018	0.001	0.029	0.006	0.189	0.008	0.012	0.001
Passenger Cars	PC-ML-diesel	ADR79-05	0.049	0.008	0.191	0.010	0.018	0.001	0.029	0.006	0.189	0.008	0.012	0.001
Passenger Cars	PC-S-E10	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.003	0.328	0.014	0.020	0.008	0.012	0.002
Passenger Cars	PC-M-E10	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.003	0.328	0.014	0.020	0.008	0.012	0.003
Passenger Cars	PC-L-E10	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.004	0.328	0.014	0.020	0.008	0.012	0.003
Passenger Cars	PC-LPG	ADR79-05	0.236	0.013	0.030	0.010	0.018	0.005	0.328	0.014	0.020	0.008	0.012	0.005
SUV	SUV-C-petrol	ADR79-05	0.236	0.013	0.030	0.016	0.028	0.004	0.328	0.014	0.020	0.011	0.019	0.004
SUV	SUV-L-petrol	ADR79-05	0.236	0.013	0.030	0.016	0.028	0.004	0.328	0.014	0.020	0.011	0.019	0.004
SUV	SUV-diesel	ADR79-05	0.049	0.008	0.191	0.016	0.028	0.001	0.029	0.006	0.189	0.011	0.019	0.001
SUV	SUV-C-E10	ADR79-05	0.236	0.013	0.030	0.016	0.028	0.004	0.328	0.014	0.020	0.011	0.019	0.004
SUV	SUV-L-E10	ADR79-05	0.236	0.013	0.030	0.016	0.028	0.005	0.328	0.014	0.020	0.011	0.019	0.004
Light Commercial Vehicles	LCV-petrol	ADR79-05	0.236	0.013	0.030	0.016	0.028	0.004	0.328	0.014	0.020	0.011	0.019	0.004
Light Commercial Vehicles	LCV-diesel	ADR79-05	0.207	0.026	0.220	0.016	0.028	0.001	0.263	0.023	0.222	0.012	0.019	0.001
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	2.495	2.371	3.633	0.027	0.054	0.019	2.193	1.654	4.003	0.017	0.031	0.019
Heavy Duty Trucks	MCV-diesel	ADR80-05	0.270	0.008	0.103	0.028	0.055	0.002	0.252	0.007	0.059	0.018	0.033	0.002
Heavy Duty Trucks	HCV-diesel	ADR80-05	0.616	0.017	0.280	0.029	0.057	0.003	0.516	0.015	0.132	0.019	0.034	0.003
Heavy Duty Trucks	AT-diesel	ADR80-05	0.728	0.021	0.257	0.030	0.057	0.008	0.606	0.017	0.165	0.019	0.034	0.006
Heavy Duty Trucks	Autogas Trucks	ADR80-05	0.236	0.013	0.030	0.010	0.018	0.003	2.785	1.912	4.685	0.017	0.031	0.015

Note: Emission estimates are based on 1,000,000 vehicles in each vehicle technology class and a 1 km per year mileage

3.1.5 COPERT Setup for BTEX Emissions

Unlike other species, non-methane VOCs (NMVOCs) speciation in COPERT Australia output is provided per fleet rather than for each vehicle technology class. Additional runs were therefore undertaken to derive emissions for benzene, toluene, ethylbenzene and xylenes (BTEX) for cars and trucks separately to match the traffic data provided to ERM. In order to simplify calculations within Excel, these runs were based on a fleet of a nominal number of 1,000,000 vehicles with a Melbourne traffic make up (Pacific Environment Limited, 2016) as provided in *Table 3-10* for car run and *Table 3-11* for truck run. Six BTEX species runs for each scenario were therefore undertaken:

- Car and Truck runs for local roads;
- Car and Truck runs for arterial roads; and
- Car and Truck runs for freeways.

Input circulation data for each road type remained consistent with the parameters used for emission estimation for other species (*Table 3-5* and *Table 3-6*).

Table 3-11 Fleet population data used for NMVOCs speciation run for cars in COPERT Australia

Sector	Subsector	Technology	Population
Passenger Cars	PC-S-petrol	ADR79-05	291951
Passenger Cars	PC-M-petrol	ADR79-05	133895
Passenger Cars	PC-L-petrol	ADR79-05	204940
Passenger Cars	PC-S-diesel	ADR79-05	6505
Passenger Cars	PC-ML-diesel	ADR79-05	5491
Passenger Cars	PC-S-E10	ADR79-05	5998
Passenger Cars	PC-M-E10	ADR79-05	10222
Passenger Cars	PC-L-E10	ADR79-05	3970
Passenger Cars	PC-LPG	ADR79-05	65723
SUV	SUV-C-petrol	ADR79-05	44688
SUV	SUV-L-petrol	ADR79-05	34973
SUV	SUV-diesel	ADR79-05	33368
SUV	SUV-C-E10	ADR79-05	1690
SUV	SUV-L-E10	ADR79-05	1267
Light Commercial Vehicles	LCV-petrol	ADR79-05	84478
Light Commercial Vehicles	LCV-diesel	ADR79-05	70756
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	0
Heavy Duty Trucks	MCV-diesel	ADR80-05	0
Heavy Duty Trucks	HCV-diesel	ADR80-05	0
Heavy Duty Trucks	AT-diesel	ADR80-05	0
Heavy Duty Trucks	Autogas Trucks	ADR80-05	0

1. Vehicle population ratios adopted from (Pacific Environment Limited, 2016)

Table 3-12 Fleet population data used for NMVOCs speciation run for trucks in COPERT Australia

Sector	Subsector	Technology	Population
Passenger Cars	PC-S-petrol	ADR79-05	0
Passenger Cars	PC-M-petrol	ADR79-05	0
Passenger Cars	PC-L-petrol	ADR79-05	0
Passenger Cars	PC-S-diesel	ADR79-05	0
Passenger Cars	PC-ML-diesel	ADR79-05	0
Passenger Cars	PC-S-E10	ADR79-05	0
Passenger Cars	PC-M-E10	ADR79-05	0
Passenger Cars	PC-L-E10	ADR79-05	0
Passenger Cars	PC-LPG	ADR79-05	0
SUV	SUV-C-petrol	ADR79-05	0
SUV	SUV-L-petrol	ADR79-05	0
SUV	SUV-diesel	ADR79-05	0
SUV	SUV-C-E10	ADR79-05	0
SUV	SUV-L-E10	ADR79-05	0
Light Commercial Vehicles	LCV-petrol	ADR79-05	0
Light Commercial Vehicles	LCV-diesel	ADR79-05	0
Heavy Duty Trucks	MCV-petrol	ADR00-UNC	72700
Heavy Duty Trucks	MCV-diesel	ADR80-05	503100
Heavy Duty Trucks	HCV-diesel	ADR80-05	191300
Heavy Duty Trucks	AT-diesel	ADR80-05	177200
Heavy Duty Trucks	Autogas Trucks	ADR80-05	55600

1. Vehicle population ratios adopted from (Pacific Environment Limited, 2016)

3.1.6 COPERT Australia Output for BTEX Species

Table 3-12 provides air emissions in tonnes per year estimated using COPERT Australia for cars fleet (comprised of PCs, SUVs and LCVs) and truck fleets of 1,000,000 vehicles for local, arterial and freeway road BTEX species runs for Dead End and Slow Lane scenarios.

Table 3-13 COPERT Australia output for BTEX Emissions for Dead End and Slow Lane Scenarios

Road type	Fleet	Benzene	Toluene	Ethylbenzene	Xylenes
Dead End scenario					
Local	PCs, SUVs and LCVs	0.005	0.010	0.002	0.007
	HDTs	0.0004	0.0001	0	0.0072
Arterial	PCs, SUVs and LCVs	0.005	0.010	0.002	0.007
	HDTs	0.0004	0.0001	0	0.0074
Freeways	PCs, SUVs and LCVs	0.005	0.010	0.002	0.007
	HDTs	0.0002	0.00003	0	0.0045
Slow Lane scenario					
Local	PCs, SUVs and LCVs	0.005	0.010	0.002	0.007
	HDTs	0.0003	0.0000	0	0.0061
Arterial	PCs, SUVs and LCVs	0.001	0.001	0.0002	0.001
	HDTs	0.0003	0.00004	0	0.006
Freeways	PCs, SUVs and LCVs	0.0005	0.001	0.0002	0.001
	HDTs	0.0002	0.00002	0	0.0031

3.1.7 Emission Estimation per Road Link

Air emissions in tonnes per year based on mileage of 1 kilometre per year were then used to calculate average emissions in grams per hour per kilometre for each road link using *Equation 3-1* for both non-BTEX species and BTEX species. For non-BTEX species this equation is based on vehicle technology classes, while for BTEX species this equation is based on broader categories: cars and trucks. It should be noted that mileage of 1 kilometre per year basis was adopted to simplify excel spreadsheet calculations.

Equation 3-1 Emission estimation per road link for non-BTEX species

$$RLE_i = \sum_j \frac{N_j}{1{,}000{,}000} \times E_{ij}$$

Where

RLE_i is road link emission for species i in g/hr/km

Nj is average number of vehicles in class j in a year for non-BTEX emissions and average number of cars/trucks in a year for BTEX emissions

Eij is emission rate for species i for vehicle class j in tonnes/year/km/million vehicles for non-BTEX emissions and emission rate for cars/trucks in tonnes/year/km/million vehicles for BTEX emissions

3.2 NON-EXHAUST EMISSIONS PER ROAD LINK

Non-exhaust emissions from vehicles comprise airborne particles produced as a result of the interaction between a vehicle's tyres and the road, including when the brakes are applied to decelerate the vehicle (European Environment Agency, 2016). These emissions are known as:

- Tyre wear;
- Brake wear; and
- Road surface wear.

Resuspension particulate matter is also a non-exhaust emission source, which relates to both freshly formed particles from abrasion and older deposited road dust brought into the air by vehicle movement (Martin Ferm, 2015). There is however an ongoing discussion on whether this source can be considered a primary source and the uncertainty in the methods for the estimation of emission factors (European Environment Agency, 2016).

3.2.1 Combustion Vehicles

COPERT Australia was used to only calculate exhaust emissions. Non-exhaust emissions for combustion vehicles for Dead End and Slow Lane scenarios were calculated in accordance with EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 (European Environment Agency, 2016). Emissions for tyre, brake and road surface wear for heavy duty vehicles was undertaken using Tier 1 methodology as no information was provided on the fleet split based on the number of truck axles (which is required for a Tier 2 assessment). Emissions for tyre, brake and road surface wear for passenger cars and light-duty vehicles however was based on Tier 2 methodology and accounted for different road speeds. Non-exhaust $PM_{2.5}$ and PM_{10} emissions were estimated for each road link using the fleet numbers provided for each scenario. Non-exhaust emissions per road link in g/hr/km were then added to exhaust emissions for the same road link.

3.2.2 Electric and Hydrogen Vehicles

A literature review was completed to compare non-exhaust emissions from combustion and electric vehicles. At the current time there is little available literature on non-exhaust PM emissions from electric vehicles, however one published study drew the following comparative conclusions (Victor R.J.H. Timmers, 2016):

- Tyre wear emissions of PM_{10} and $PM_{2.5}$ from electric vehicles are slightly higher than gasoline and diesel combustion vehicles:
  - 7.2 mg/vkm for electric vehicles compared to 6.1 mg/vkm for combustion vehicles of PM_{10}; and
  - 3.7 mg/vkm for electric vehicles compared to 2.9 mg/vkm for combustion vehicles of $PM_{2.5}$;

- Brake wear emissions of PM_{10} and $PM_{2.5}$ from electric vehicles are significantly lower than gasoline and diesel combustion vehicles due to regenerative brake system:
    - 0 mg/vkm for electric vehicles compared to 9.3 mg/vkm for combustion vehicles of PM_{10};
    - 0 mg/vkm for electric vehicles compared to 2.2 mg/vkm for combustion vehicles of $PM_{2.5}$;
    - It should be noted that zero brake wear emissions from electric vehicles have been conservatively adopted by the study due to limited research of this emission source (Victor R.J.H. Timmers, 2016).
- Road wear emissions of PM_{10} and $PM_{2.5}$ from electric vehicles are slightly higher than gasoline and diesel combustion vehicles due to heavier weight of the electric vehicles due to heavy batteries:
    - 8.9 mg/vkm for electric vehicles compared to 7.5 mg/vkm for combustion vehicles of PM_{10}; and
    - 3.8 mg/vkm for electric vehicles compared to 3.1 mg/vkm for combustion vehicles of $PM_{2.5}$;
- Resuspension emissions of PM_{10} and $PM_{2.5}$ from electric vehicles are higher than gasoline and diesel combustion vehicles:
    - 49.6 mg/vkm for electric vehicles compared to 40 mg/vkm for combustion vehicles of PM_{10}; and
    - 14.9 mg/vkm for electric vehicles compared to 12 mg/vkm for combustion vehicles of $PM_{2.5}$.

Overall, the research paper (Victor R.J.H. Timmers, 2016) indicates that electric vehicles are associated with non-exhaust emissions of 65.7 mg/vkm of PM_{10} and 22.4 mg/vkm of $PM_{2.5}$, compared to 62.9 mg/vkm and 20.2 mg/vkm associated with gasoline and diesel vehicles.

While the research paper by Victor R.J.H. Timmers and A.J. Achten indicates that the total non-exhaust emissions from electric vehicles are 4.5 % higher for PM_{10} and 11% higher for $PM_{2.5}$, these total emission estimates take into account resuspension emissions (Victor R.J.H. Timmers, 2016). As previously discussed however, there is limited research on this emission source and the uncertainties surrounding the methods for the estimation of emission factors (European Environment Agency, 2016). There is an ongoing discussion on whether this source can be considered primary and therefore there is potential for double-counting of emissions (Victor R.J.H. Timmers, 2016). For these reasons EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 (European Environment Agency, 2016) does not contain emission factors for resuspension and therefore these emission rates were not included in the assessment.

If resuspension emission rates are ignored in comparative analysis between electric and combustion vehicles, non-exhaust emissions from electric vehicles are significantly reduced compared to combustion vehicles. In order not to overstate health benefits from adoption of electric vehicles in this assessment, this assessment conservatively adopted the same non-exhaust emission factors for electric vehicles as for combustion vehicles. Non-exhaust emissions for electric and hydrogen vehicles for Electric Avenue, Fleet Street, Private Drive, Private Drive Empty Running and Hydrogen Highway scenarios therefore were estimated using the same approach as described in *Section 3.2.1*. It is recommended that non-exhaust emission factors for electric and hydrogen vehicles adopted in this assessment are revisited once the research is more conclusive about the total non-exhaust emission rates associated with these types of vehicles.

3.3 TOTAL EMISSION REDUCTIONS

The health impact assessment, to which this report is appended, required detail on total emission reduction for each SA2 region for each considered species. In order to estimate total emission reductions from scenarios as compared to base case (Dead End scenario), total emissions in kilograms per year for each species (from both exhaust and non-exhaust emissions) were first calculated for each road link using *Equation 3-2*. Total emissions for each road link were then added for each SA2 region to estimate total emission reduction per SA2 region.

Equation 3-2 Total emission in kilograms per year estimated for each road link

$$TE_i = \frac{RLE_i \times 365 \times 24 \times L}{1{,}000}$$

Where
TEj is total emission for species i in kg/year
RLE_i is total road link emission for species i in g/hr/km (including exhaust and non-exhaust emissions)
L is road length in km

3.4 GREENHOUSE GAS EMISSIONS

Greenhouse gas emissions for the Dead End and Slow Lane scenarios were estimated using the *Road Transport Emission Factors: 2010 NAEI* (NAEI, 2012). These emission factors are based on the analysis of emission test data for in-service vehicles in the UK for a range of drive cycles. There are emission factors based on vehicle type, fuel used and mode of transport.

The emission factors are reported in mass per km travelled and include the greenhouse gases carbon dioxide (CO_2) and nitrous oxide (N_2O). A CO_2

equivalence (CO_{2e}) emission factor was determined by multiplying the N_2O emissions factor to its global warming potential (298) and adding it to the CO_2 emission factor. The resulting emission factors were applied to the same data used in the COPERT modelling. Based on the reported vehicle type the relevant CO_{2e} was applied for the assumed road lengths travelled on the different road types. The resulting estimated annual greenhouse gas emissions are:

- Dead End Scenario – 22,855,000 tonnes of CO_{2e} / year
- Slow Lane Scenario – 17,424,000 tonnes of CO_{2e} / year

As greenhouse gases do no directly impact population health, no further assessment has been completed.

4 POPULATION EXPOSURE TO TRAFFIC POLLUTION ANALYSIS

In relation to concentrations of NO_2 and $PM_{2.5}$, the health risk assessment required additional detail in relation to exposure for each SA2 region. To provide this information to the health risk assessment, emission estimation results for each scenario for NO_2 and $PM_{2.5}$, completed using the methodology outlined in Section *3,* were used to assess population exposure to traffic pollution. This part of the assessment was performed using the geographic information system ArcGIS, adopting the following inputs:

- 2046 road network shapefile provided to ERM by Infrastructure Victoria;
- Total emissions per road link for each scenario calculated using methodology outlined in *Section 3*;
- Statistical Area Level 2 (SA2) Edition 2016 Digital Boundaries in ESRI Shapefile Format (Australian Bureau of Statistics, 2017); and
- Population for Victoria on square kilometre basis as collected by Australian Bureau of Statistics (ABS) based on 2016 census, provided to ERM.

It should be noted that 2046 population statistics, developed as part of the wider study, were available only at the level of SA2 areas and therefore did not provide sufficient detail on how the population is likely to locate spatially within SA2 areas in relation to the location of the road network. This assessment therefore used population distribution on one square kilometre basis, available from ABS for year 2016. This allowed the analysis to identify the areas with population exposed to traffic pollution within SA2 regions. ERM understands that the analysis results provided to Aurecon for health impacts assessment were then scaled to reflect the likely population growth by 2046.

The population exposure to traffic pollution for each scenario was derived through the following steps:

- Buffers of 2, 5, 10, 25, 50, 100, 150, 168, 175, 200 metres were created around each road link;
- Point data set created for each road buffer using 'Features Vertices to Points' tool;
- Annual mean contribution to ambient air quality in $\mu g/m^3$ from each road link was calculated for each buffer area using equations provided in Section C3.2 of Design Manual for Roads and Bridges (The Highways Agency, Transport Scotland, Welsh Assembly Government Llywodraeth Cynulliad Cymru, the Department for Regional Development Northern Ireland, 2007);
- Point data was interpolated using inverse distance weighted interpolation method (IDW tool);
- Grids were summed for each road link using cell statistics tool;

- Traffic contribution grids were summed for all road links for each scenario to derive final contribution grids;

- A fishnet was created with a cell size of 1 km^2 using the extent contained in the population data;

- Population raster values for each fishnet cell were derived using spatial join with data derived from the Australian Bureau of Statistics for population data based on the 2016 census[2]; and

- The average concentration for each cell (square kilometre) of population statistics was derived using zonal statistics tool.

The average concentration for each square kilometre of population statistics data for all SA2 regions was provided to Aurecon in spreadsheet form to assist the health risk assessment of NO_2 and $PM_{2.5}$ emissions.

[2] http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/3218.02016-17?OpenDocument

5 RESULTS

5.1 EMISSION REDUCTIONS

Total NOx, CO, VOCs, $PM_{2.5}$, PM_{10}, SO_2, benzene, toluene, ethylbenzene and xylenes emissions in kilograms per year for all scenarios are provided in Annex A. Dead End scenario has been adopted as a base case in this assessment and all other scenarios have been compared to the base case emissions.

The results of the emission estimation indicate that overall, for Melbourne Metropolitan area, all scenarios achieve reduction in emissions of all species, as compared to the base case. *Table 5-1* presents the total emission reduction (percent) for all species for Melbourne Metropolitan area for all scenarios considered in this assessment in comparison to the base case (Dead End scenario).

Table 5-1 Total emission reduction (percent) for all scenarios in comparison to the base case for Melbourne Metropolitan area

Species	Total emission reduction (%)					
	Slow Lane	Electric Avenue	Hydrogen Highway	Private Drive	Private Drive Empty Running	Fleet Street
CO	51	100	100	100	100	100
VOCs	51	100	100	100	100	100
NOX	30	100	100	100	100	100
$PM_{2.5}$	18	44	41	40	36	48
PM_{10}	17	43	41	40	36	48
SO_2	42	100	100	100	100	100
Benzene	81	100	100	100	100	100
Toluene	82	100	100	100	100	100
Ethylbenzene	82	100	100	100	100	100
Xylenes	76	100	100	100	100	100

The emission estimation results presented in *Table 5-1* indicate that Electric Avenue, Hydrogen Highway, Private Drive, Private Drive Empty Running and Fleet Street achieve 100 percent reduction in the annual emissions of CO, VOCs, NOx, SO_2, Benzene, Toluene, Ethylbenzene and Xylenes in Melbourne Metropolitan area compared to the base case. These emission reductions are due to traffic in these scenarios comprising only electric or hydrogen vehicles, which are not associated with hydrocarbon combustion exhaust emissions. These scenarios are also associated with the overall reduction in PM_{10} and $PM_{2.5}$ emissions as compared to the base case, which are also attributed to the elimination of particulate matter emissions from the exhausts.

The emission estimation results presented in *Table 5-1* further indicate that Slow Lane scenario achieves overall reduction in the annual emissions of all species in Melbourne Metropolitan area, as compared to the base case. These overall reduction is associated to the traffic in Slow Lane being split between combustion vehicles and electric vehicles, therefore reducing overall exhaust emissions.

On an individual SA2 level, the results of the emission estimation indicate that Electric Avenue, Hydrogen Highway, Private Drive and Fleet Street scenarios achieve emission reductions in emissions of all species for all SA2 regions compared to the base case. *Table 5-2* shows minimum and maximum reductions in $PM_{2.5}$ and PM_{10} emissions for individual SA2 areas for Electric Avenue, Hydrogen Highway, Private Drive and Fleet Street scenarios compared to the base case.

Table 5-2 Minimum and Maximum reductions in Pm2.5 and PM10 emissions for SA2 areas within Melbourne Metropolitan area for Electric Avenue, Hydrogen Highway, Private Drive and Fleet Street compared to the base case

Scenario	$PM_{2.5}$		PM_{10}	
	Minimum reduction (%)	Maximum reduction (%)	Minimum reduction (%)	Maximum reduction (%)
Electric Avenue	40	49	39	49
Hydrogen Highway	8	56	7	56
Private Drive	11	57	10	56
Fleet Street	25	73	25	73

On individual SA2 level, the results of the emission estimation indicate that Private Drive Empty Running and Slow Lane scenarios achieve emission reductions in $PM_{2.5}$ and PM_{10} emissions for the majority of SA2 regions, however an increase in $PM_{2.5}$ and PM_{10} emissions is projected for a number of SA2 regions.

Table 5-3 and *Table 5-4* present the SA2 areas associated with the increase in particulate matter emission in the Private Drive Empty Running and Slow Lane scenarios respectively compared to the base case and the magnitude of change in kilograms per year. The increases in particle emissions for each SA2 region presented in *Table 5-3* and *Table 5-4* are associated with the overall increase in vehicle numbers on roads within these SA2 regions as provided in the results of the traffic modelling. Even though electric vehicles are not associated with exhaust particulate matter emissions, the increase in vehicle kilometres travelled within the Private Drive Empty Running and Slow Lane scenarios and associated non-exhaust particulate matter emissions outweigh elimination of exhaust particulate matter emissions.

It should be also noted that Slow Lane scenario is associated with the overall increase in both car and truck numbers, while in Private Drive Empty Running

scenario there is a negative change in total truck numbers, however this negative change is not as substantial as the increase in cars numbers.

Table 5-3 Increase in particulate matter emissions (kilograms per year) in Private Drive Empty Running scenario compared to the base case

SA2 REGION	Reporting region[1]	Increase in emissions (kg/year)	
		$PM_{2.5}$	PM_{10}
Carlton	Inner Metro	208.2	444.6
Fitzroy		78.6	173.8
Melbourne		1409.5	2724.9
South Yarra - West		256.8	509.6
St Kilda		130.6	267.4
St Kilda East		61.4	150.2

1. As provided to ERM in Master Network Nodes shapefile

Table 5-4 Increase in particulate matter emissions (kilograms per year) in Slow Lane scenario compared to the base case

SA2 REGION	Reporting region[1]	Increase in emissions (kg/year)	
		$PM_{2.5}$	PM_{10}
Albert Park	Inner Metro	70.3	339.3
Melbourne	Inner Metro	309.3	627.7
Seabrook	Mid-Western	15.6	43.0
South Melbourne	Inner Metro	286.9	527.6
South Yarra - West	Inner Metro	7.1	91.5
St Kilda	Inner Metro	0.4	172.3
St Kilda East	Inner Metro	103.3	284.1

1. As provided to ERM in Master Network Nodes shapefile

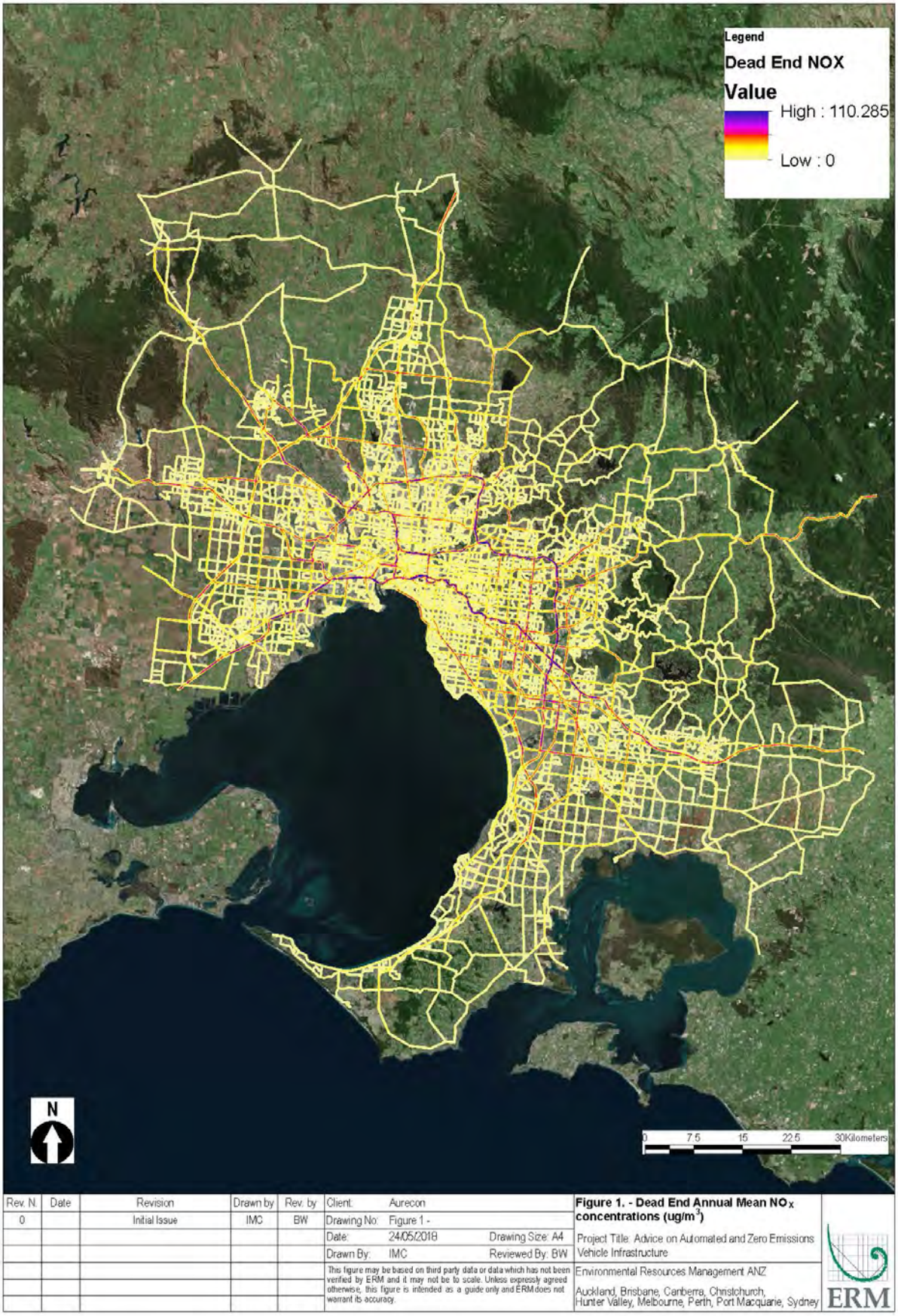
The minimum and maximum reductions in $PM_{2.5}$ emissions for other SA2 areas for Private Drive Empty Running scenario as compared to the base case are from 2 to 56 percent respectively; and the minimum and maximum reductions in PM_{10} emissions for other SA2 areas for this scenario compared to the base case are from 0 to 56 percent respectively. The minimum and maximum reductions in $PM_{2.5}$ emissions for other SA2 areas for Slow Lane scenario as compared to the base case are from 0 to 36 percent respectively; and the minimum and maximum reductions in PM_{10} emissions for other SA2 areas for this scenario compared to the base case are from 0 to 35 percent respectively.

5.2 *TRAFFIC CONTRIBUTION TO AMBIENT CONCENTRATION*

As previously discussed, in relation to concentrations of NO_2 and $PM_{2.5}$, the health risk assessment required additional detail in relation to exposure for each SA2 region. These information has been prepared using ArcGIS software.

Figure 5-1 to *Figure 5-9* show traffic contribution to annual mean ambient concentration of $PM_{2.5}$ for each scenario and annual mean NO_X for Dead End and Slow Lane scenarios. *Figure 5-1* and *Figure 5-3* demonstrate that annual mean NO_X concentrations along major freeways are reduced in the Slow Lane scenario compared to the base case. *Figure 5-2* and *Figure 5-4* to Figure 5-9 demonstrate that annual mean $PM_{2.5}$ concentrations along the majority of freeways and arterial roads are reduced in all scenarios compared to the Dead End scenario (base case). *Figure 5-2* further indicates that Dead End scenario $PM_{2.5}$ contribution is relatively high around all metropolitan areas, while $PM_{2.5}$ contributions for all other scenarios are concentrated around the major freeways in a close proximity to the Melbourne Central Business District (CBD).

Figure 5-1



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Date: 24/05/2018 Drawing Size: A4
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Figure 1. - Dead End Annual Mean NO_X concentrations (ug/m^3)

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Figure 5-2

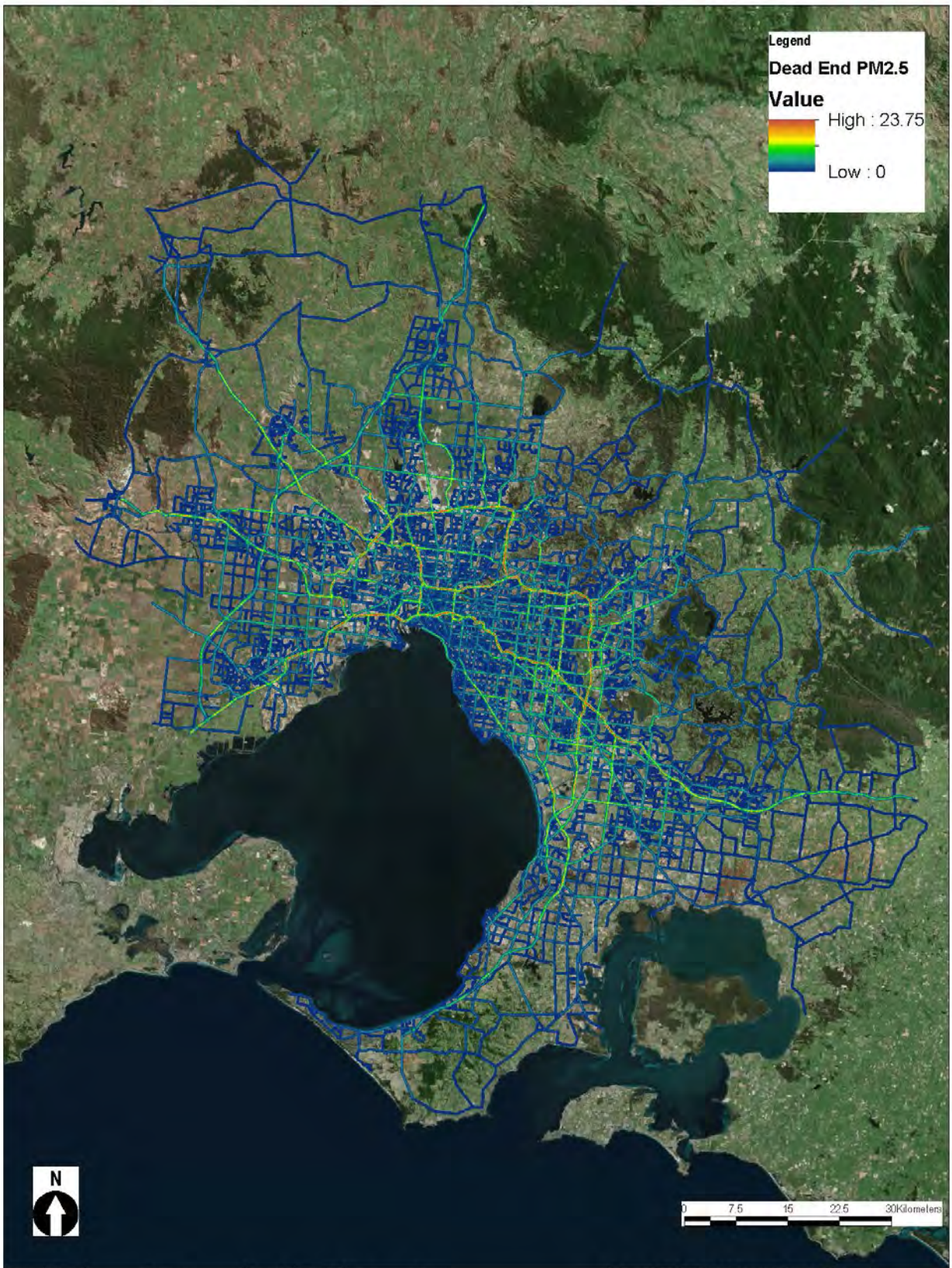

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Figure 2. - Dead End Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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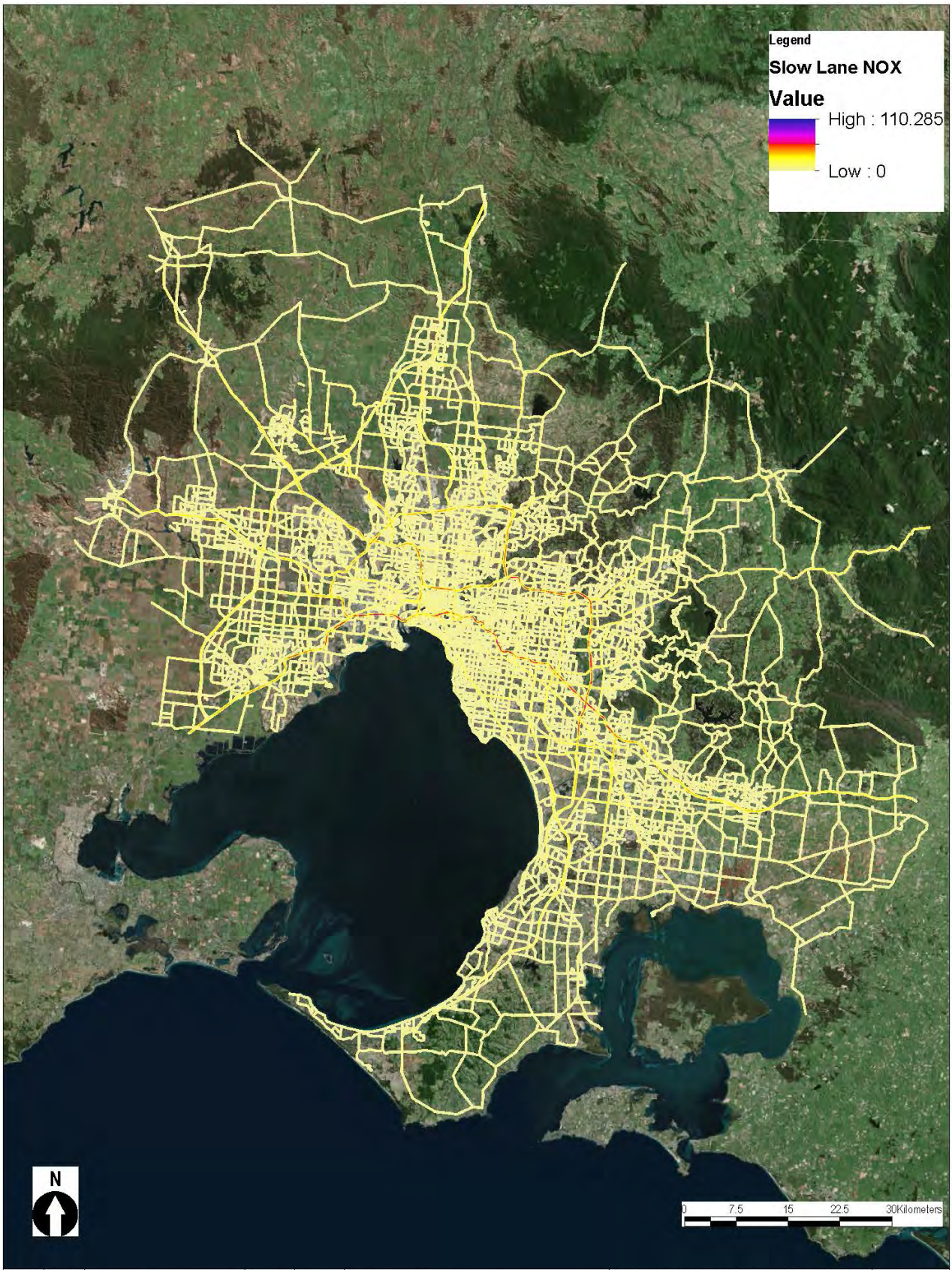
Figure 5-3



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Date: 24/05/2018 Drawing Size: A4

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Figure 3. - Slow Lane Annual Mean NO_X concentrations (ug/m^3)

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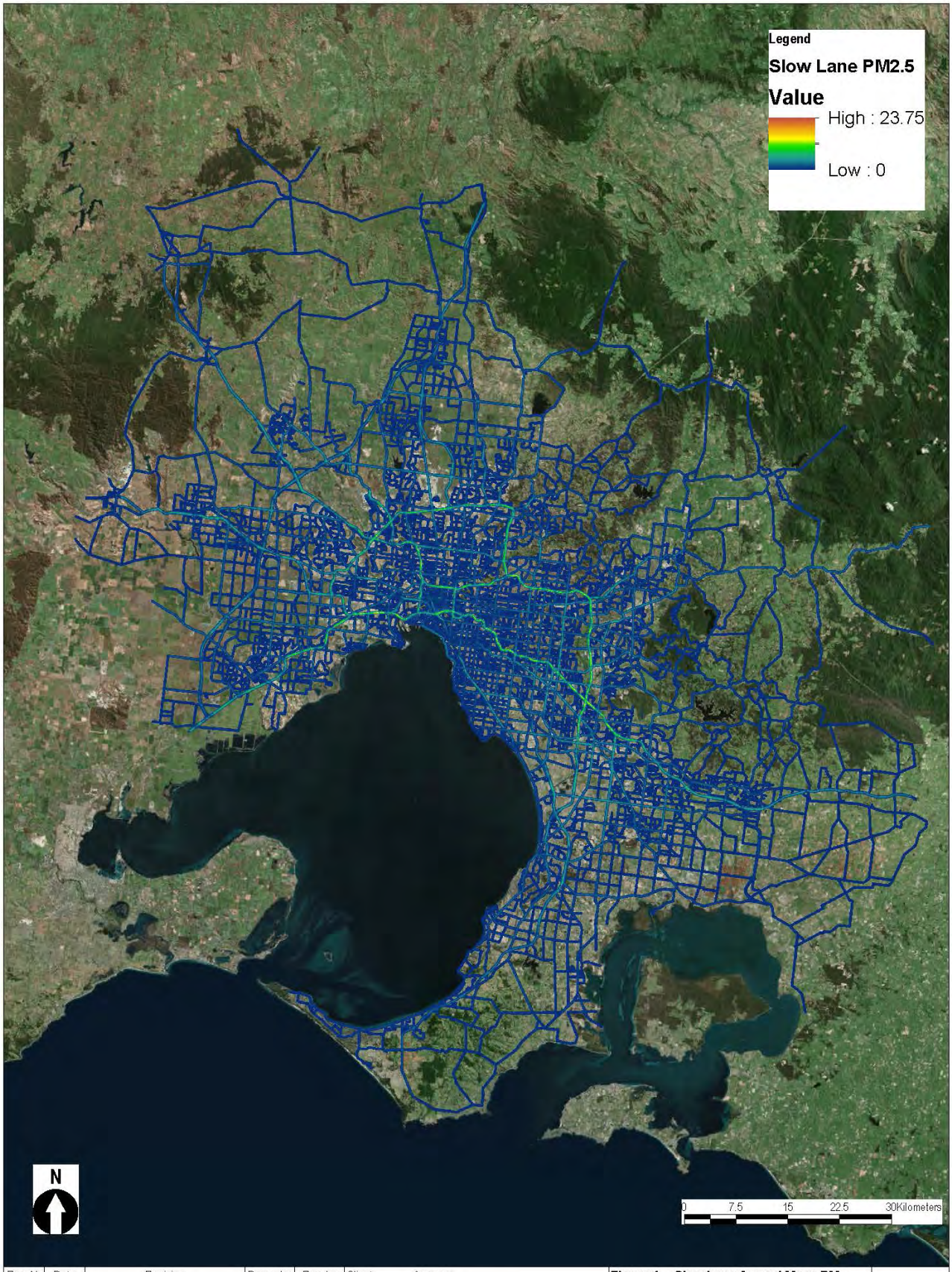
Figure 5-4



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Drawn By:	IMC	Reviewed By: BW

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Figure 4. - Slow Lane Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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Figure 5-5

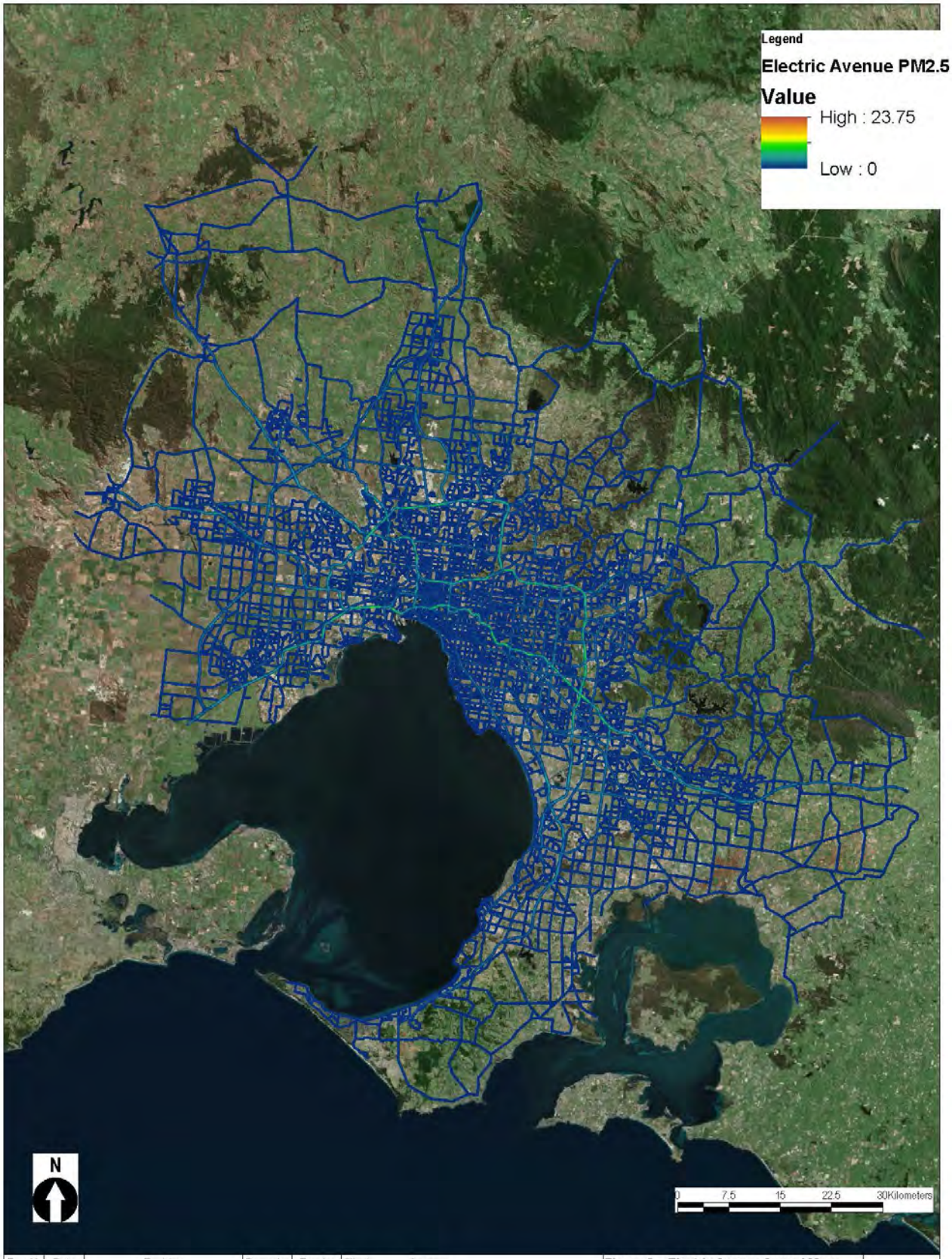

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Figure 5. - Electric Avenue Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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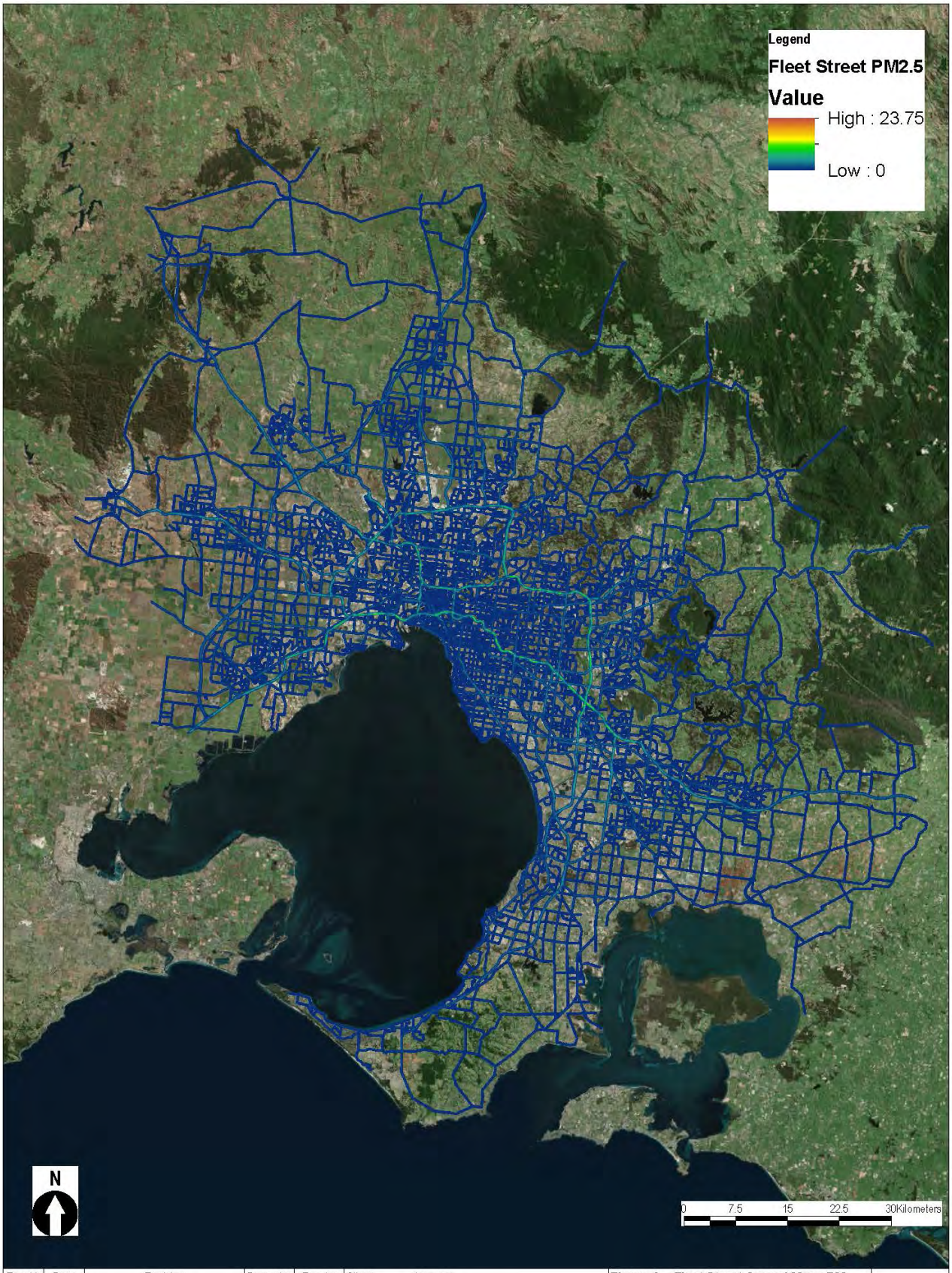
Figure 5-6



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					This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.		

Figure 6. - Fleet Street Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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Figure 5-7

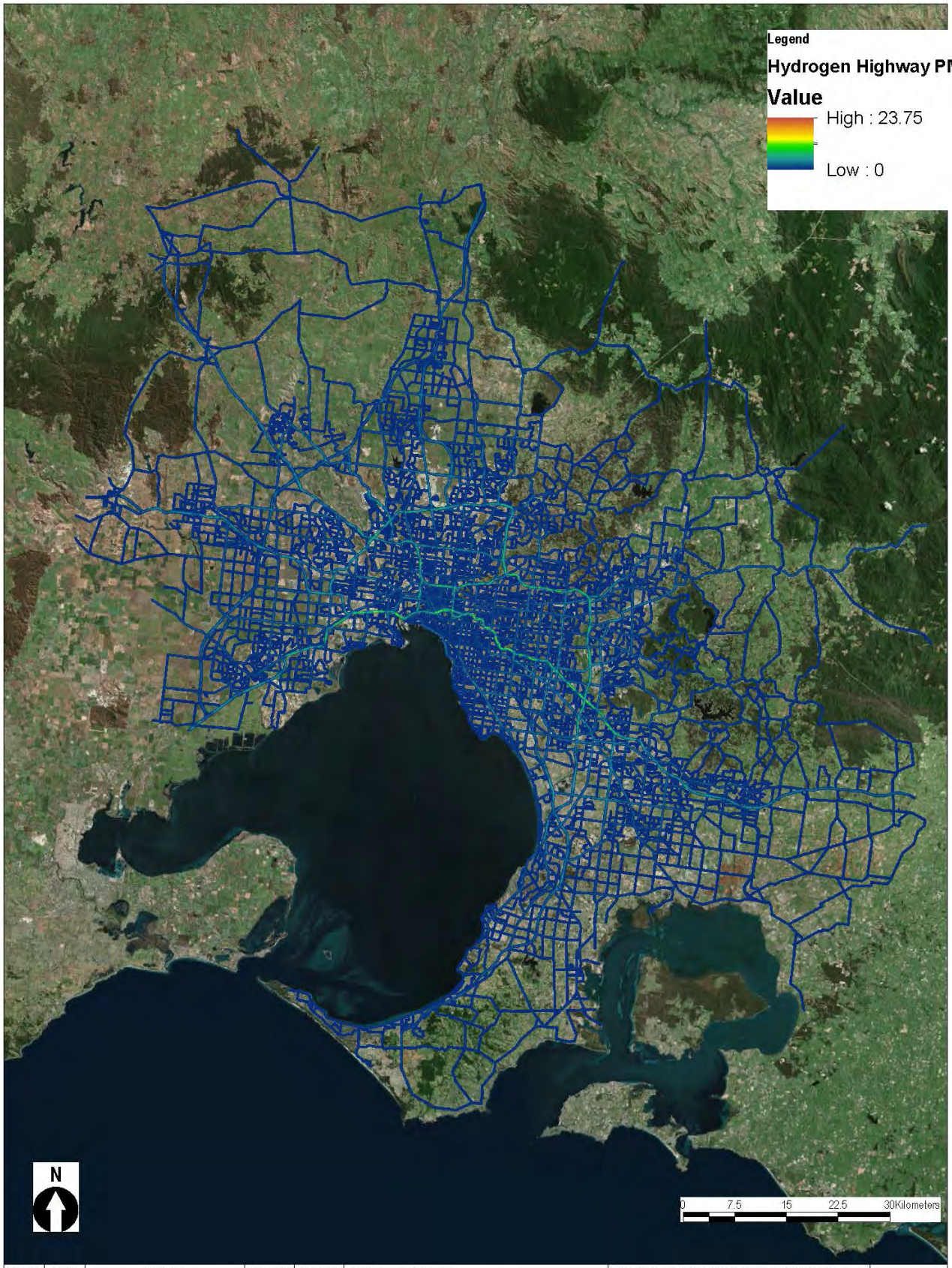

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Figure 7. - Hydrogen Highway Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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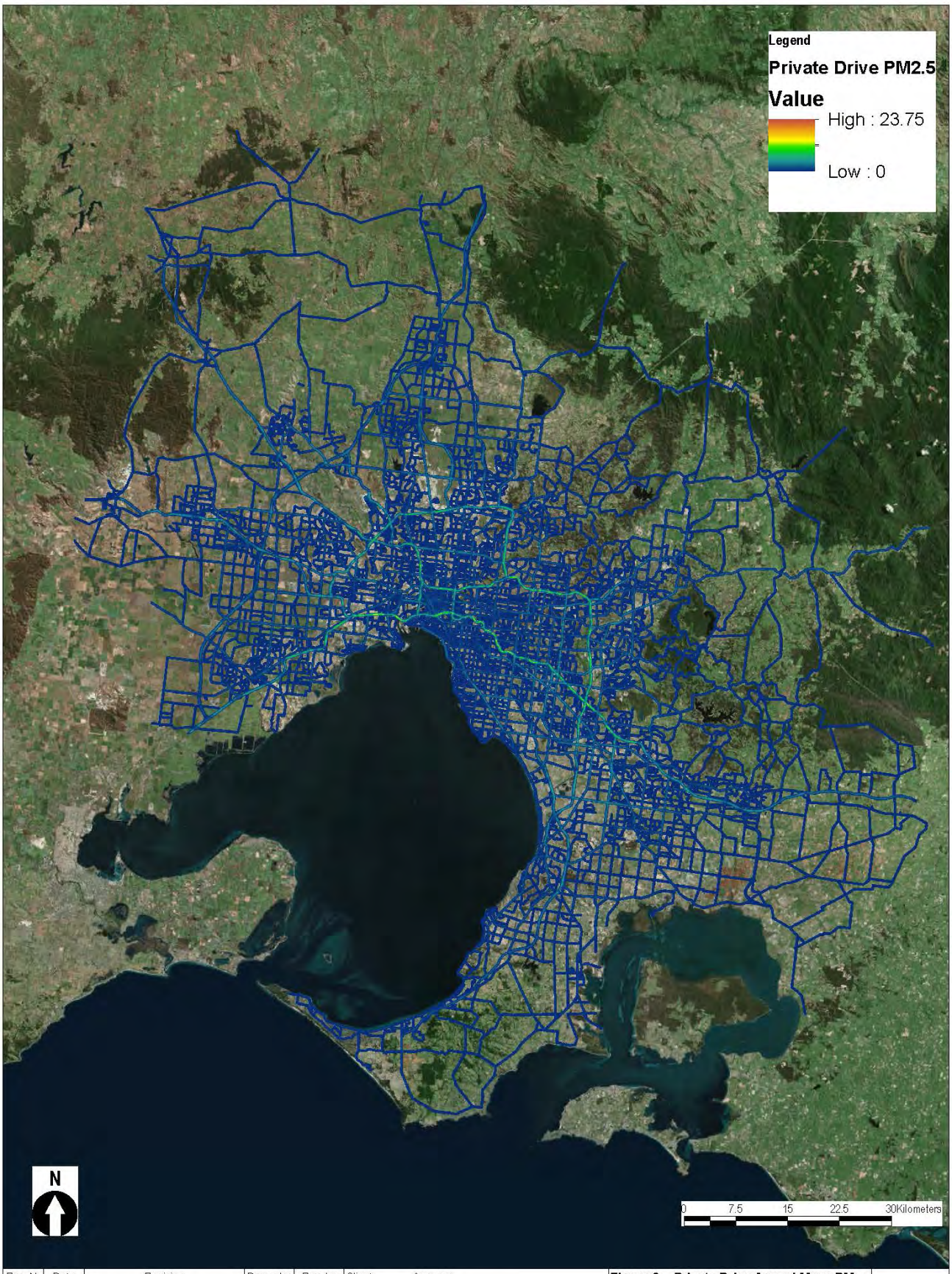
Figure 5-8



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Drawn By: IMC Reviewed By: BW

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Figure 8. - Private Drive Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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Figure 5-9

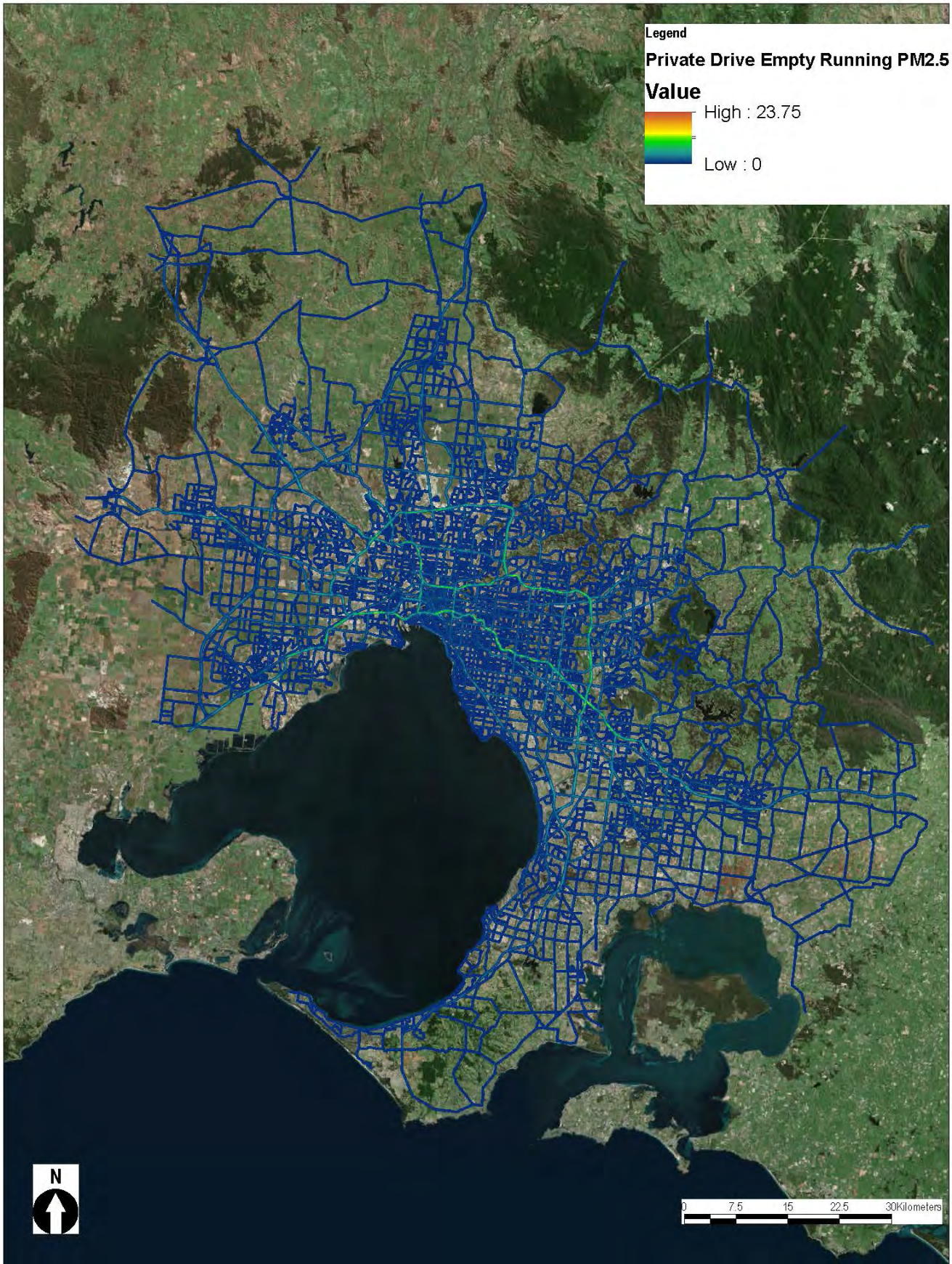

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Figure 9. - Private Drive Empty Running Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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6 CONCLUSION

Infrastructure Victoria has been directed by the Special Minister to provide advice in relation to the impact of AV and ZEV to the Victorian economy, which includes a response on potential for improvements in population health (reduced risk of premature mortality and morbidity) due to reduced exposure to a number of pollutants and how those impacts will vary by socioeconomic and demographic groups across Victoria. ERM was engaged by Aurecon (the main contract holder with Infrastructure Victoria for this package of work) to undertake air emission estimation for traffic modelling results for Melbourne Metropolitan Area provided to Infrastructure Victoria for the considered scenarios by KPMG.

The scope of work included seven scenarios for which traffic projections for the assessment year of 2046 as provided to ERM:

- Dead End (base case);
- Electric Avenue;
- Fleet street;
- Hydrogen Highway;
- Private Drive;
- Private Drive Empty Running; and
- Slow lane.

Dead End and Slow Lane scenario projections for 2046 included the traditional fleet, which comprised combustion vehicles. Emissions from these scenarios therefore comprised both exhaust and non-exhaust emissions. Electric Avenue, Fleet Street, Private Drive and Private Drive Empty Running scenario projections for 2046 included electric vehicles only, some of which are automated (robotaxi). Emissions from these scenarios therefore comprised only non-exhaust emissions. Hydrogen Highway scenario projection for 2046 included hydrogen vehicles only and therefore emissions from this scenario comprised only non-exhaust emissions.

Exhaust emissions for all scenarios were calculated using COPERT Australia software (EMISIA SA, 2014). Non-exhaust emissions for all scenarios were calculated in accordance with EMEP/EEA Air Pollutant Emission Inventory Guidebook 2016 (European Environment Agency, 2016). The estimated emissions were then used to calculate total emission reductions per SA2 region for each species for each scenario as compared to the base case (Dead End) scenario.

The results of the emission estimation indicate that overall, for Melbourne Metropolitan area, all scenarios achieve reduction in emissions of all species, as

compared to the base case. Furthermore, Slow Lane scenario achieves emission reduction for each SA2 region for combustion related emissions (CO, NO_X, VOCs, SO_2, benzene, toluene, ethylbenzene and xylenes) compared to the base case (Dead End scenario). All other scenarios achieve 100% total emission reductions per SA2 region for these species as these species are not emitted from electric or hydrogen vehicles.

The results of the emission estimation further indicate that Electric Avenue, Hydrogen Highway, Private Drive and Fleet Street scenarios achieve emission reductions in $PM_{2.5}$ and PM_{10} emissions for all SA2 regions individually compared to the base case. For Private Drive Empty Running and Slow Lane scenarios, emission reductions in $PM_{2.5}$ and PM_{10} emissions are achieved for the majority of SA2 regions, however an increase in $PM_{2.5}$ and PM_{10} emissions is projected for a number of SA2 regions.

The increase in particle emissions for some SA2 regions in Private Drive Empty Running scenario compared to the base case is associated with the overall increase in car numbers on roads within these SA2 regions as provided in the results of the traffic modelling. The increase in particle emissions for some SA2 regions in Slow Lane scenario compared to the base case is associated with the overall increase in both car and truck numbers on roads within these SA2 regions as provided in the results of the traffic modelling. Therefore for these scenarios even though electric vehicles are not associated with the exhaust particulate matter emissions, the increase in vehicle kilometres travelled within scenario and associated non-exhaust particulate matter emissions outweigh elimination of exhaust particulate matter emissions.

In relation to concentrations of NO_2 and $PM_{2.5}$, the health risk assessment required additional detail in relation to exposure for each SA2 region and therefore additional analysis was undertaken using the geographic information system ArcGIS to provide this information to the health risk assessment. The results of the analysis indicate that annual mean NO_X concentrations along major freeways are visibly reduced in Slow Lane scenario compared to the base case and annual mean $PM_{2.5}$ concentrations along the majority of freeways and arterial roads are visibly reduced in all scenarios compared to the base case. The analysis further indicates that Dead End scenario $PM_{2.5}$ contribution is relatively high around all metropolitan areas, while $PM_{2.5}$ contributions for all other scenarios are concentrated around the major freeways in a close proximity to the Melbourne Central Business District (CBD).

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Annex A

Total Emissions for Dead End Scenarios

Table A-1 Total emissions in kilograms per year per SA2 region for Dead End scenario

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Abbotsford	64,146	10,658	12,732	2,927	5,454	444	438	844	146	627
Airport West	74,633	14,171	25,371	6,031	11,168	720	822	1,580	273	1,213
Albert Park	105,656	22,945	29,596	5,204	9,790	737	619	1,183	205	973
Alphington - Fairfield	54,552	8,858	9,816	2,341	4,361	382	371	714	124	521
Altona	141,162	29,038	42,655	8,751	16,327	1,157	1,117	2,142	370	1,688
Altona Meadows	64,285	13,322	21,806	4,668	8,683	574	593	1,139	197	897
Altona North	388,181	85,994	142,236	27,794	51,870	3,193	3,160	6,050	1,046	4,958
Ardeer - Albion	95,301	18,939	32,730	7,350	13,639	863	978	1,879	325	1,468
Armadale	38,931	5,965	6,396	1,616	3,006	266	266	512	89	369
Ascot Vale	89,664	16,109	20,480	4,556	8,491	682	653	1,257	217	946
Ashburton (Vic.)	55,061	8,968	9,965	2,363	4,402	385	373	718	124	525
Ashwood - Chadstone	174,096	33,721	51,035	10,813	20,144	1,376	1,374	2,639	456	2,062
Aspendale Gardens - Waterways	79,908	16,584	26,280	5,402	10,066	650	680	1,305	226	1,041
Bacchus Marsh	296,669	52,424	79,577	18,561	34,460	2,406	2,573	4,951	856	3,758
Balwyn	89,671	13,790	14,860	3,717	6,917	608	607	1,171	203	845
Balwyn North	178,131	31,452	47,708	11,188	20,766	1,448	1,575	3,030	524	2,300
Bayswater	220,034	38,298	44,649	9,618	17,973	1,483	1,409	2,711	469	2,041
Bayswater North	187,505	32,578	37,863	8,217	15,351	1,276	1,211	2,330	403	1,749
Beaconsfield - Officer	286,245	52,087	74,351	16,603	30,894	2,244	2,273	4,372	756	3,335
Beaumaris	38,696	6,149	6,718	1,645	3,062	271	265	511	88	371
Belgrave - Selby	264,715	48,792	58,674	11,891	22,263	1,784	1,650	3,170	548	2,439
Bentleigh - McKinnon	106,639	18,358	21,163	4,671	8,722	735	698	1,344	233	1,004
Bentleigh East (North)	91,233	14,836	16,567	3,880	7,234	621	606	1,169	202	857
Bentleigh East (South)	94,535	15,815	17,965	4,075	7,602	645	622	1,198	207	887
Berwick - North	220,458	40,043	61,530	14,266	26,485	1,847	1,984	3,817	660	2,909
Berwick - South	228,871	42,605	60,197	13,148	24,484	1,779	1,797	3,454	597	2,653
Blackburn	238,899	42,663	59,748	13,415	24,963	1,820	1,865	3,587	621	2,730
Blackburn South	72,312	12,225	13,971	3,134	5,850	495	474	913	158	678
Boronia	199,564	34,141	39,258	8,707	16,256	1,370	1,306	2,514	435	1,874
Box Hill	173,117	27,270	29,835	7,261	13,521	1,179	1,165	2,246	389	1,632
Box Hill North	150,587	28,112	42,681	9,431	17,541	1,204	1,257	2,416	418	1,865
Braeside	147,841	30,455	45,520	9,089	16,968	1,136	1,132	2,171	375	1,737
Braybrook	125,781	26,821	34,433	6,099	11,471	860	733	1,402	242	1,148
Brighton (Vic.)	116,441	21,571	25,790	5,311	9,938	819	749	1,440	249	1,100
Brighton East	180,037	33,009	39,568	8,067	15,100	1,215	1,127	2,165	375	1,662
Broadmeadows	137,594	22,755	34,636	8,813	16,313	1,160	1,335	2,572	445	1,918
Brunswick	98,954	15,907	17,269	4,305	8,010	732	703	1,356	235	977
Brunswick East	45,594	7,171	7,776	1,931	3,593	320	314	606	105	438
Brunswick West	132,316	26,241	49,918	11,547	21,389	1,300	1,502	2,887	499	2,249

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Bulleen	152,597	28,992	46,136	10,148	18,867	1,242	1,327	2,549	441	1,983
Bundoora - East	119,643	20,811	32,244	7,734	14,341	992	1,103	2,123	367	1,606
Bundoora - North	37,621	6,531	9,252	2,211	4,103	306	324	624	108	468
Bundoora - West	44,892	8,008	15,009	3,750	6,931	436	529	1,018	176	775
Bunyip - Garfield	331,059	86,120	150,203	26,676	49,949	2,853	2,523	4,805	830	4,204
Burnside	39,107	7,140	8,566	1,740	3,258	260	242	465	81	358
Burnside Heights	23,027	3,830	4,289	1,006	1,874	165	157	303	52	222
Burwood	150,755	24,710	27,791	6,418	11,970	1,018	992	1,912	331	1,409
Burwood East	72,471	11,711	13,072	3,060	5,705	487	478	921	159	676
Cairnlea	44,175	9,075	11,405	2,125	3,990	312	270	518	90	413
Camberwell	123,404	18,801	20,074	5,111	9,507	845	844	1,629	282	1,171
Campbellfield - Coolaroo	291,935	49,976	63,831	14,755	27,460	2,146	2,201	4,238	733	3,173
Carlton	54,129	9,409	10,786	2,424	4,524	393	367	707	122	525
Carlton North - Princes Hill	82,140	17,570	30,879	6,440	11,982	730	764	1,464	253	1,174
Carnegie	78,459	12,461	13,692	3,307	6,159	537	528	1,018	176	741
Caroline Springs	78,401	14,503	20,474	4,526	8,425	617	625	1,201	208	919
Carrum - Patterson Lakes	79,517	14,385	19,885	4,488	8,351	619	642	1,234	214	939
Carrum Downs	267,443	47,677	78,141	19,050	35,278	2,390	2,748	5,290	915	4,011
Caulfield - North	126,584	20,073	21,912	5,372	10,002	885	867	1,671	289	1,211
Caulfield - South	65,645	10,158	10,861	2,770	5,151	466	459	885	153	635
Chelsea - Bonbeach	68,057	12,293	14,537	3,058	5,719	473	439	844	146	640
Chelsea Heights	71,011	14,740	25,177	5,428	10,088	634	697	1,339	231	1,059
Cheltenham - Highett (East)	235,536	41,979	49,357	10,487	19,604	1,624	1,519	2,921	505	2,208
Cheltenham - Highett (West)	46,160	7,329	7,937	1,983	3,689	334	324	625	108	450
Chirnside Park	111,125	19,520	22,597	4,974	9,288	794	741	1,426	247	1,065
Clarinda - Oakleigh South	84,610	16,025	19,478	3,871	7,253	580	527	1,013	175	785
Clayton	308,048	58,906	72,080	14,106	26,440	2,087	1,894	3,635	629	2,836
Clayton South	159,817	34,602	44,700	7,810	14,695	1,093	923	1,764	305	1,456
Coburg	172,551	28,534	31,876	7,501	13,981	1,228	1,177	2,268	392	1,660
Coburg North	57,816	9,557	10,596	2,538	4,728	424	403	777	135	566
Collingwood	83,267	14,815	18,405	4,035	7,527	605	580	1,116	193	842
Craigieburn - Central	63,142	11,988	15,425	3,178	5,939	458	436	837	145	647
Craigieburn - North	112,456	22,726	34,912	7,414	13,804	938	978	1,877	325	1,474
Craigieburn - South	81,449	14,935	17,782	3,692	6,907	570	524	1,007	174	768
Craigieburn - West	65,093	12,089	14,429	2,992	5,598	466	424	814	141	621
Cranbourne	169,005	31,331	37,713	7,629	14,284	1,150	1,059	2,034	352	1,565
Cranbourne East	418,788	71,484	81,667	18,385	34,309	2,941	2,792	5,376	930	3,987
Cranbourne North	156,183	28,369	33,731	7,003	13,100	1,071	995	1,912	331	1,457
Cranbourne South	353,159	70,222	88,188	17,331	32,462	2,591	2,308	4,427	766	3,458
Cranbourne West	146,020	26,942	37,418	8,229	15,325	1,132	1,139	2,191	379	1,676
Croydon - East	120,810	19,896	22,373	5,177	9,655	827	802	1,545	267	1,137

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Croydon - West	153,181	26,898	31,501	6,728	12,576	1,034	979	1,882	326	1,421
Croydon Hills - Warranwood	112,105	19,348	22,316	4,928	9,202	777	736	1,417	245	1,058
Croydon South	29,613	4,946	5,579	1,287	2,401	208	199	383	66	282
Dandenong	1,072,101	236,201	328,824	59,452	111,561	7,801	6,950	13,289	2,298	10,965
Dandenong North	259,869	56,775	105,158	22,176	41,217	2,426	2,632	5,046	872	4,059
Deer Park - Derrimut	284,399	58,317	95,496	20,120	37,445	2,396	2,529	4,854	839	3,850
Delahey	63,262	11,683	14,012	2,861	5,355	435	400	769	133	589
Dingley Village	134,511	29,607	41,868	7,569	14,199	969	879	1,680	291	1,391
Docklands	64,473	14,499	20,446	3,658	6,867	477	416	795	137	661
Doncaster	234,072	44,114	71,135	15,888	29,518	1,947	2,087	4,011	694	3,107
Doncaster East (North)	72,773	11,240	12,119	3,030	5,639	498	495	955	165	689
Doncaster East (South)	98,935	17,287	24,329	5,553	10,327	749	777	1,494	258	1,132
Donvale - Park Orchards	247,135	48,759	76,813	16,521	30,743	2,066	2,116	4,063	703	3,176
Doreen	56,793	11,213	13,820	2,683	5,030	404	357	684	118	536
Doveton	85,265	18,248	32,971	7,009	13,027	787	846	1,623	281	1,297
Dromana	167,566	25,911	38,886	10,608	19,596	1,423	1,698	3,275	566	2,407
East Melbourne	108,111	22,665	34,837	6,876	12,842	852	803	1,538	266	1,237
Edithvale - Aspendale	65,577	12,595	15,444	3,010	5,642	444	402	772	134	603
Elsternwick	72,071	13,456	16,156	3,298	6,173	507	462	887	153	680
Eltham	177,469	27,691	29,977	7,452	13,870	1,229	1,213	2,340	405	1,690
Elwood	53,710	12,096	15,844	2,692	5,071	373	306	585	101	491
Emerald - Cockatoo	449,426	93,547	118,464	21,706	40,777	3,143	2,707	5,183	896	4,169
Endeavour Hills - North	108,581	21,946	34,914	7,380	13,738	906	935	1,794	310	1,415
Endeavour Hills - South	90,852	18,410	34,695	7,869	14,587	883	1,008	1,937	335	1,518
Epping - East	142,270	25,021	36,227	8,480	15,750	1,146	1,204	2,318	401	1,749
Epping - South	196,204	33,076	41,039	9,536	17,752	1,418	1,434	2,762	478	2,056
Epping - West	69,208	11,438	16,636	4,335	8,023	610	672	1,295	224	954
Essendon - Aberfeldie	147,765	25,388	33,197	8,068	14,984	1,212	1,226	2,361	408	1,745
Essendon Airport	76,283	14,804	33,370	8,296	15,310	870	1,122	2,159	373	1,670
Fawkner	91,449	14,666	19,848	5,110	9,467	728	806	1,554	269	1,144
Ferntree Gully (North)	120,212	21,061	24,536	5,308	9,918	828	780	1,501	260	1,128
Ferntree Gully (South) - Upper Ferntree Gully	139,164	24,476	28,564	6,159	11,509	960	903	1,738	301	1,307
Fitzroy	42,119	7,763	11,176	2,511	4,672	344	344	661	114	503
Fitzroy North	73,386	11,934	13,283	3,137	5,847	507	493	950	164	696
Flemington	33,370	6,718	9,974	2,057	3,837	265	262	504	87	397
Flemington Racecourse	21,153	3,953	4,769	962	1,802	145	133	256	44	197
Flinders	308,369	55,247	72,689	16,010	29,833	2,256	2,289	4,403	762	3,351
Footscray	140,835	28,492	36,969	7,083	13,275	1,009	902	1,730	299	1,372
Forest Hill	131,095	22,781	26,503	5,737	10,719	888	844	1,624	281	1,220
Frankston	226,396	35,678	40,541	10,043	18,680	1,595	1,610	3,105	537	2,258
Frankston North	132,340	23,103	38,428	9,594	17,753	1,209	1,393	2,683	464	2,022

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Frankston South	153,606	24,862	27,423	6,606	12,304	1,088	1,053	2,030	351	1,477
Gisborne	208,705	35,413	59,697	15,001	27,750	1,845	2,169	4,178	723	3,148
Gladstone Park - Westmeadows	163,337	28,313	43,970	11,018	20,398	1,450	1,657	3,192	552	2,394
Glen Iris - East	107,272	17,391	19,314	4,579	8,534	742	722	1,392	241	1,017
Glen Waverley - East	180,468	31,539	36,781	7,926	14,811	1,227	1,162	2,235	387	1,682
Glen Waverley - West	304,431	54,089	68,175	14,715	27,463	2,134	2,081	4,002	692	3,042
Glenroy	127,403	20,908	31,591	8,289	15,329	1,123	1,290	2,487	430	1,841
Gowanbrae	20,127	3,232	6,578	1,857	3,418	219	287	553	96	412
Greensborough	151,221	25,708	37,446	9,215	17,085	1,259	1,364	2,627	454	1,960
Greenvale - Bulla	663,734	157,653	242,881	43,615	81,743	5,211	4,742	9,053	1,565	7,655
Hadfield	35,782	5,979	6,734	1,559	2,908	253	242	466	81	343
Hallam	178,286	36,468	59,428	12,537	23,332	1,500	1,581	3,035	525	2,404
Hampton	78,862	13,050	14,676	3,399	6,338	546	527	1,016	176	747
Hampton Park - Lynbrook	177,915	35,182	49,675	10,070	18,806	1,335	1,290	2,476	428	1,950
Hastings - Somers	316,074	53,190	61,142	13,987	26,083	2,214	2,142	4,125	714	3,053
Hawthorn	152,329	28,161	40,907	8,794	16,384	1,145	1,142	2,194	379	1,696
Hawthorn East	78,497	11,986	12,809	3,257	6,059	539	538	1,037	180	746
Healesville - Yarra Glen	257,603	68,146	94,427	14,149	26,790	1,799	1,309	2,479	428	2,303
Heidelberg - Rosanna	191,003	35,082	53,303	12,206	22,672	1,590	1,689	3,248	562	2,481
Heidelberg West	117,390	20,491	23,540	5,268	9,832	854	796	1,532	265	1,138
Hillside	497,413	92,294	123,365	26,379	49,199	3,692	3,643	7,002	1,211	5,379
Hoppers Crossing - North	108,476	18,973	26,870	6,286	11,679	863	900	1,731	300	1,304
Hoppers Crossing - South	102,885	16,740	18,592	4,412	8,222	718	696	1,342	232	981
Hughesdale	46,486	7,759	8,744	2,020	3,767	327	313	603	104	444
Hurstbridge	22,460	4,475	5,551	1,063	1,994	158	139	267	46	210
Ivanhoe	55,605	8,930	9,714	2,410	4,485	407	392	756	131	546
Ivanhoe East - Eaglemont	91,366	17,451	30,515	6,990	12,963	818	925	1,778	307	1,379
Keilor	387,681	69,172	137,114	34,932	64,489	3,955	4,985	9,597	1,660	7,308
Keilor Downs	97,582	18,931	25,364	5,162	9,645	712	692	1,328	230	1,038
Keilor East	94,033	15,873	18,010	4,109	7,665	661	630	1,214	210	897
Kensington (Vic.)	30,008	6,016	7,962	1,608	3,007	233	212	408	71	318
Kew	220,253	35,944	51,176	12,840	23,798	1,753	1,940	3,739	647	2,776
Kew East	78,164	13,945	27,002	6,801	12,564	777	960	1,848	320	1,408
Keysborough	512,585	112,899	171,684	32,732	61,203	4,018	3,853	7,375	1,275	6,034
Kilsyth	79,747	13,034	14,376	3,473	6,467	579	555	1,070	185	778
Kinglake	67,106	16,293	21,900	3,534	6,671	476	370	704	122	614
Kings Park (Vic.)	33,503	6,321	7,636	1,540	2,883	234	213	409	71	315
Kingsbury	85,610	14,247	15,973	3,737	6,966	611	583	1,124	195	824
Knoxfield - Scoresby	333,084	68,539	111,612	23,229	43,255	2,759	2,876	5,518	954	4,393
Koo Wee Rup	212,451	51,300	71,579	12,085	22,751	1,593	1,296	2,470	427	2,116
Lalor	132,116	21,131	30,091	7,889	14,601	1,102	1,232	2,376	411	1,748

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Langwarrin	291,889	53,745	76,558	17,237	32,061	2,345	2,427	4,668	807	3,561
Laverton	435,640	92,591	152,168	30,927	57,633	3,631	3,709	7,109	1,229	5,719
Lilydale - Coldstream	476,287	83,661	97,363	21,138	39,489	3,318	3,116	5,996	1,037	4,499
Lynbrook - Lyndhurst	95,147	18,901	27,046	5,572	10,396	740	725	1,391	241	1,091
Lysterfield	57,414	11,771	14,889	2,717	5,105	387	339	648	112	522
Macedon	144,521	31,069	48,910	9,634	17,982	1,150	1,154	2,211	382	1,793
Malvern - Glen Iris	257,121	55,423	96,035	19,331	36,022	2,159	2,173	4,163	720	3,384
Malvern East	274,441	56,979	90,976	18,340	34,207	2,201	2,152	4,124	713	3,310
Maribyrnong	83,280	15,350	18,190	3,836	7,173	605	551	1,059	183	802
Meadow Heights	52,232	9,430	11,171	2,338	4,372	359	334	642	111	488
Melbourne	72,989	13,442	15,875	3,374	6,306	538	488	939	162	709
Melbourne Airport	193,268	36,235	62,229	14,511	26,900	1,743	1,959	3,768	652	2,900
Melton	439,943	81,001	105,271	22,709	42,360	3,290	3,183	6,119	1,059	4,667
Melton South	264,733	47,306	65,859	15,525	28,839	2,215	2,265	4,360	754	3,270
Melton West	90,084	16,564	26,793	6,348	11,769	814	882	1,696	293	1,289
Mentone	100,982	18,249	21,683	4,503	8,425	686	639	1,229	213	937
Mernda	147,659	27,628	36,128	7,560	14,117	1,074	1,033	1,985	343	1,530
Mickleham - Yuroke	389,403	86,749	137,988	27,096	50,575	3,270	3,228	6,181	1,069	5,025
Mill Park - North	113,862	19,916	25,071	5,669	10,561	845	830	1,597	276	1,197
Mill Park - South	85,192	15,423	22,239	5,125	9,523	697	729	1,403	243	1,064
Mitcham (Vic.)	109,755	18,189	20,484	4,732	8,825	759	732	1,410	244	1,039
Monbulk - Silvan	99,388	18,512	22,288	4,533	8,486	687	628	1,207	209	928
Montmorency - Briar Hill	101,467	16,406	18,101	4,356	8,115	716	694	1,338	232	974
Montrose	98,499	17,225	20,200	4,293	8,027	653	622	1,196	207	905
Moonee Ponds	63,534	10,626	11,849	2,872	5,346	486	459	885	153	643
Moorabbin - Heatherton	252,833	47,458	57,631	11,439	21,431	1,698	1,558	2,991	517	2,320
Moorabbin Airport	54,777	10,945	13,723	2,546	4,780	363	323	620	107	495
Mooroolbark	82,503	12,671	13,303	3,524	6,546	613	598	1,154	200	820
Mordialloc - Parkdale	153,226	29,231	35,652	7,033	13,178	1,050	952	1,827	316	1,420
Mornington	178,307	26,140	26,905	7,336	13,622	1,257	1,263	2,440	422	1,726
Mount Dandenong - Olinda	161,126	25,946	28,818	6,817	12,706	1,094	1,073	2,067	358	1,513
Mount Eliza	165,841	24,720	25,899	6,830	12,692	1,148	1,153	2,226	385	1,587
Mount Evelyn	80,064	14,766	17,760	3,595	6,732	539	499	959	166	738
Mount Martha	120,894	18,043	19,978	5,424	10,060	892	915	1,767	306	1,260
Mount Waverley - North	111,426	18,423	20,881	4,745	8,854	744	725	1,396	242	1,034
Mount Waverley - South	291,294	58,559	93,295	19,499	36,318	2,365	2,410	4,624	800	3,660
Mulgrave	360,893	76,821	118,794	23,355	43,610	2,840	2,790	5,346	924	4,324
Murrumbeena	45,524	7,177	7,849	1,912	3,561	311	307	592	102	430
Narre Warren - North East	62,554	10,500	12,002	2,763	5,152	441	425	819	142	605
Narre Warren - South West	191,915	35,486	56,516	12,948	24,036	1,615	1,770	3,404	589	2,616
Narre Warren North	174,857	34,661	42,962	8,233	15,443	1,218	1,079	2,069	358	1,629

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Narre Warren South (East)	22,348	3,971	4,573	1,024	1,911	169	155	298	52	221
Narre Warren South (West)	69,113	11,736	13,438	3,004	5,607	474	453	873	151	649
Newport	187,776	39,538	65,433	13,360	24,894	1,572	1,574	3,017	522	2,421
Niddrie - Essendon West	40,100	6,885	7,746	1,815	3,382	306	284	547	95	400
Noble Park - East	76,592	15,376	22,645	4,599	8,583	590	575	1,104	191	874
Noble Park - West	55,510	9,427	10,634	2,466	4,597	406	383	737	128	542
Noble Park North	100,864	21,063	32,613	6,541	12,205	802	795	1,524	263	1,222
None	111,412	23,039	30,867	5,805	10,882	792	719	1,378	238	1,109
North Melbourne	117,138	23,833	35,732	7,288	13,596	925	917	1,758	304	1,394
Northcote	55,477	9,282	10,319	2,467	4,595	415	391	754	131	550
Nunawading	187,296	35,552	50,112	10,529	19,637	1,401	1,386	2,662	460	2,069
Oakleigh - Huntingdale	260,994	47,957	57,522	11,720	21,938	1,767	1,635	3,142	544	2,412
Ormond - Glen Huntly	69,892	10,895	11,737	2,950	5,488	492	484	933	161	672
Pakenham - North	77,741	13,329	15,225	3,433	6,406	553	522	1,006	174	745
Pakenham - South	300,194	58,891	90,363	19,041	35,472	2,401	2,388	4,585	793	3,595
Panton Hill - St Andrews	167,696	39,365	52,370	8,607	16,233	1,167	932	1,776	307	1,525
Parkville	107,960	21,925	35,457	7,513	13,982	914	944	1,812	313	1,430
Pascoe Vale	92,020	15,448	17,349	4,050	7,549	666	632	1,218	211	893
Pascoe Vale South	115,861	22,536	37,700	8,456	15,701	1,025	1,111	2,135	369	1,658
Pearcedale - Tooradin	214,012	47,476	64,091	11,343	21,316	1,528	1,328	2,538	439	2,103
Plenty - Yarrambat	183,026	34,979	45,282	9,258	17,304	1,322	1,260	2,420	419	1,878
Point Cook - East	23,069	4,357	5,212	1,081	2,022	171	153	294	51	224
Point Cook - North	115,891	21,176	29,785	6,715	12,492	927	943	1,813	314	1,379
Point Cook - South	68,109	11,655	13,180	3,046	5,678	503	472	908	157	668
Point Nepean	153,771	24,158	26,021	6,556	12,196	1,105	1,077	2,079	360	1,496
Port Melbourne	47,243	11,110	14,666	2,480	4,672	350	278	530	92	446
Port Melbourne Industrial	195,512	51,754	100,915	19,001	35,445	1,882	1,880	3,588	620	3,086
Prahran - Windsor	61,409	9,625	10,513	2,564	4,775	415	412	795	137	577
Preston - East	242,901	40,279	45,149	10,548	19,662	1,716	1,646	3,172	549	2,327
Preston - West	76,316	12,693	14,280	3,310	6,172	535	514	989	171	728
Research - North Warrandyte	158,747	31,582	39,458	7,383	13,858	1,063	946	1,814	314	1,444
Reservoir - East	128,462	21,585	24,254	5,660	10,552	931	882	1,700	294	1,247
Reservoir - West	114,566	19,038	21,161	5,048	9,404	843	800	1,541	267	1,124
Richmond (Vic.)	267,950	55,680	87,011	17,466	32,591	2,144	2,062	3,952	683	3,165
Riddells Creek	35,568	6,412	7,645	1,572	2,942	236	221	425	74	325
Ringwood	357,762	68,270	103,736	22,562	41,984	2,870	2,985	5,734	992	4,452
Ringwood East	171,087	29,880	34,789	7,529	14,067	1,171	1,107	2,130	369	1,601
Ringwood North	40,142	7,478	8,927	1,852	3,465	289	262	504	87	384
Rockbank - Mount Cottrell	972,787	188,461	293,806	64,096	119,221	8,075	8,406	16,148	2,793	12,557
Romsey	193,500	36,443	43,770	8,973	16,793	1,392	1,257	2,415	418	1,848
Rosebud - McCrae	157,732	24,164	31,096	8,386	15,525	1,242	1,374	2,652	459	1,926

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Rowville - Central	107,914	22,791	29,287	5,248	9,864	740	638	1,221	211	995
Rowville - North	86,669	17,187	21,413	4,034	7,571	585	521	999	173	792
Rowville - South	110,389	24,220	36,566	6,956	13,010	857	820	1,570	271	1,285
Roxburgh Park - Somerton	153,760	27,875	33,080	6,900	12,906	1,060	984	1,891	327	1,439
Sandringham - Black Rock	64,535	9,950	10,706	2,689	5,003	443	440	850	147	612
Seabrook	11,138	2,094	2,499	521	974	82	74	142	25	108
Seaford (Vic.)	166,759	26,650	41,117	10,900	20,147	1,438	1,692	3,262	564	2,414
Seddon - Kingsville	49,975	9,970	12,371	2,365	4,436	351	310	594	103	468
Skye - Sandhurst	84,687	17,077	24,208	4,984	9,301	678	649	1,246	216	976
Somerville	579,241	94,530	133,330	33,866	62,747	4,704	5,200	10,022	1,734	7,416
South Melbourne	83,580	17,416	23,463	4,574	8,562	646	582	1,116	193	885
South Morang (North)	50,739	8,852	10,293	2,265	4,230	357	338	650	112	486
South Morang (South)	68,621	11,390	12,865	2,952	5,506	470	454	875	151	646
South Yarra - East	117,036	19,808	22,595	5,096	9,510	810	774	1,490	258	1,105
South Yarra - West	30,317	5,044	5,746	1,292	2,412	201	196	377	65	280
Southbank	159,893	39,481	69,818	12,903	24,116	1,378	1,289	2,459	425	2,101
Springvale	242,909	49,544	62,426	11,500	21,599	1,654	1,449	2,774	480	2,225
Springvale South	81,169	16,945	21,591	3,880	7,293	549	475	909	157	739
St Albans - North	69,887	12,714	15,040	3,169	5,926	494	455	875	151	663
St Albans - South	53,383	10,389	12,763	2,485	4,659	371	332	637	110	498
St Kilda	106,574	22,847	29,275	5,229	9,831	749	634	1,212	210	988
St Kilda East	44,789	8,033	9,422	2,019	3,773	318	295	566	98	427
Strathmore	136,866	26,133	45,844	10,732	19,887	1,287	1,449	2,786	482	2,145
Sunbury	279,418	71,316	97,685	15,071	28,503	1,955	1,465	2,779	480	2,515
Sunbury - South	643,895	134,207	226,234	48,385	89,965	5,726	6,152	11,807	2,042	9,348
Sunshine	77,849	15,451	19,152	3,662	6,868	542	480	921	159	725
Sunshine North	168,049	34,389	53,459	11,208	20,873	1,389	1,460	2,803	485	2,215
Sunshine West	133,807	28,327	47,623	9,959	18,535	1,176	1,220	2,340	405	1,865
Surrey Hills (East) - Mont Albert	104,768	16,793	18,618	4,416	8,230	708	696	1,342	232	981
Surrey Hills (West) - Canterbury	163,199	25,095	26,899	6,808	12,666	1,129	1,121	2,163	374	1,556
Sydenham	74,661	13,077	15,247	3,290	6,147	511	483	929	161	698
Tarneit	467,584	89,823	118,944	24,247	45,315	3,413	3,202	6,148	1,063	4,782
Taylors Hill	30,494	4,898	5,369	1,308	2,436	217	210	406	70	294
Taylors Lakes	242,935	49,471	86,754	19,047	35,370	2,200	2,435	4,676	808	3,683
Templestowe	197,978	31,755	35,215	8,351	15,563	1,339	1,316	2,537	439	1,856
Templestowe Lower	110,858	17,445	19,091	4,641	8,643	752	744	1,435	248	1,043
The Basin	35,771	6,243	7,270	1,573	2,938	244	231	445	77	334
Thomastown	383,112	62,916	107,424	28,318	52,299	3,530	4,271	8,232	1,424	6,145
Thornbury	67,945	11,174	12,345	2,977	5,545	498	475	916	159	666
Toorak	98,478	17,729	23,084	4,955	9,246	704	681	1,310	227	1,000
Truganina	295,304	56,730	69,534	13,559	25,415	2,006	1,815	3,483	603	2,721

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Tullamarine	130,777	23,685	47,262	12,003	22,161	1,363	1,703	3,279	567	2,499
Upwey - Tecoma	37,953	6,228	6,968	1,629	3,037	263	254	490	85	360
Vermont	78,390	13,329	15,352	3,397	6,342	529	508	978	169	730
Vermont South	126,134	22,265	26,121	5,564	10,401	856	807	1,553	269	1,173
Viewbank - Yallambie	125,999	22,804	34,977	8,218	15,251	1,081	1,153	2,219	384	1,683
Wallan	679,065	148,412	246,501	49,673	92,593	5,883	5,796	11,105	1,920	8,963
Wandin - Seville	102,169	20,803	26,177	4,837	9,083	698	611	1,171	203	938
Wantirna	252,516	49,208	76,201	16,251	30,255	2,015	2,096	4,025	696	3,154
Wantirna South	298,648	57,490	86,997	18,620	34,671	2,356	2,429	4,666	807	3,641
Warrandyte - Wonga Park	170,299	29,489	33,782	7,595	14,173	1,228	1,151	2,217	384	1,644
Watsonia	78,061	14,205	26,520	6,560	12,128	766	918	1,767	306	1,348
Wattle Glen - Diamond Creek	146,144	26,715	31,764	6,610	12,363	1,020	941	1,808	313	1,376
Werribee - East	80,950	13,292	14,749	3,518	6,553	581	557	1,074	186	784
Werribee - South	517,479	110,960	184,858	38,015	70,805	4,487	4,583	8,786	1,519	7,044
Werribee - West	426,049	96,034	151,836	29,401	54,922	3,554	3,431	6,567	1,135	5,369
West Footscray - Tottenham	82,821	17,414	22,233	3,985	7,491	565	486	929	161	756
West Melbourne	112,191	26,687	44,845	8,339	15,589	925	888	1,697	293	1,431
Wheelers Hill	191,485	38,849	61,229	12,710	23,680	1,552	1,583	3,036	525	2,407
Whittlesea	589,594	160,891	235,556	36,326	68,620	4,398	3,324	6,296	1,088	5,835
Williamstown	56,821	9,468	10,671	2,465	4,597	397	381	735	127	541
Wollert	332,505	61,619	90,181	20,443	38,002	2,752	2,850	5,482	948	4,182
Wyndham Vale	405,938	82,570	116,952	23,093	43,171	3,058	2,863	5,489	949	4,365
Yarra - North	174,848	30,822	51,326	12,471	23,095	1,530	1,773	3,413	590	2,593
Yarra Valley	446,266	139,173	202,328	26,830	51,074	3,070	1,887	3,523	608	3,834
Yarraville	105,089	22,878	36,303	7,060	13,185	843	809	1,549	268	1,263
Grand Total	49,408,691	9,516,533	13,432,156	2,829,720	5,276,784	380,284	376,322	722,737	49,408,691	9,516,533

Table A-2 Total emissions in kilograms per year per SA2 region for Slow Lane scenario

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Abbotsford	19,084	3,070	7,058	2,266	4,311	250	56	101	18	96
Airport West	59,568	9,543	20,959	4,730	8,540	456	167	309	54	295
Albert Park	56,872	13,616	22,977	5,274	10,129	534	201	372	65	387
Alphington - Fairfield	22,717	3,450	5,657	2,029	3,885	221	107	203	35	159
Altona	102,310	19,088	33,451	7,229	13,383	732	396	747	129	669
Altona Meadows	54,358	9,665	18,611	3,917	7,156	391	184	344	60	319
Altona North	236,492	50,296	119,641	23,719	43,925	2,288	355	599	105	975
Ardeer - Albion	61,878	11,804	27,687	6,123	11,234	573	101	175	31	247
Armadale	11,681	1,655	3,119	1,221	2,350	135	50	93	16	74
Ascot Vale	52,700	8,780	13,544	3,617	6,799	378	256	489	85	391
Ashburton (Vic.)	18,344	2,921	4,945	1,734	3,337	185	82	155	27	125
Ashwood - Chadstone	88,888	16,341	38,126	8,554	15,907	835	213	386	67	425
Aspendale Gardens - Waterways	37,857	8,089	18,767	4,277	7,981	385	46	74	13	144
Bacchus Marsh	148,054	23,258	56,086	14,686	27,378	1,401	363	662	116	665
Balwyn	22,841	3,250	6,710	2,717	5,240	295	87	162	28	132
Balwyn North	88,507	14,080	34,244	9,011	16,664	884	193	347	61	371
Bayswater	59,012	12,464	24,721	7,928	15,578	752	168	301	53	329
Bayswater North	54,173	11,399	21,423	6,845	13,481	631	174	318	55	326
Beaconsfield - Officer	143,961	24,662	53,898	13,722	25,778	1,311	427	789	137	759
Beaumaris	13,139	1,963	3,087	1,276	2,465	122	64	123	21	95
Belgrave - Selby	68,929	15,675	30,040	9,349	18,565	835	194	349	61	398
Bentleigh - McKinnon	36,068	6,703	12,062	3,902	7,571	391	139	258	45	232
Bentleigh East (North)	24,919	4,058	8,224	3,141	6,137	319	88	163	28	143
Bentleigh East (South)	26,557	4,826	9,333	3,242	6,329	321	93	171	30	158
Berwick - North	125,501	20,715	46,415	11,570	21,433	1,128	342	629	110	617
Berwick - South	107,771	19,231	40,506	10,567	19,976	1,006	315	580	101	572
Blackburn	99,302	17,948	41,377	10,799	20,321	1,045	243	438	76	474
Blackburn South	21,997	4,047	7,578	2,487	4,817	254	80	148	26	135
Boronia	57,753	10,838	19,615	6,658	13,003	633	218	406	71	368
Box Hill	47,044	7,147	14,042	5,383	10,416	575	183	340	59	283
Box Hill North	71,278	13,148	31,328	7,488	13,951	707	151	269	47	318
Braeside	64,382	14,548	32,911	7,678	14,510	699	88	143	25	265
Braybrook	49,322	13,010	23,080	5,209	10,034	510	142	255	44	313
Brighton (Vic.)	47,747	8,931	14,475	4,308	8,272	438	209	394	68	339
Brighton East	55,069	12,177	23,767	6,964	13,565	686	154	276	48	311
Broadmeadows	68,687	10,421	24,937	7,134	13,224	702	154	276	48	285
Brunswick	57,701	8,272	9,940	3,348	6,322	384	338	650	113	477
Brunswick East	18,495	2,622	3,990	1,511	2,894	166	94	180	31	136
Brunswick West	107,750	17,726	43,110	9,438	17,021	892	225	407	71	452
Bulleen	75,161	14,160	36,179	8,454	15,683	794	104	172	30	274
Bundoora - East	56,677	9,491	23,373	5,806	10,690	556	113	201	35	232
Bundoora - North	20,685	3,346	6,469	1,766	3,275	171	76	142	25	123
Bundoora - West	30,011	4,806	12,392	2,943	5,324	273	50	88	15	109
Bunyip - Garfield	268,632	59,969	133,712	22,707	41,707	2,070	594	1,071	186	1,377
Burnside	9,726	2,342	4,909	1,445	2,820	139	18	31	5	47
Burnside Heights	9,782	1,498	2,076	755	1,447	76	52	100	17	76
Burwood	35,372	6,069	12,431	4,463	8,675	462	117	215	38	198

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Burwood East	15,536	2,734	5,797	2,069	4,015	213	47	85	15	83
Cairnlea	19,250	4,359	6,890	1,697	3,268	160	79	148	26	140
Camberwell	35,281	4,759	9,264	3,859	7,431	423	149	279	49	217
Campbellfield - Coolaroo	107,358	18,666	38,755	11,987	22,855	1,174	315	576	101	561
Carlton	39,835	6,061	7,945	2,368	4,469	287	221	424	73	319
Carlton North - Princes Hill	66,433	11,961	27,060	5,581	10,183	551	174	320	56	333
Carnegie	28,646	4,429	8,567	3,205	6,190	344	112	209	36	174
Caroline Springs	42,641	7,343	14,762	3,836	7,154	373	137	255	44	238
Carrum - Patterson Lakes	33,714	6,183	11,944	3,224	6,046	308	105	194	34	189
Carrum Downs	151,906	25,328	55,432	14,498	26,577	1,323	388	711	124	720
Caulfield - North	51,957	7,882	12,600	4,463	8,549	490	250	475	82	370
Caulfield - South	24,957	3,418	4,980	1,965	3,748	215	132	253	44	187
Chelsea - Bonbeach	22,123	4,282	6,872	1,950	3,735	199	96	182	31	158
Chelsea Heights	42,896	8,346	18,451	4,172	7,683	385	81	143	25	186
Cheltenham - Highett (East)	80,842	15,498	26,948	8,230	15,878	830	319	596	104	537
Cheltenham - Highett (West)	21,046	3,053	4,064	1,519	2,898	159	116	223	39	166
Chirnside Park	47,430	8,824	13,577	4,327	8,382	401	220	417	72	350
Clarinda - Oakleigh South	26,888	6,163	10,937	2,954	5,747	282	90	164	29	172
Clayton	96,314	22,624	42,448	11,500	22,355	1,122	275	496	86	570
Clayton South	57,715	15,778	27,623	6,177	11,987	575	164	296	51	372
Coburg	79,537	12,513	18,715	6,174	11,788	679	400	762	132	593
Coburg North	30,733	4,644	6,034	1,972	3,733	220	171	329	57	247
Collingwood	41,936	7,005	12,258	3,457	6,537	386	178	337	58	280
Craigieburn - Central	25,623	5,224	9,672	2,590	4,947	251	84	155	27	155
Craigieburn - North	66,092	12,734	25,442	5,800	10,737	554	178	327	57	347
Craigieburn - South	29,911	5,667	9,377	2,828	5,422	284	127	239	41	208
Craigieburn - West	28,772	5,547	8,170	2,338	4,485	222	138	261	45	220
Cranbourne	55,806	12,505	23,270	6,855	13,437	638	172	313	55	337
Cranbourne East	154,264	26,200	41,824	14,738	28,612	1,414	715	1,354	235	1,104
Cranbourne North	51,887	10,732	19,839	6,216	12,180	587	175	322	56	320
Cranbourne South	177,456	37,190	56,038	14,110	26,954	1,292	805	1,525	264	1,349
Cranbourne West	71,046	13,019	25,642	6,862	12,969	627	239	444	77	418
Croydon - East	34,810	5,860	10,804	4,080	7,976	393	138	257	45	220
Croydon - West	45,025	9,516	18,696	6,105	12,043	565	131	236	41	254
Croydon Hills - Warranwood	37,978	7,244	12,499	4,208	8,226	386	152	284	49	254
Croydon South	10,191	1,738	2,776	964	1,870	94	47	89	15	73
Dandenong	469,864	122,151	232,537	50,319	96,138	4,551	1,128	2,007	349	2,709
Dandenong North	194,270	37,266	93,529	18,473	33,557	1,678	309	536	94	773
Deer Park - Derrimut	164,042	33,095	77,093	16,741	31,074	1,567	280	483	85	691
Delahey	20,479	4,153	7,314	2,226	4,321	214	76	142	25	134
Dingley Village	52,247	14,103	28,841	6,269	12,004	566	79	130	23	254
Docklands	39,190	8,966	16,351	3,519	6,631	355	125	231	40	246
Doncaster	125,075	22,725	57,070	13,345	24,671	1,256	222	388	68	504
Doncaster East (North)	18,905	2,768	5,203	2,298	4,495	219	79	148	26	119
Doncaster East (South)	38,558	7,111	17,436	4,569	8,612	428	78	136	24	166
Donvale - Park Orchards	144,003	27,539	59,892	13,307	24,656	1,200	399	734	128	767
Doreen	24,373	5,230	8,034	2,189	4,232	195	107	201	35	182
Doveton	66,321	12,510	30,737	5,997	10,910	561	120	212	37	278
Dromana	67,093	9,579	22,547	7,893	14,766	697	147	263	46	266

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
East Melbourne	75,388	13,792	28,490	6,131	11,373	642	251	467	81	441
Edithvale - Aspendale	17,485	4,120	7,579	1,982	3,821	196	52	95	16	107
Elsternwick	35,006	7,028	11,677	3,202	6,167	330	143	269	47	243
Eltham	53,702	7,590	13,527	5,814	11,309	583	241	455	79	354
Elwood	28,531	6,783	10,886	2,389	4,592	241	111	207	36	205
Emerald - Cockatoo	177,294	43,357	70,174	17,422	33,932	1,519	665	1,237	214	1,264
Endeavour Hills - North	64,293	12,374	27,733	6,162	11,461	571	149	269	47	309
Endeavour Hills - South	72,713	12,606	30,886	6,470	11,717	610	140	249	43	299
Epping - East	72,079	11,904	25,396	7,038	13,133	647	230	428	75	393
Epping - South	66,924	11,877	24,104	7,484	14,367	721	210	386	67	368
Epping - West	49,222	7,255	12,404	3,348	6,113	336	212	404	70	322
Essendon - Aberfeldie	111,849	16,995	24,298	6,574	12,131	705	575	1,103	191	846
Essendon Airport	73,029	11,702	31,275	6,881	12,275	628	92	156	27	232
Fawkner	41,552	6,076	12,718	4,162	7,809	420	130	240	42	212
Ferntree Gully (North)	36,462	6,988	12,409	4,022	7,851	388	140	260	45	237
Ferntree Gully (South) - Upper Ferntree Gully	44,652	8,691	15,062	4,897	9,574	455	176	328	57	297
Fitzroy	29,787	4,722	8,252	1,983	3,657	212	131	250	43	202
Fitzroy North	27,994	4,222	7,476	2,609	4,978	301	123	232	40	185
Flemington	21,856	4,070	8,013	1,875	3,488	189	71	132	23	127
Flemington Racecourse	8,257	1,757	3,149	851	1,632	89	29	53	9	53
Flinders	98,767	20,292	42,384	12,985	25,131	1,104	231	410	72	488
Footscray	75,493	16,115	27,460	6,468	12,296	667	289	539	94	514
Forest Hill	37,297	7,624	14,903	4,630	9,007	463	114	207	36	214
Frankston	66,556	9,805	18,868	7,878	15,332	742	262	491	85	401
Frankston North	80,433	12,872	27,994	7,339	13,387	653	231	429	75	405
Frankston South	55,258	8,369	13,017	5,363	10,439	503	272	518	90	401
Gisborne	119,023	16,496	44,268	11,975	22,020	1,187	195	340	60	392
Gladstone Park - Westmeadows	101,573	16,392	31,916	8,484	15,570	823	321	598	104	545
Glen Iris - East	35,382	5,615	10,062	3,596	6,924	385	150	281	49	231
Glen Waverley - East	50,145	10,015	18,933	5,973	11,640	588	168	308	54	302
Glen Waverley - West	91,967	18,489	40,386	11,237	21,582	1,106	216	382	67	450
Glenroy	77,438	11,103	21,619	6,246	11,428	630	268	502	87	424
Gowanbrae	17,699	2,447	5,670	1,499	2,677	143	42	76	13	73
Greensborough	87,171	13,447	26,702	7,238	13,359	708	311	585	102	502
Greenvale - Bulla	358,890	94,344	187,757	36,421	68,762	3,121	760	1,340	233	1,974
Hadfield	16,377	2,560	3,981	1,390	2,669	148	80	152	26	119
Hallam	104,648	20,738	49,078	10,550	19,474	996	179	310	54	437
Hampton	24,916	4,078	7,116	2,615	5,067	261	107	201	35	166
Hampton Park - Lynbrook	81,782	17,095	36,955	8,674	16,387	818	197	354	62	418
Hastings - Somers	100,709	17,762	30,066	11,207	21,946	987	426	800	139	681
Hawthorn	66,367	11,505	29,687	7,398	13,824	761	133	233	41	275
Hawthorn East	23,723	3,216	5,888	2,358	4,514	266	106	200	35	154
Healesville - Yarra Glen	125,370	40,459	65,951	12,258	23,765	991	355	641	111	891
Heidelberg - Rosanna	119,998	20,335	41,723	10,324	19,116	1,023	388	722	125	667
Heidelberg West	60,430	10,356	14,631	4,270	8,134	459	311	593	103	471
Hillside	195,422	36,614	73,223	20,694	39,341	1,943	596	1,095	191	1,085
Hoppers Crossing - North	55,493	8,708	18,452	4,976	9,283	489	177	330	57	296
Hoppers Crossing - South	34,824	5,299	8,976	3,580	6,938	353	159	301	52	238
Hughesdale	18,340	3,084	5,291	1,796	3,475	187	79	149	26	124

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Hurstbridge	8,736	1,954	3,100	838	1,630	74	36	67	12	63
Ivanhoe	29,446	4,207	5,317	1,825	3,446	210	168	323	56	238
Ivanhoe East - Eaglemont	55,365	9,746	24,922	5,714	10,457	542	86	147	26	205
Keilor	278,020	43,877	114,314	27,209	49,160	2,547	384	653	115	908
Keilor Downs	39,014	8,734	17,275	4,375	8,364	414	95	170	30	207
Keilor East	36,041	6,099	9,551	3,213	6,189	322	170	323	56	262
Kensington (Vic.)	22,910	4,167	6,112	1,431	2,675	152	111	212	37	175
Kew	102,222	14,450	35,043	10,361	19,162	1,094	248	449	79	432
Kew East	60,138	8,587	22,803	5,651	10,159	560	90	155	27	192
Keysborough	258,512	62,532	130,619	27,642	52,102	2,416	512	896	156	1,307
Kilsyth	35,373	5,399	7,122	2,687	5,141	257	195	374	65	282
Kinglake	34,836	10,019	15,758	3,242	6,267	261	121	224	39	258
Kings Park (Vic.)	12,617	2,594	4,227	1,208	2,338	114	52	98	17	89
Kingsbury	35,640	5,851	8,246	2,541	4,838	275	185	354	61	277
Knoxfield - Scoresby	172,814	37,460	89,862	19,600	36,524	1,709	248	414	73	708
Koo Wee Rup	126,909	32,574	52,239	10,131	19,242	889	478	893	154	932
Lalor	73,287	10,509	21,044	6,203	11,444	618	258	485	84	407
Langwarrin	145,381	27,159	52,163	13,755	25,857	1,234	482	898	156	856
Laverton	269,574	53,569	126,089	26,481	49,075	2,543	464	805	141	1,131
Lilydale - Coldstream	168,624	33,789	56,497	18,040	35,263	1,612	685	1,282	223	1,162
Lynbrook - Lyndhurst	51,498	10,447	20,631	4,879	9,171	462	156	287	50	296
Lysterfield	16,597	4,646	8,559	2,166	4,288	186	39	68	12	98
Macedon	82,859	16,415	38,808	8,320	15,281	882	110	179	32	306
Malvern - Glen Iris	156,657	30,389	80,426	16,004	29,399	1,537	206	342	60	575
Malvern East	161,312	31,286	75,364	16,010	29,732	1,559	332	591	103	730
Maribyrnong	43,178	7,922	10,897	2,904	5,517	303	223	425	74	344
Meadow Heights	16,640	3,459	6,156	1,887	3,683	176	60	111	19	107
Melbourne	63,641	10,311	13,403	3,683	6,934	437	351	673	117	516
Melbourne Airport	112,996	20,586	49,312	11,277	20,725	979	248	447	78	513
Melton	204,843	37,086	65,891	18,197	34,480	1,744	792	1,488	258	1,319
Melton South	186,240	29,410	47,024	12,519	23,059	1,240	852	1,625	281	1,300
Melton West	67,820	10,499	20,600	5,058	9,205	488	246	464	80	396
Mentone	30,472	6,360	11,990	3,628	7,047	357	98	179	31	183
Mernda	58,617	12,135	23,423	6,382	12,244	578	182	334	58	344
Mickleham - Yuroke	242,325	52,805	105,369	21,605	40,099	1,949	634	1,157	201	1,332
Mill Park - North	53,299	9,160	16,003	4,717	8,955	458	222	420	73	355
Mill Park - South	50,125	8,462	15,963	4,181	7,751	404	184	345	60	304
Mitcham (Vic.)	36,377	6,230	11,103	3,795	7,322	392	149	278	48	237
Monbulk - Silvan	29,524	6,475	10,974	3,239	6,368	288	110	205	36	200
Montmorency - Briar Hill	40,906	6,340	9,859	3,499	6,726	370	200	381	66	297
Montrose	22,383	5,508	11,549	3,686	7,358	322	40	66	12	107
Moonee Ponds	45,292	6,800	7,657	2,295	4,294	264	272	524	91	386
Moorabbin - Heatherton	71,836	17,382	33,993	9,498	18,585	905	175	308	54	396
Moorabbin Airport	14,172	3,920	7,924	2,027	3,943	194	22	36	6	70
Mooroolbark	42,801	5,648	6,488	2,757	5,215	285	258	497	86	355
Mordialloc - Parkdale	49,897	11,001	19,529	5,342	10,331	524	172	317	55	321
Mornington	59,476	7,089	10,472	5,870	11,402	541	321	615	107	439
Mount Dandenong - Olinda	32,344	5,113	10,234	4,509	8,976	406	119	221	39	189
Mount Eliza	46,473	5,673	9,986	5,293	10,371	501	223	423	74	311

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Mount Evelyn	23,157	5,698	10,815	3,120	6,164	275	60	107	19	134
Mount Martha	48,732	6,226	9,320	4,295	8,245	399	253	485	84	355
Mount Waverley - North	22,659	4,173	9,194	3,265	6,382	331	59	105	19	112
Mount Waverley - South	153,206	29,334	71,063	15,311	28,376	1,450	286	503	88	654
Mulgrave	192,291	42,498	96,389	20,492	38,329	1,917	317	541	95	845
Murrumbeena	13,926	2,095	4,242	1,676	3,265	176	52	97	17	81
Narre Warren - North East	19,829	3,199	5,171	1,991	3,888	184	92	173	30	139
Narre Warren - South West	106,227	17,934	43,531	10,707	19,835	1,035	209	371	65	434
Narre Warren North	61,320	14,330	23,824	6,314	12,372	564	227	421	73	424
Narre Warren South (East)	12,652	2,050	2,462	761	1,435	77	73	141	24	107
Narre Warren South (West)	20,709	3,611	6,643	2,469	4,859	233	80	150	26	131
Newport	121,801	23,042	54,464	10,925	20,082	1,075	266	478	83	563
Niddrie - Essendon West	27,651	4,368	5,023	1,505	2,823	160	164	316	55	237
Noble Park - East	37,426	7,690	16,902	3,876	7,271	356	94	170	30	194
Noble Park - West	25,788	3,965	5,066	1,683	3,193	178	145	278	48	209
Noble Park North	50,516	11,071	25,239	5,463	10,204	485	93	163	28	233
None	52,138	11,507	22,744	5,581	10,570	567	134	240	42	282
North Melbourne	76,450	14,498	30,278	7,159	13,318	742	214	391	68	406
Northcote	41,238	6,107	6,988	2,102	3,940	251	247	475	82	349
Nunawading	77,881	15,887	35,892	8,901	16,857	846	169	299	52	370
Oakleigh - Huntingdale	82,385	18,190	35,445	10,262	19,965	1,024	231	415	72	467
Ormond - Glen Huntly	26,198	3,624	5,741	2,302	4,420	249	131	249	43	187
Pakenham - North	30,963	5,411	8,195	2,787	5,411	259	149	284	49	231
Pakenham - South	166,257	30,666	70,579	15,727	29,339	1,469	431	789	137	836
Panton Hill - St Andrews	68,228	19,610	32,360	6,871	13,372	581	214	391	68	476
Parkville	76,231	13,820	29,395	6,398	11,754	640	219	404	70	404
Pascoe Vale	45,328	6,867	9,211	3,050	5,774	338	248	475	82	359
Pascoe Vale South	82,466	14,217	31,170	7,046	12,905	683	228	420	73	418
Pearcedale - Tooradin	87,391	24,369	42,457	9,332	18,137	789	237	427	74	557
Plenty - Yarrambat	66,719	14,374	26,704	7,340	14,205	661	204	373	65	395
Point Cook - East	14,939	2,723	3,589	974	1,848	97	80	153	26	122
Point Cook - North	64,332	10,747	20,302	5,249	9,780	520	236	442	77	388
Point Cook - South	36,925	5,942	7,585	2,542	4,827	248	206	396	68	302
Point Nepean	63,803	9,203	12,498	5,304	10,220	495	349	669	116	499
Port Melbourne	35,137	7,832	10,819	2,143	4,061	218	171	325	56	287
Port Melbourne Industrial	189,851	39,282	95,833	16,605	30,085	1,557	288	495	86	778
Prahran - Windsor	17,711	2,638	5,511	2,141	4,131	233	64	119	21	100
Preston - East	104,919	16,870	26,244	8,696	16,666	940	508	964	167	764
Preston - West	34,075	5,490	8,834	2,931	5,616	320	160	303	53	242
Research - North Warrandyte	41,533	11,620	22,226	5,731	11,311	506	84	142	25	230
Reservoir - East	72,730	11,470	15,282	4,678	8,866	527	397	760	132	580
Reservoir - West	61,447	9,389	12,284	3,960	7,477	442	341	653	113	493
Richmond (Vic.)	171,368	31,628	69,438	14,724	27,238	1,510	496	915	159	921
Riddells Creek	6,625	1,524	3,305	1,134	2,250	99	12	20	4	30
Ringwood	171,541	33,746	76,595	18,403	34,489	1,664	379	678	118	811
Ringwood East	52,795	10,377	18,830	5,994	11,706	580	192	356	62	334
Ringwood North	18,213	3,554	5,158	1,447	2,775	136	88	167	29	141
Rockbank - Mount Cottrell	568,118	100,616	221,124	51,881	95,928	4,955	1,496	2,741	477	2,824
Romsey	86,269	16,308	23,491	7,020	13,480	646	424	807	140	670

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Rosebud - McCrae	64,798	8,934	16,487	6,352	11,974	585	250	471	82	379
Rowville - Central	38,099	10,288	18,384	4,384	8,552	392	104	186	32	238
Rowville - North	22,488	5,787	10,906	2,929	5,753	265	56	99	17	130
Rowville - South	50,961	12,618	26,609	5,533	10,412	486	93	160	28	252
Roxburgh Park - Somerton	49,477	10,046	17,783	5,370	10,414	520	183	340	59	321
Sandringham - Black Rock	18,446	2,558	4,563	2,024	3,928	201	83	158	27	122
Seabrook	8,476	1,536	2,016	536	1,017	55	45	87	15	69
Seaford (Vic.)	77,409	10,887	25,182	7,755	14,247	730	192	350	61	332
Seddon - Kingsville	23,369	4,985	7,911	1,941	3,708	200	98	185	32	169
Skye - Sandhurst	51,064	10,140	17,456	4,059	7,596	367	204	384	67	349
Somerville	258,017	39,204	82,177	26,458	49,814	2,360	839	1,562	272	1,378
South Melbourne	70,924	13,596	21,822	4,861	9,090	511	306	579	100	505
South Morang (North)	19,160	3,657	6,063	1,925	3,726	180	80	151	26	133
South Morang (South)	20,684	3,660	6,628	2,398	4,673	227	81	152	26	133
South Yarra - East	49,363	8,220	14,099	4,481	8,556	505	214	403	70	333
South Yarra - West	9,089	1,803	4,063	1,299	2,503	140	20	34	6	42
Southbank	128,403	26,674	61,780	11,387	20,898	1,101	273	488	85	616
Springvale	83,084	21,111	38,118	9,292	18,033	894	238	430	75	515
Springvale South	25,258	6,870	12,625	3,019	5,881	282	63	110	19	151
St Albans - North	27,776	5,276	8,243	2,433	4,683	239	126	238	41	203
St Albans - South	21,032	4,578	7,635	1,993	3,835	197	81	152	26	145
St Kilda	67,103	14,784	23,027	5,229	10,004	546	285	535	93	496
St Kilda East	26,434	4,839	7,487	2,123	4,058	227	123	232	40	194
Strathmore	105,430	17,392	38,317	8,575	15,528	823	295	547	95	529
Sunbury	141,084	43,864	71,379	13,451	26,054	1,134	419	760	131	1,003
Sunbury - South	425,243	80,481	174,209	38,077	69,847	3,568	965	1,742	303	2,004
Sunshine	29,972	6,738	11,125	2,764	5,317	273	116	215	37	209
Sunshine North	95,117	20,049	42,168	9,463	17,582	896	196	347	61	450
Sunshine West	95,671	18,163	40,189	8,171	14,971	776	233	424	74	471
Surrey Hills (East) - Mont Albert	25,550	4,054	8,395	3,166	6,147	335	89	164	29	144
Surrey Hills (West) - Canterbury	50,822	6,959	12,397	5,074	9,765	553	232	437	76	336
Sydenham	22,327	4,132	7,602	2,643	5,140	251	83	154	27	140
Tarneit	201,240	40,145	76,965	20,115	38,441	1,889	678	1,257	218	1,227
Taylors Hill	11,009	1,625	2,315	913	1,752	90	58	111	19	84
Taylors Lakes	153,488	28,423	67,732	14,869	27,252	1,382	278	490	86	634
Templestowe	48,366	7,950	16,272	6,309	12,346	627	167	307	54	274
Templestowe Lower	28,201	4,379	8,921	3,542	6,877	361	103	190	33	163
The Basin	9,625	1,972	3,534	1,176	2,315	103	35	64	11	62
Thomastown	231,544	34,233	83,079	22,379	40,824	2,135	508	918	161	942
Thornbury	39,307	5,866	7,335	2,367	4,471	269	225	431	75	321
Toorak	39,143	7,470	16,243	4,199	7,928	442	106	192	34	203
Truganina	93,422	21,826	40,991	11,665	22,784	1,088	269	484	84	553
Tullamarine	99,527	16,336	40,305	9,384	16,899	839	184	328	57	389
Upwey - Tecoma	11,211	1,697	2,943	1,239	2,425	117	50	95	16	75
Vermont	20,255	4,060	8,236	2,693	5,258	266	58	104	18	110
Vermont South	33,034	6,997	13,059	3,832	7,454	380	107	196	34	200
Viewbank - Yallambie	87,561	13,967	27,744	6,949	12,759	678	311	584	101	509
Wallan	505,080	95,354	205,391	41,195	75,519	3,847	1,464	2,713	471	2,756
Wandin - Seville	35,373	10,128	18,012	4,254	8,324	363	90	160	28	222

SA2 regions	CO	VOCs	NOx	$PM_{2.5}$	PM_{10}	SO_2	Benzene	Toluene	Ethylbenzene	Xylenes
Wantirna	112,988	23,706	57,077	13,211	24,783	1,170	171	287	50	461
Wantirna South	129,583	26,336	62,552	14,847	27,855	1,313	233	404	71	562
Warrandyte - Wonga Park	70,569	12,387	17,721	5,701	10,968	541	357	680	118	547
Watsonia	58,709	9,186	21,899	5,277	9,526	491	132	241	42	251
Wattle Glen - Diamond Creek	53,345	10,928	18,134	5,412	10,574	500	216	405	70	370
Werribee - East	31,477	4,781	6,847	2,462	4,716	256	165	315	55	240
Werribee - South	388,168	72,885	157,997	32,413	59,579	3,181	972	1,774	308	1,930
Werribee - West	304,172	62,932	121,015	24,652	45,756	2,378	887	1,636	284	1,734
West Footscray - Tottenham	28,791	7,544	13,458	3,111	5,998	302	82	148	26	181
West Melbourne	69,686	15,811	37,149	7,325	13,566	688	94	155	27	288
Wheelers Hill	107,067	21,388	49,899	11,025	20,541	1,041	200	351	61	469
Whittlesea	367,211	108,007	181,567	31,967	60,795	2,695	1,093	1,995	345	2,539
Williamstown	22,094	3,661	5,845	1,929	3,708	204	103	196	34	158
Wollert	201,401	35,204	66,352	16,698	31,036	1,565	738	1,387	241	1,237
Wyndham Vale	195,920	41,067	81,665	19,025	36,069	1,774	589	1,083	188	1,140
Yarra - North	104,305	15,613	40,031	10,390	18,986	1,061	180	314	55	369
Yarra Valley	245,799	93,844	157,707	24,679	47,740	1,994	462	779	134	1,666
Yarraville	60,992	12,677	28,269	5,617	10,404	550	137	245	43	300
Grand Total	24,070,520	4,701,979	9,432,455	2,315,769	4,362,684	219,832	71,464	131,457	22,855	134,422

Table A-3 Total emissions in kilograms per year per SA2 region for Electric Avenue, Hydrogen Highway, Private Drive, Private Drive Empty Running and Fleet Street scenarios

SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Abbotsford	1,598	3,010	1,910	3,575	1,970	3,688	2,444	4,591	1,083	2,010
Airport West	3,454	6,449	3,405	6,234	3,518	6,453	4,016	7,394	3,187	5,807
Albert Park	2,910	5,472	3,578	6,717	3,859	7,244	4,567	8,598	2,833	5,292
Alphington - Fairfield	1,248	2,356	1,663	3,128	1,569	2,952	1,752	3,302	1,101	2,063
Altona	4,974	9,321	5,373	9,969	5,507	10,226	5,713	10,641	4,165	7,690
Altona Meadows	2,674	5,000	3,044	5,612	3,085	5,695	3,204	5,937	2,552	4,693
Altona North	16,318	30,499	18,271	33,615	18,820	34,670	19,427	35,990	15,134	27,751
Ardeer - Albion	4,353	8,128	4,105	7,520	4,669	8,568	4,953	9,123	3,813	6,943
Armadale	869	1,641	919	1,728	958	1,800	1,586	2,992	437	819
Ascot Vale	2,471	4,648	2,766	5,178	2,782	5,206	3,330	6,246	2,031	3,782
Ashburton (Vic.)	1,248	2,355	1,357	2,553	1,298	2,441	1,505	2,835	822	1,540
Ashwood - Chadstone	6,211	11,633	6,921	12,786	7,026	12,984	7,495	13,904	5,492	10,067
Aspendale Gardens - Waterways	3,083	5,766	3,252	5,973	3,282	6,037	3,254	6,006	2,656	4,860
Bacchus Marsh	10,672	19,988	10,005	18,492	10,141	18,756	10,340	19,171	10,106	18,574
Balwyn	1,984	3,746	2,145	4,030	2,112	3,969	2,744	5,170	1,304	2,439
Balwyn North	6,425	12,031	6,910	12,722	7,519	13,854	8,392	15,540	5,649	10,321
Bayswater	5,217	9,837	5,920	11,108	5,840	10,958	6,024	11,323	5,160	9,635
Bayswater North	4,523	8,527	4,994	9,372	5,029	9,438	5,173	9,723	4,679	8,741
Beaconsfield - Officer	9,311	17,459	9,852	18,275	9,995	18,541	10,123	18,828	9,187	16,964
Beaumaris	881	1,662	868	1,634	867	1,631	899	1,694	902	1,691
Belgrave - Selby	6,448	12,150	6,732	12,628	6,609	12,398	6,698	12,585	5,930	11,071
Bentleigh - McKinnon	2,502	4,718	2,901	5,451	2,944	5,531	3,053	5,749	2,371	4,434
Bentleigh East (North)	2,077	3,919	2,527	4,746	2,511	4,715	2,658	5,002	1,882	3,515
Bentleigh East (South)	2,178	4,109	2,398	4,504	2,436	4,574	2,496	4,696	1,946	3,637
Berwick - North	7,989	14,957	8,797	16,223	8,916	16,456	9,074	16,803	7,918	14,525
Berwick - South	7,234	13,568	7,749	14,363	7,821	14,506	7,852	14,602	7,020	12,953
Blackburn	7,503	14,076	8,271	15,327	8,565	15,873	9,282	17,261	6,702	12,323
Blackburn South	1,654	3,121	1,966	3,692	1,833	3,443	1,952	3,674	1,343	2,510
Boronia	4,654	8,779	4,889	9,183	4,741	8,905	4,843	9,110	4,238	7,927
Box Hill	3,839	7,248	4,175	7,847	4,109	7,723	4,675	8,804	2,557	4,781
Box Hill North	5,352	10,024	5,806	10,705	6,231	11,500	6,526	12,081	4,943	9,051
Braeside	5,240	9,813	5,589	10,320	5,820	10,764	5,730	10,624	5,045	9,284
Braybrook	3,269	6,149	3,963	7,432	3,857	7,233	4,244	7,977	2,748	5,132
Brighton (Vic.)	2,895	5,455	3,291	6,188	3,325	6,252	3,594	6,771	2,321	4,349
Brighton East	4,402	8,295	5,034	9,446	5,108	9,586	5,476	10,305	4,052	7,564
Broadmeadows	5,085	9,520	5,286	9,745	5,469	10,085	5,703	10,550	4,368	7,982
Brunswick	2,301	4,345	2,646	4,992	2,551	4,812	3,193	6,028	1,525	2,870
Brunswick East	1,044	1,971	1,234	2,323	1,176	2,213	1,480	2,791	673	1,262
Brunswick West	6,685	12,468	6,923	12,648	7,597	13,894	8,232	15,121	6,556	11,873

SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Bulleen	5,862	10,968	6,300	11,588	6,710	12,348	7,112	13,134	5,407	9,867
Bundoora - East	4,476	8,379	4,040	7,424	4,277	7,870	4,577	8,453	3,381	6,143
Bundoora - North	1,240	2,325	1,323	2,449	1,331	2,466	1,375	2,555	1,260	2,315
Bundoora - West	2,229	4,159	2,166	3,951	2,311	4,225	2,406	4,414	1,949	3,530
Bunyip - Garfield	15,836	29,561	15,346	28,364	15,516	28,709	15,565	28,839	15,588	28,737
Burnside	886	1,669	1,019	1,910	1,089	2,042	1,208	2,270	992	1,849
Burnside Heights	555	1,048	550	1,036	540	1,017	564	1,063	455	854
Burwood	3,395	6,406	3,545	6,657	3,398	6,382	3,801	7,154	2,092	3,906
Burwood East	1,602	3,024	1,681	3,156	1,569	2,946	1,875	3,530	1,040	1,943
Cairnlea	1,159	2,181	1,252	2,352	1,174	2,205	1,191	2,240	969	1,814
Camberwell	2,671	5,045	3,296	6,196	3,156	5,933	3,625	6,830	1,963	3,673
Campbellfield - Coolaroo	8,198	15,411	8,945	16,673	8,958	16,691	9,343	17,452	6,958	12,877
Carlton	1,365	2,575	1,973	3,718	1,954	3,683	2,632	4,968	963	1,809
Carlton North - Princes Hill	3,724	6,956	4,142	7,613	4,532	8,336	5,311	9,812	3,699	6,749
Carnegie	1,849	3,490	2,403	4,517	2,580	4,849	2,891	5,446	1,829	3,419
Caroline Springs	2,332	4,377	2,821	5,224	2,897	5,374	3,033	5,645	2,787	5,133
Carrum - Patterson Lakes	2,463	4,620	2,440	4,520	2,381	4,416	2,529	4,706	1,932	3,572
Carrum Downs	10,966	20,499	10,363	19,029	10,720	19,700	10,887	20,063	9,615	17,523
Caulfield - North	2,943	5,557	3,387	6,373	3,520	6,624	4,120	7,767	2,162	4,052
Caulfield - South	1,480	2,795	1,578	2,972	1,591	2,997	1,779	3,355	1,025	1,926
Chelsea - Bonbeach	1,607	3,028	1,446	2,718	1,336	2,512	1,615	3,042	978	1,834
Chelsea Heights	3,045	5,688	3,208	5,873	3,296	6,052	3,210	5,912	2,528	4,625
Cheltenham - Highett (East)	5,643	10,637	6,184	11,617	6,022	11,314	6,323	11,901	4,668	8,736
Cheltenham - Highett (West)	1,048	1,979	1,106	2,084	1,100	2,073	1,161	2,189	970	1,823
Chirnside Park	2,708	5,106	2,902	5,457	2,909	5,469	2,980	5,609	3,055	5,725
Clarinda - Oakleigh South	2,091	3,938	2,157	4,047	2,140	4,016	2,175	4,088	1,713	3,201
Clayton	7,680	14,464	8,803	16,515	8,675	16,275	8,828	16,593	6,122	11,431
Clayton South	4,185	7,870	4,754	8,913	4,468	8,378	4,598	8,632	3,539	6,611
Coburg	4,053	7,650	5,060	9,523	4,896	9,214	5,485	10,337	3,284	6,155
Coburg North	1,357	2,562	1,645	3,099	1,572	2,962	1,748	3,297	1,031	1,939
Collingwood	2,243	4,221	2,745	5,141	2,887	5,407	3,376	6,339	1,795	3,336
Craigieburn - Central	1,696	3,188	2,080	3,887	1,925	3,597	2,071	3,878	1,669	3,102
Craigieburn - North	4,272	7,993	4,145	7,641	4,141	7,641	4,412	8,166	3,737	6,851
Craigieburn - South	1,900	3,583	2,371	4,452	2,130	4,001	2,308	4,344	1,791	3,353
Craigieburn - West	1,589	2,995	1,754	3,299	1,695	3,188	1,734	3,264	1,559	2,925
Cranbourne	4,192	7,897	5,032	9,442	5,029	9,437	5,182	9,740	4,559	8,516
Cranbourne East	9,837	18,558	10,402	19,561	10,404	19,565	10,629	20,012	9,814	18,390
Cranbourne North	3,843	7,243	4,380	8,222	4,500	8,448	4,629	8,703	4,045	7,559
Cranbourne South	9,470	17,822	9,549	17,922	9,461	17,756	9,567	17,968	9,601	17,977
Cranbourne West	4,652	8,729	4,992	9,278	5,035	9,361	5,124	9,546	4,586	8,472
Croydon - East	2,776	5,238	3,090	5,806	3,032	5,698	3,107	5,847	2,584	4,834

SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Croydon - West	3,678	6,933	4,402	8,259	4,563	8,562	4,725	8,881	4,307	8,041
Croydon Hills - Warranwood	2,693	5,079	2,919	5,485	2,935	5,514	3,018	5,677	2,895	5,420
Croydon South	690	1,301	699	1,315	680	1,278	688	1,296	618	1,158
Dandenong	33,460	62,767	36,381	67,813	37,030	69,023	37,901	70,760	31,671	58,683
Dandenong North	13,214	24,649	13,854	25,348	14,299	26,212	14,924	27,442	13,090	23,825
Deer Park - Derrimut	11,577	21,638	12,377	22,781	12,961	23,888	13,261	24,522	11,102	20,349
Delahey	1,627	3,065	1,725	3,239	1,616	3,035	1,725	3,244	1,287	2,408
Dingley Village	4,156	7,792	4,589	8,528	4,653	8,650	4,689	8,735	3,777	6,984
Docklands	2,073	3,887	2,727	5,087	2,795	5,212	3,539	6,629	2,148	3,983
Doncaster	9,152	17,119	9,914	18,222	10,818	19,910	11,473	21,191	8,934	16,322
Doncaster East (North)	1,628	3,073	1,525	2,867	1,490	2,801	1,561	2,940	1,365	2,553
Doncaster East (South)	3,133	5,877	3,126	5,781	3,272	6,052	3,558	6,603	2,733	5,020
Donvale - Park Orchards	9,591	17,948	9,455	17,421	10,233	18,875	10,697	19,785	8,896	16,311
Doreen	1,450	2,730	1,407	2,645	1,432	2,691	1,453	2,733	1,469	2,754
Doveton	4,056	7,570	4,634	8,481	4,453	8,169	4,735	8,711	4,384	7,993
Dromana	5,936	11,114	5,398	9,919	5,510	10,140	5,680	10,487	5,528	10,084
East Melbourne	3,986	7,465	5,686	10,540	5,716	10,604	6,248	11,645	3,946	7,270
Edithvale - Aspendale	1,586	2,986	1,552	2,911	1,429	2,682	1,715	3,227	1,020	1,907
Elsternwick	1,811	3,413	2,173	4,085	2,300	4,323	2,813	5,302	1,930	3,609
Eltham	3,958	7,474	4,358	8,195	4,267	8,023	4,401	8,289	3,549	6,644
Elwood	1,497	2,815	1,856	3,483	1,910	3,586	1,983	3,731	1,178	2,205
Emerald - Cockatoo	11,902	22,395	11,156	20,941	11,128	20,889	11,252	21,143	11,192	20,947
Endeavour Hills - North	4,318	8,079	4,575	8,421	4,646	8,569	4,808	8,891	4,254	7,808
Endeavour Hills - South	4,671	8,714	5,034	9,181	5,304	9,700	5,537	10,166	4,727	8,594
Epping - East	4,851	9,095	5,112	9,481	5,237	9,717	5,325	9,907	5,129	9,439
Epping - South	5,213	9,807	5,549	10,358	5,591	10,432	5,786	10,820	4,726	8,760
Epping - West	2,493	4,670	2,315	4,283	2,445	4,523	2,551	4,731	2,234	4,109
Essendon - Aberfeldie	4,441	8,346	5,108	9,536	4,985	9,304	5,799	10,850	3,908	7,254
Essendon Airport	4,932	9,179	4,813	8,724	5,180	9,417	5,543	10,135	4,932	8,887
Fawkner	2,947	5,531	3,127	5,797	3,282	6,085	3,518	6,547	2,460	4,523
Ferntree Gully (North)	2,857	5,387	3,083	5,792	2,975	5,587	3,044	5,726	2,475	4,629
Ferntree Gully (South) - Upper Ferntree Gully	3,293	6,209	3,588	6,740	3,479	6,537	3,520	6,622	3,181	5,954
Fitzroy	1,427	2,677	1,574	2,926	1,671	3,105	2,590	4,845	937	1,721
Fitzroy North	1,709	3,226	2,156	4,054	2,132	4,009	2,803	5,287	984	1,840
Flemington	1,122	2,101	1,483	2,752	1,513	2,806	1,807	3,366	1,161	2,133
Flemington Racecourse	506	953	701	1,316	673	1,264	755	1,420	438	818
Flinders	8,884	16,687	8,452	15,720	8,581	15,969	8,697	16,219	9,292	17,206
Footscray	3,805	7,155	4,873	9,130	4,725	8,860	5,554	10,429	3,297	6,162
Forest Hill	3,077	5,801	3,303	6,199	3,282	6,161	3,546	6,669	2,447	4,571
Frankston	5,372	10,130	5,793	10,855	5,601	10,493	5,817	10,921	5,519	10,285
Frankston North	5,594	10,456	4,930	9,054	5,238	9,627	5,315	9,796	5,036	9,192

SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Frankston South	3,442	6,498	3,782	7,115	3,659	6,885	3,724	7,016	3,895	7,302
Gisborne	8,654	16,175	7,777	14,258	8,067	14,813	8,271	15,238	8,193	14,909
Gladstone Park - Westmeadows	6,226	11,650	6,071	11,170	6,245	11,491	6,544	12,082	5,298	9,690
Glen Iris - East	2,434	4,595	2,876	5,407	2,791	5,246	3,255	6,134	1,810	3,384
Glen Waverley - East	4,244	8,003	4,567	8,574	4,619	8,672	4,804	9,034	3,462	6,470
Glen Waverley - West	8,073	15,186	8,622	16,083	8,667	16,172	9,099	17,016	6,325	11,714
Glenroy	4,826	9,035	4,637	8,549	4,932	9,091	5,102	9,435	3,686	6,737
Gowanbrae	1,115	2,079	1,041	1,890	1,170	2,131	1,176	2,150	1,004	1,810
Greensborough	5,234	9,810	5,144	9,507	5,331	9,860	5,569	10,326	4,779	8,752
Greenvale - Bulla	25,320	47,371	24,254	44,990	25,432	47,187	26,184	48,674	23,132	42,724
Hadfield	867	1,637	1,141	2,147	1,101	2,072	1,213	2,286	797	1,494
Hallam	7,229	13,511	7,978	14,678	8,309	15,298	8,572	15,823	7,386	13,485
Hampton	1,836	3,465	1,902	3,574	1,918	3,605	2,068	3,894	1,594	2,984
Hampton Park - Lynbrook	5,686	10,663	6,684	12,410	6,592	12,241	6,817	12,682	6,119	11,292
Hastings - Somers	7,562	14,260	7,444	13,975	7,359	13,817	7,481	14,066	8,076	15,098
Hawthorn	5,033	9,438	6,773	12,548	6,697	12,410	7,123	13,263	4,460	8,192
Hawthorn East	1,728	3,263	2,050	3,856	1,944	3,656	2,240	4,222	968	1,811
Healesville - Yarra Glen	7,982	14,974	6,620	12,407	6,672	12,505	6,733	12,627	7,815	14,617
Heidelberg - Rosanna	7,043	13,190	7,956	14,726	8,385	15,521	8,997	16,700	6,789	12,469
Heidelberg West	2,801	5,284	3,499	6,585	3,439	6,474	3,570	6,725	2,466	4,625
Hillside	15,069	28,291	14,379	26,811	14,052	26,177	14,650	27,345	12,949	23,983
Hoppers Crossing - North	3,490	6,546	3,612	6,689	3,596	6,665	3,624	6,744	3,269	6,032
Hoppers Crossing - South	2,311	4,363	2,658	4,999	2,629	4,943	2,722	5,126	2,277	4,265
Hughesdale	1,124	2,122	1,321	2,483	1,403	2,636	1,546	2,912	1,048	1,960
Hurstbridge	584	1,101	529	993	516	969	527	991	535	1,001
Ivanhoe	1,271	2,400	1,603	3,022	1,517	2,859	1,864	3,518	865	1,626
Ivanhoe East - Eaglemont	4,104	7,664	4,317	7,922	4,676	8,588	4,917	9,061	3,799	6,910
Keilor	20,477	38,175	19,475	35,399	20,787	37,897	22,199	40,651	18,157	32,785
Keilor Downs	2,855	5,361	3,224	6,005	3,302	6,151	3,433	6,408	2,752	5,101
Keilor East	2,243	4,231	2,290	4,306	2,344	4,408	2,460	4,633	1,913	3,588
Kensington (Vic.)	905	1,702	1,134	2,121	1,146	2,143	1,412	2,648	687	1,277
Kew	7,256	13,605	8,158	15,065	8,680	16,027	10,589	19,681	5,710	10,438
Kew East	4,051	7,554	4,157	7,556	4,755	8,661	5,239	9,603	3,522	6,352
Keysborough	19,081	35,714	18,360	33,980	19,935	36,923	20,369	37,801	17,784	32,741
Kilsyth	1,855	3,502	1,997	3,761	1,875	3,532	1,918	3,616	1,869	3,517
Kinglake	2,080	3,905	1,901	3,565	1,916	3,593	1,976	3,707	2,208	4,136
Kings Park (Vic.)	860	1,620	881	1,655	843	1,584	865	1,628	742	1,391
Kingsbury	1,999	3,773	2,057	3,872	1,967	3,704	2,179	4,107	1,247	2,345
Knoxfield - Scoresby	13,465	25,167	13,407	24,745	14,543	26,826	15,151	28,016	13,552	24,774
Koo Wee Rup	6,812	12,779	6,568	12,284	6,613	12,369	6,682	12,507	6,580	12,279
Lalor	4,529	8,488	4,395	8,125	4,573	8,451	4,895	9,078	3,869	7,094

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Langwarrin	9,674	18,136	9,433	17,501	9,619	17,850	9,795	18,210	9,650	17,806
Laverton	17,910	33,476	19,746	36,359	20,263	37,330	20,175	37,378	17,040	31,193
Lilydale - Coldstream	11,485	21,655	12,003	22,549	12,550	23,574	12,626	23,747	13,014	24,361
Lynbrook - Lyndhurst	3,306	6,198	3,685	6,848	3,835	7,126	4,000	7,448	3,307	6,101
Lysterfield	1,481	2,786	1,469	2,753	1,472	2,758	1,479	2,776	1,312	2,449
Macedon	5,469	10,224	5,140	9,483	5,167	9,533	5,244	9,697	5,168	9,464
Malvern - Glen Iris	11,428	21,348	14,327	26,306	14,368	26,407	15,483	28,635	11,148	20,360
Malvern East	10,787	20,185	13,964	25,777	14,017	25,897	15,110	28,051	11,239	20,649
Maribyrnong	2,056	3,876	2,304	4,338	2,194	4,131	2,307	4,345	1,557	2,924
Meadow Heights	1,256	2,367	1,343	2,522	1,353	2,540	1,368	2,573	1,169	2,186
Melbourne	1,813	3,418	3,112	5,866	2,998	5,651	4,783	9,031	1,924	3,616
Melbourne Airport	8,615	16,097	7,907	14,516	8,535	15,698	8,845	16,328	7,781	14,210
Melton	12,447	23,394	12,581	23,478	12,369	23,080	12,552	23,462	12,019	22,331
Melton South	8,617	16,168	8,681	16,148	8,550	15,908	8,683	16,182	8,300	15,390
Melton West	3,576	6,689	3,452	6,369	3,494	6,457	3,551	6,576	3,488	6,421
Mentone	2,477	4,668	2,735	5,134	2,733	5,130	2,803	5,272	2,238	4,181
Mernda	4,234	7,957	4,714	8,795	4,579	8,544	4,670	8,730	4,318	8,015
Mickleham - Yuroke	15,875	29,683	14,346	26,499	15,198	28,096	15,613	28,923	13,999	25,753
Mill Park - North	3,099	5,830	3,493	6,530	3,429	6,409	3,547	6,643	3,146	5,845
Mill Park - South	2,892	5,421	3,089	5,717	3,132	5,802	3,209	5,958	2,874	5,277
Mitcham (Vic.)	2,561	4,832	2,672	5,022	2,674	5,025	2,968	5,589	2,066	3,868
Monbulk - Silvan	2,390	4,504	2,244	4,214	2,115	3,972	2,146	4,034	2,038	3,812
Montmorency - Briar Hill	2,351	4,437	2,576	4,848	2,556	4,810	2,719	5,123	1,873	3,510
Montrose	2,355	4,439	2,614	4,899	2,664	4,993	2,719	5,106	2,489	4,642
Moonee Ponds	1,506	2,842	1,939	3,658	1,684	3,177	2,187	4,129	1,166	2,196
Moorabbin - Heatherton	6,188	11,655	6,872	12,887	6,914	12,967	6,979	13,114	5,633	10,511
Moorabbin Airport	1,386	2,608	1,438	2,694	1,425	2,670	1,421	2,667	1,100	2,051
Mooroolbark	1,880	3,553	2,117	3,993	2,037	3,843	2,075	3,917	1,864	3,512
Mordialloc - Parkdale	3,835	7,222	3,989	7,488	3,886	7,294	4,161	7,826	3,066	5,732
Mornington	3,870	7,316	3,920	7,384	3,767	7,094	3,866	7,291	4,535	8,512
Mount Dandenong - Olinda	3,591	6,778	2,974	5,586	2,951	5,544	2,994	5,635	2,885	5,392
Mount Eliza	3,541	6,692	3,867	7,274	3,578	6,732	3,754	7,075	3,795	7,111
Mount Evelyn	1,969	3,710	2,466	4,622	2,373	4,448	2,436	4,573	2,117	3,951
Mount Martha	2,902	5,473	2,909	5,456	2,918	5,475	2,999	5,634	3,223	6,026
Mount Waverley - North	2,486	4,690	2,589	4,859	2,424	4,550	2,619	4,927	1,366	2,551
Mount Waverley - South	11,324	21,184	11,796	21,709	12,148	22,380	12,688	23,454	10,003	18,286
Mulgrave	13,634	25,516	15,357	28,357	15,939	29,479	16,463	30,531	13,790	25,334
Murrumbeena	1,070	2,021	1,336	2,511	1,361	2,558	1,480	2,786	936	1,749
Narre Warren - North East	1,483	2,797	1,372	2,578	1,379	2,591	1,377	2,590	1,292	2,418
Narre Warren - South West	7,291	13,638	8,513	15,652	8,542	15,720	8,778	16,208	7,342	13,395
Narre Warren North	4,603	8,666	4,269	8,014	4,203	7,887	4,173	7,841	3,584	6,702

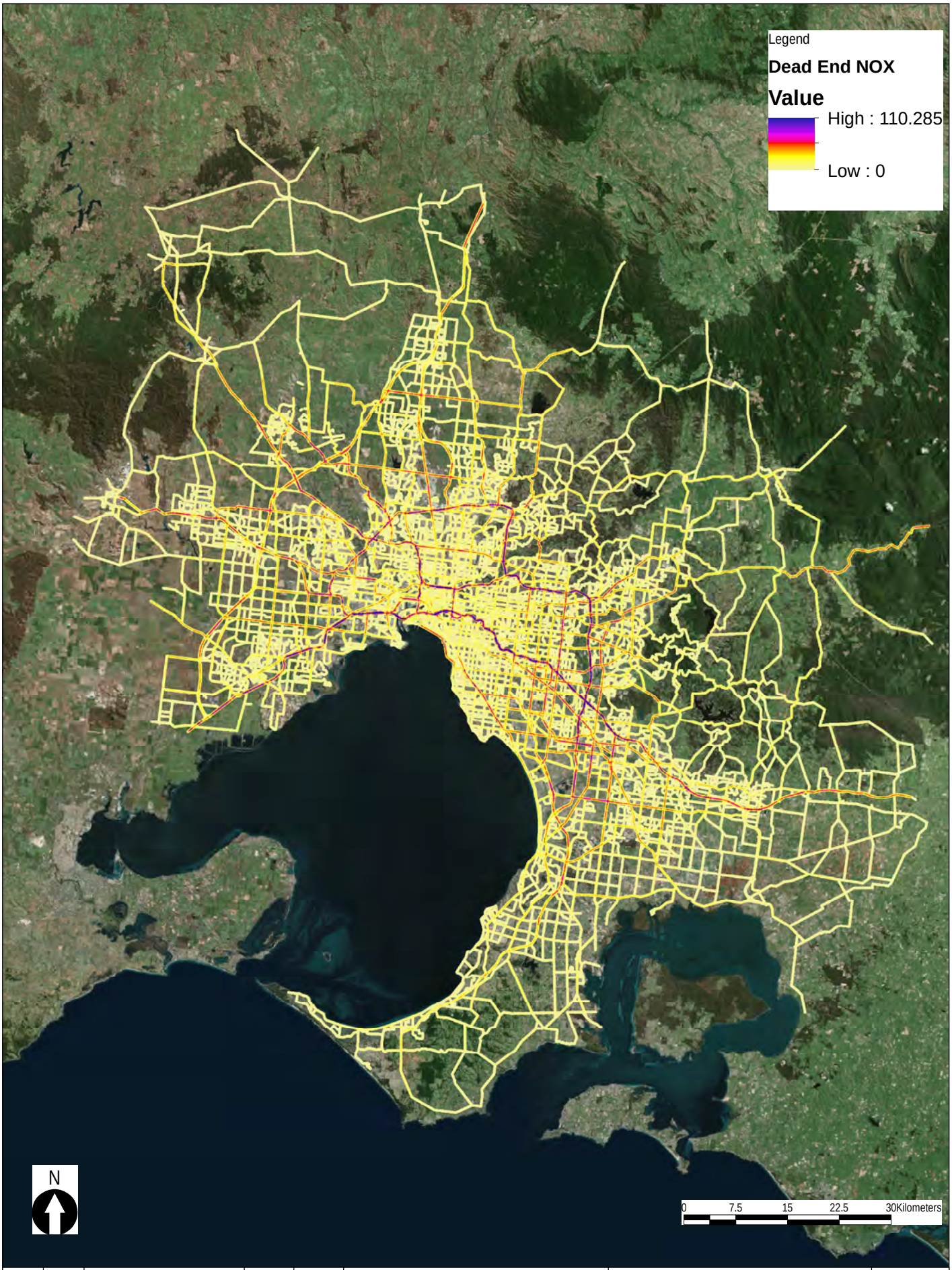
SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Narre Warren South (East)	541	1,020	521	983	510	961	509	961	428	806
Narre Warren South (West)	1,658	3,127	1,862	3,497	1,744	3,277	1,739	3,273	1,486	2,781
Newport	7,768	14,523	9,303	17,124	9,610	17,711	9,204	17,063	7,191	13,190
Niddrie - Essendon West	974	1,837	1,087	2,051	1,075	2,030	1,190	2,247	913	1,723
Noble Park - East	2,594	4,860	2,794	5,189	2,909	5,403	3,038	5,652	2,333	4,290
Noble Park - West	1,276	2,407	1,367	2,576	1,276	2,405	1,305	2,462	986	1,856
Noble Park North	3,802	7,115	3,841	7,100	4,067	7,524	4,315	8,004	3,431	6,293
None	3,411	6,405	3,293	6,149	3,443	6,429	3,483	6,513	3,591	6,669
North Melbourne	4,085	7,650	5,678	10,533	5,764	10,691	6,958	12,972	4,245	7,794
Northcote	1,301	2,455	1,797	3,392	1,744	3,292	2,138	4,038	1,058	1,993
Nunawading	6,021	11,295	6,676	12,386	7,193	13,353	7,675	14,290	5,797	10,690
Oakleigh - Huntingdale	6,366	11,997	8,350	15,665	8,141	15,274	8,408	15,811	5,874	10,962
Ormond - Glen Huntly	1,577	2,978	1,866	3,513	1,825	3,434	2,019	3,805	1,260	2,362
Pakenham - North	1,853	3,496	1,844	3,470	1,837	3,455	1,887	3,554	1,908	3,579
Pakenham - South	11,075	20,737	10,946	20,283	11,236	20,824	11,325	21,034	10,636	19,604
Panton Hill - St Andrews	4,718	8,864	4,004	7,507	3,963	7,432	4,026	7,557	4,018	7,514
Parkville	4,250	7,950	4,931	9,103	5,203	9,607	6,713	12,472	4,008	7,327
Pascoe Vale	2,123	4,007	2,602	4,901	2,420	4,558	2,619	4,939	1,593	2,994
Pascoe Vale South	4,823	9,015	5,282	9,734	5,633	10,379	5,956	11,007	4,778	8,731
Pearcedale - Tooradin	6,499	12,201	5,504	10,275	5,810	10,848	5,850	10,936	5,835	10,854
Plenty - Yarrambat	5,155	9,690	4,767	8,893	5,018	9,365	5,090	9,517	4,672	8,670
Point Cook - East	584	1,101	675	1,272	678	1,278	712	1,341	650	1,222
Point Cook - North	3,765	7,063	3,773	6,998	3,825	7,102	3,956	7,365	3,286	6,077
Point Cook - South	1,649	3,112	1,781	3,357	1,779	3,353	1,836	3,462	1,746	3,286
Point Nepean	3,530	6,667	3,516	6,624	3,529	6,649	3,547	6,689	3,852	7,241
Port Melbourne	1,373	2,580	1,727	3,249	1,690	3,179	1,970	3,711	1,141	2,142
Port Melbourne Industrial	11,395	21,230	13,989	25,567	15,037	27,521	14,324	26,437	12,542	22,858
Prahran - Windsor	1,357	2,563	1,571	2,952	1,637	3,077	2,388	4,502	956	1,786
Preston - East	5,666	10,693	7,075	13,309	6,882	12,947	7,512	14,152	4,744	8,888
Preston - West	1,817	3,429	2,442	4,593	2,391	4,498	2,554	4,811	1,656	3,102
Research - North Warrandyte	3,984	7,498	3,723	6,979	3,564	6,681	3,608	6,774	3,122	5,824
Reservoir - East	3,040	5,738	3,787	7,135	3,721	7,011	4,101	7,734	2,652	4,984
Reservoir - West	2,700	5,097	3,231	6,091	3,136	5,910	3,479	6,564	2,176	4,091
Richmond (Vic.)	10,153	19,007	13,324	24,620	13,467	24,913	14,496	26,949	9,633	17,683
Riddells Creek	862	1,624	702	1,318	701	1,315	728	1,368	743	1,385
Ringwood	13,043	24,423	13,199	24,399	14,289	26,412	14,944	27,699	12,713	23,324
Ringwood East	4,086	7,705	4,273	8,024	4,327	8,125	4,485	8,436	3,652	6,828
Ringwood North	972	1,831	1,012	1,903	979	1,842	1,018	1,916	955	1,793
Rockbank - Mount Cottrell	37,173	69,570	36,511	67,349	38,038	70,239	38,730	71,724	33,773	61,949
Romsey	4,857	9,151	4,451	8,376	4,332	8,154	4,473	8,425	4,852	9,110
Rosebud - McCrae	4,605	8,649	4,337	8,047	4,414	8,189	4,511	8,388	4,468	8,234

SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Rowville - Central	2,914	5,480	3,012	5,645	2,958	5,542	2,996	5,621	2,698	5,036
Rowville - North	2,144	4,037	2,152	4,034	2,010	3,768	2,048	3,846	1,644	3,070
Rowville - South	3,945	7,384	3,878	7,187	3,990	7,390	4,114	7,634	3,455	6,349
Roxburgh Park - Somerton	3,626	6,836	4,160	7,809	3,849	7,227	4,101	7,713	3,162	5,912
Sandringham - Black Rock	1,446	2,730	1,412	2,656	1,412	2,655	1,502	2,828	1,295	2,425
Seabrook	272	513	444	836	429	807	487	917	390	733
Seaford (Vic.)	6,157	11,522	5,786	10,608	5,913	10,848	6,246	11,509	5,136	9,333
Seddon - Kingsville	1,301	2,450	1,412	2,654	1,411	2,652	1,648	3,102	940	1,760
Skye - Sandhurst	2,776	5,207	2,895	5,388	2,884	5,370	2,952	5,503	2,899	5,374
Somerville	19,331	36,245	17,269	31,959	18,297	33,884	18,559	34,450	18,592	34,198
South Melbourne	2,655	4,986	3,180	5,953	3,647	6,812	4,124	7,744	2,854	5,296
South Morang (North)	1,207	2,275	1,537	2,884	1,418	2,663	1,479	2,782	1,320	2,471
South Morang (South)	1,562	2,947	1,867	3,506	1,774	3,332	1,847	3,475	1,586	2,968
South Yarra - East	2,759	5,205	3,327	6,256	3,461	6,508	4,375	8,246	1,914	3,582
South Yarra - West	702	1,324	844	1,584	971	1,822	1,549	2,921	618	1,152
Southbank	7,592	14,172	10,179	18,733	10,294	18,965	10,999	20,388	7,987	14,631
Springvale	6,115	11,507	7,145	13,400	7,038	13,199	7,271	13,659	5,030	9,394
Springvale South	2,009	3,780	2,180	4,086	2,190	4,105	2,234	4,194	1,698	3,170
St Albans - North	1,723	3,248	1,853	3,483	1,799	3,382	1,910	3,595	1,456	2,728
St Albans - South	1,360	2,560	1,563	2,935	1,528	2,870	1,663	3,128	1,135	2,124
St Kilda	2,933	5,517	3,764	7,070	3,983	7,485	5,360	10,099	2,760	5,164
St Kilda East	1,084	2,044	1,442	2,712	1,486	2,796	2,081	3,924	1,221	2,286
Strathmore	6,195	11,571	6,235	11,441	6,685	12,276	7,067	13,022	5,807	10,568
Sunbury	8,381	15,730	8,759	16,409	8,746	16,384	8,969	16,817	8,699	16,261
Sunbury - South	28,244	52,756	26,011	47,841	26,781	49,292	27,680	51,085	24,823	45,335
Sunshine	1,949	3,669	2,202	4,134	2,128	3,996	2,355	4,428	1,481	2,772
Sunshine North	6,442	12,050	6,771	12,501	7,207	13,312	7,692	14,251	5,847	10,727
Sunshine West	5,793	10,824	5,938	10,922	6,562	12,075	6,133	11,329	5,663	10,351
Surrey Hills (East) - Mont Albert	2,347	4,430	2,464	4,629	2,432	4,568	2,672	5,029	1,416	2,646
Surrey Hills (West) - Canterbury	3,589	6,779	4,280	8,049	4,090	7,692	4,623	8,713	2,468	4,620
Sydenham	1,775	3,347	1,915	3,595	1,802	3,384	1,915	3,602	1,730	3,234
Tarneit	13,605	25,560	13,906	25,981	13,930	26,023	14,845	27,777	12,573	23,374
Taylors Hill	704	1,328	642	1,208	624	1,174	634	1,195	605	1,136
Taylors Lakes	10,947	20,440	10,710	19,651	10,856	19,947	11,506	21,213	9,924	18,111
Templestowe	4,522	8,535	4,441	8,342	4,247	7,978	4,434	8,345	2,949	5,511
Templestowe Lower	2,520	4,758	2,419	4,544	2,268	4,262	2,494	4,695	1,588	2,970
The Basin	838	1,580	773	1,452	771	1,448	787	1,479	781	1,459
Thomastown	16,867	31,514	15,182	27,791	16,874	30,927	17,731	32,622	14,183	25,759
Thornbury	1,565	2,955	1,922	3,624	1,838	3,466	2,085	3,935	1,234	2,321
Toorak	2,738	5,147	3,250	6,054	3,424	6,382	4,222	7,911	2,168	4,009
Truganina	7,318	13,780	8,196	15,373	7,736	14,512	8,600	16,161	6,918	12,921

SA2 regions	Electric Avenue		Hydrogen Highway		Private Drive		Private Drive Empty Running		Fleet Street	
	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}
Tullamarine	7,064	13,168	6,901	12,552	7,411	13,521	7,549	13,831	6,713	12,120
Upwey - Tecoma	863	1,629	975	1,833	922	1,734	943	1,775	819	1,533
Vermont	1,757	3,314	1,746	3,276	1,699	3,188	1,887	3,549	1,388	2,593
Vermont South	3,027	5,707	2,811	5,277	2,807	5,270	3,033	5,703	1,861	3,479
Viewbank - Yallambie	4,781	8,951	5,083	9,390	5,466	10,101	5,844	10,830	4,827	8,853
Wallan	29,539	55,210	27,539	50,894	28,768	53,203	29,338	54,354	28,209	51,922
Wandin - Seville	2,785	5,242	3,158	5,914	3,278	6,140	3,311	6,208	2,941	5,491
Wantirna	9,589	17,947	8,852	16,338	10,101	18,652	10,685	19,790	9,060	16,591
Wantirna South	10,878	20,368	10,135	18,746	11,110	20,541	11,668	21,628	9,876	18,097
Warrandyte - Wonga Park	4,065	7,667	3,817	7,184	3,698	6,961	3,748	7,061	3,438	6,454
Watsonia	3,898	7,273	3,995	7,289	4,381	8,010	4,637	8,509	3,758	6,811
Wattle Glen - Diamond Creek	3,583	6,752	3,709	6,968	3,772	7,086	3,873	7,287	3,653	6,834
Werribee - East	1,796	3,391	1,925	3,626	1,816	3,419	1,875	3,534	1,380	2,591
Werribee - South	22,016	41,146	21,986	40,576	22,437	41,452	22,103	40,932	21,925	40,274
Werribee - West	17,112	32,006	16,017	29,662	16,336	30,285	16,666	30,944	15,961	29,446
West Footscray - Tottenham	2,144	4,033	2,335	4,379	2,243	4,207	2,565	4,818	1,597	2,982
West Melbourne	4,781	8,930	5,386	9,920	5,538	10,206	6,974	12,925	4,358	7,976
Wheelers Hill	7,186	13,445	8,820	16,277	8,374	15,468	8,731	16,177	7,805	14,337
Whittlesea	20,836	39,018	20,514	38,271	20,480	38,207	20,607	38,479	20,517	38,180
Williamstown	1,348	2,544	1,495	2,812	1,536	2,889	1,522	2,866	1,014	1,898
Wollert	11,808	22,127	11,693	21,691	12,109	22,464	12,345	22,951	11,465	21,147
Wyndham Vale	13,240	24,835	12,997	24,221	13,263	24,718	13,742	25,645	12,210	22,639
Yarra - North	7,159	13,381	8,018	14,694	8,797	16,136	10,028	18,507	6,357	11,550
Yarra Valley	15,179	28,421	17,248	32,245	17,298	32,337	17,302	32,364	15,637	29,180
Yarraville	4,049	7,576	4,320	7,975	4,382	8,101	4,691	8,708	2,974	5,480
Grand Total	1,597,642	2,996,401	1,676,096	3,112,283	1,711,344	3,178,534	1,799,223	3,350,969	1,480,268	2,733,300

Annex B

Traffic Contribution to Ambient Concentration Figures



Rev. N.	Date	Revision	Drawn by	Rev. by
0		Initial Issue	IMC	BW

Client: Aurecon

Drawing No: Figure 1 -

Date: 24/05/2018 Drawing Size: A4

Drawn By: IMC Reviewed By: BW

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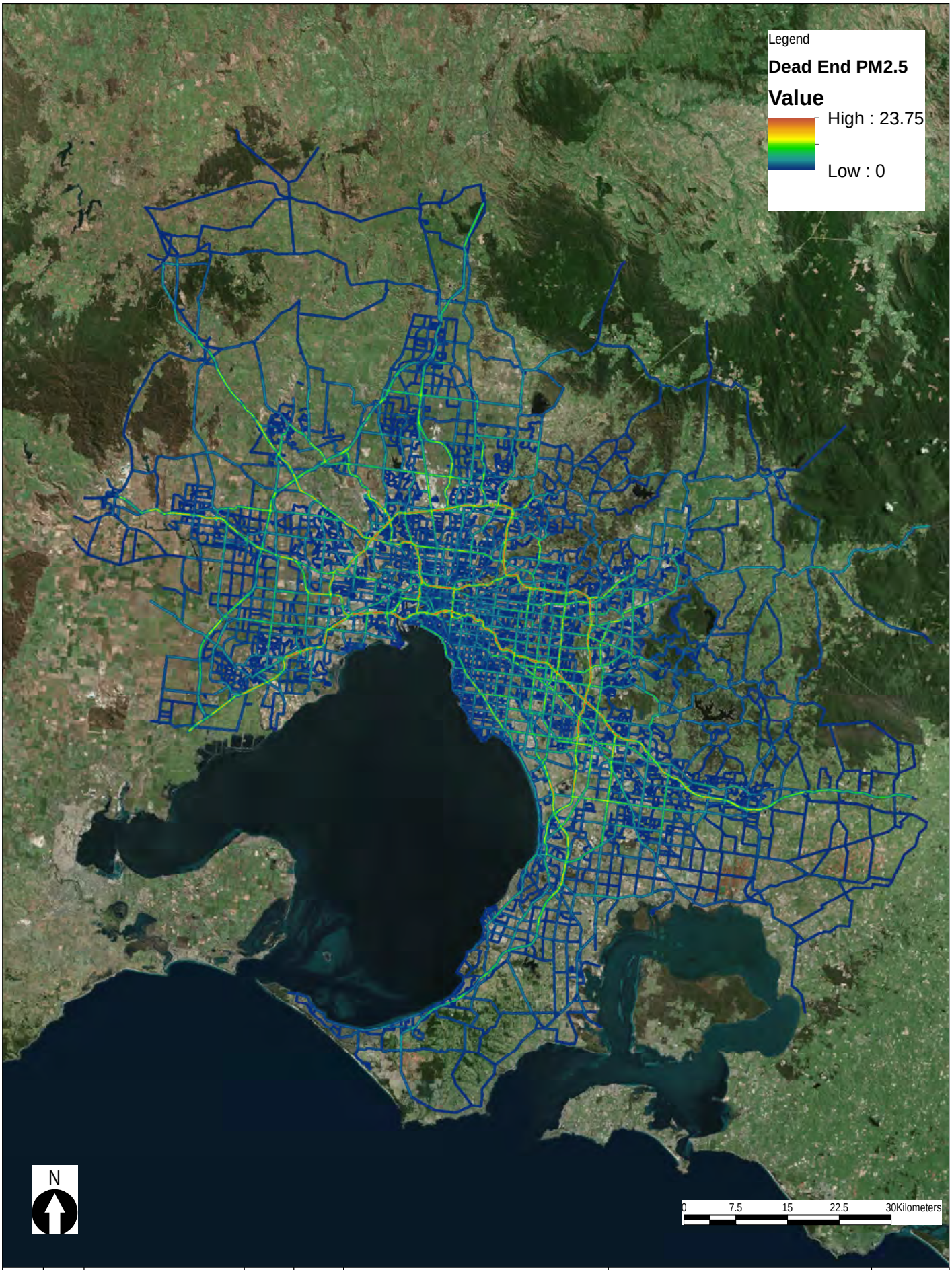
Figure 1. - Dead End Annual Mean NO_X concentrations (ug/m^3)

Project Title: Advice on Automated and Zero Emissions Vehicle Infrastructure

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Rev. N.	Date	Revision	Drawn by	Rev. by
0		Initial Issue	IMC	BW

Client: Aurecon

Drawing No: Figure 2 -

Date: 24/05/2018 Drawing Size: A4

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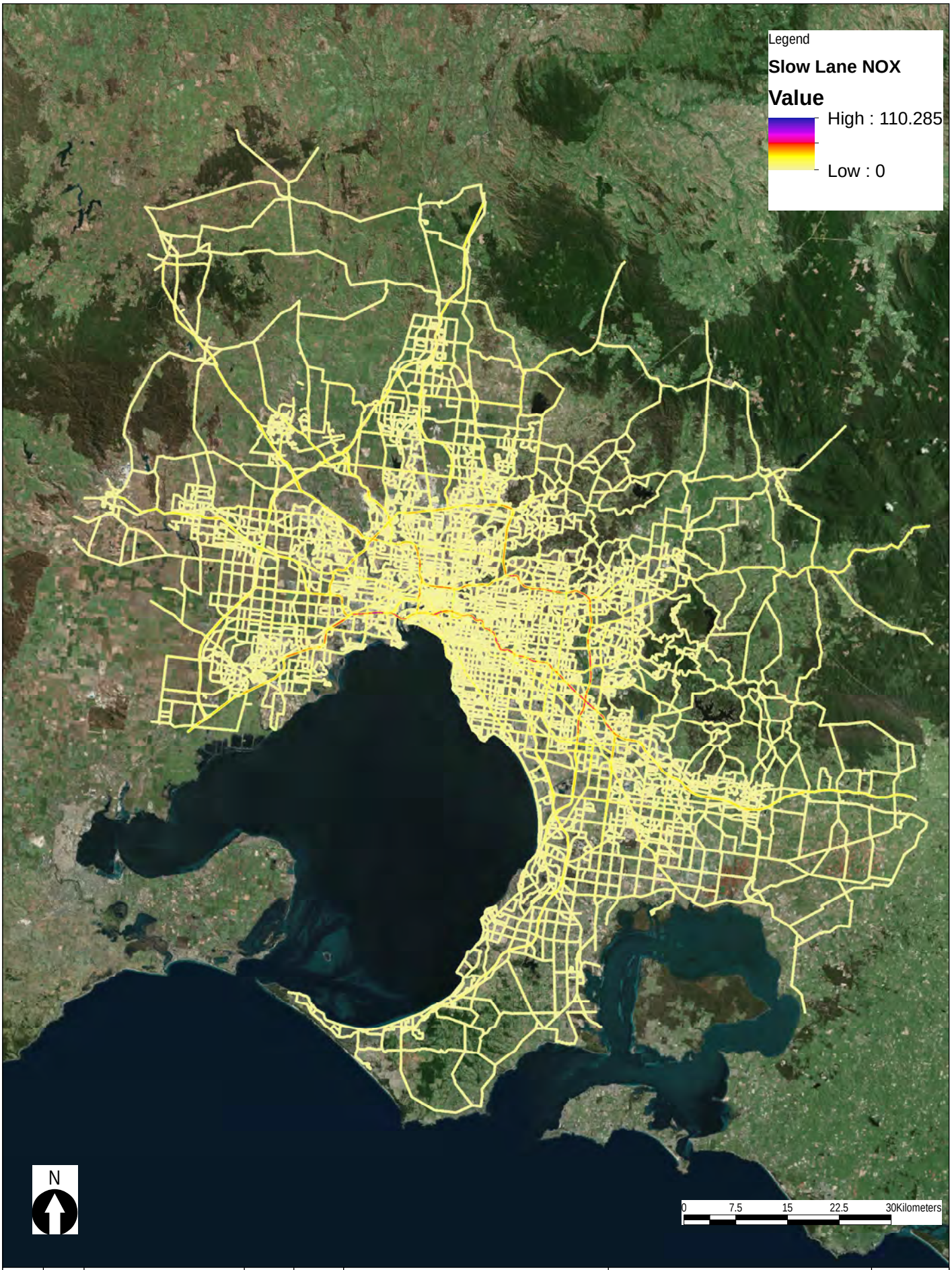
Figure 2. - Dead End Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

Project Title: Advice on Automated and Zero Emissions Vehicle Infrastructure

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Rev. N.	Date	Revision	Drawn by	Rev. by
0		Initial Issue	IMC	BW

Client: Aurecon

Drawing No: Figure 3 -

Date: 24/05/2018 Drawing Size: A4

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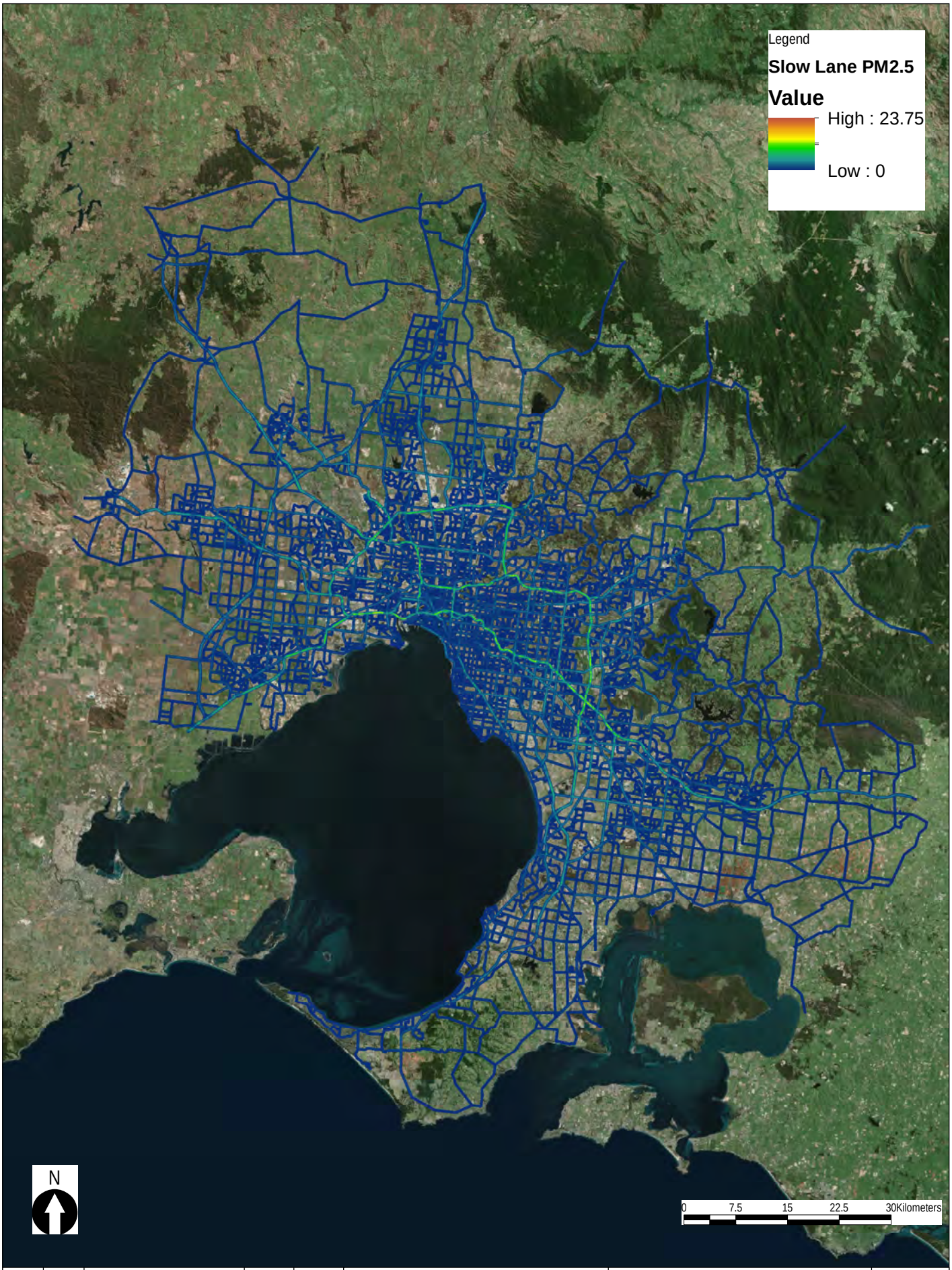
Figure 3. - Slow Lane Annual Mean NO_x concentrations (ug/m^3)

Project Title: Advice on Automated and Zero Emissions Vehicle Infrastructure

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Hunter Valley, Melbourne, Perth, Port Macquarie, Sydney

ERM



Rev. N.	Date	Revision	Drawn by	Rev. by
0		Initial Issue	IMC	BW

Client: Aurecon

Drawing No: Figure 4 -

Date: 24/05/2018 Drawing Size: A4

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Figure 4. - Slow Lane Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

Project Title: Advice on Automated and Zero Emissions Vehicle Infrastructure

Environmental Resources Management ANZ

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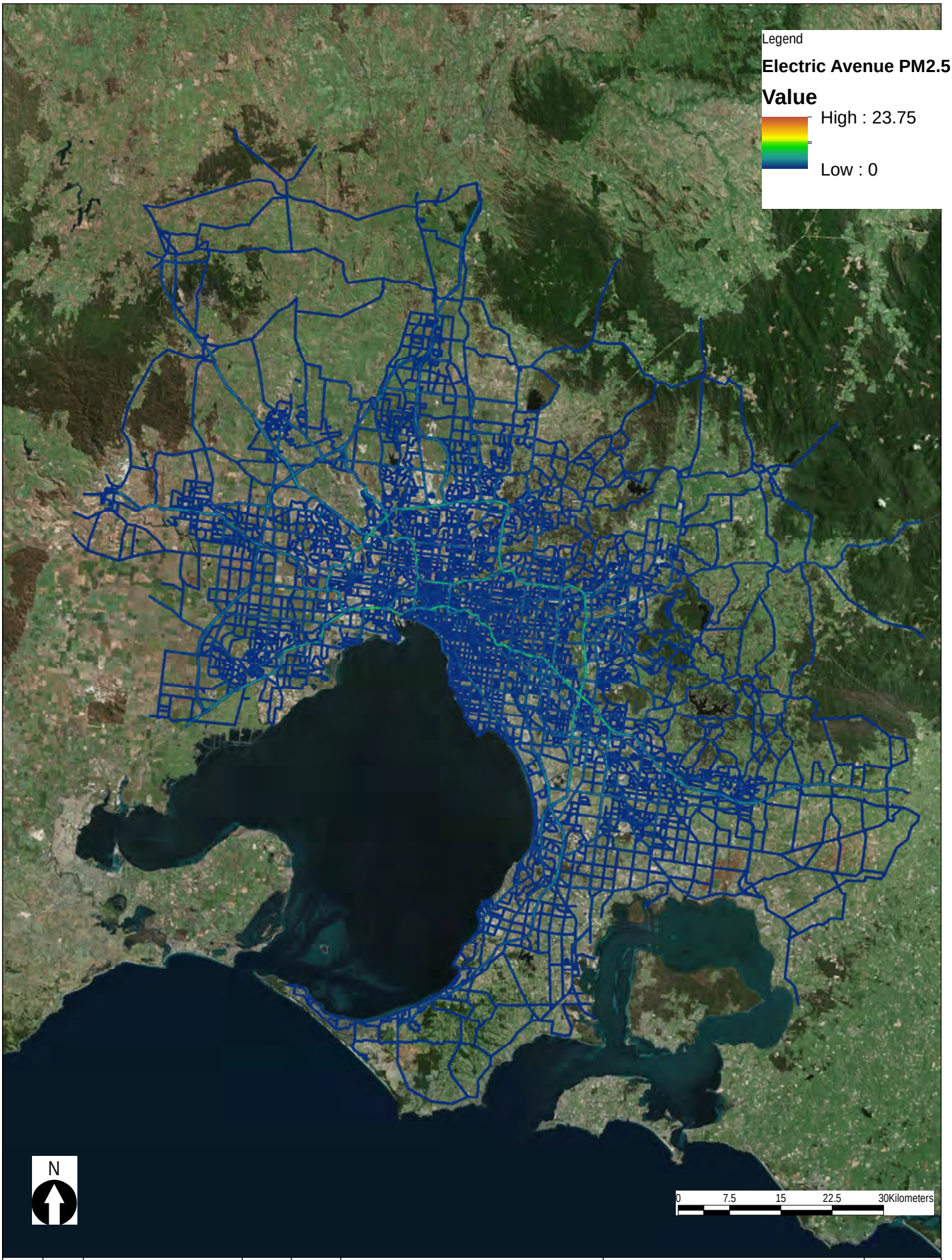

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Figure 5. - Electric Avenue Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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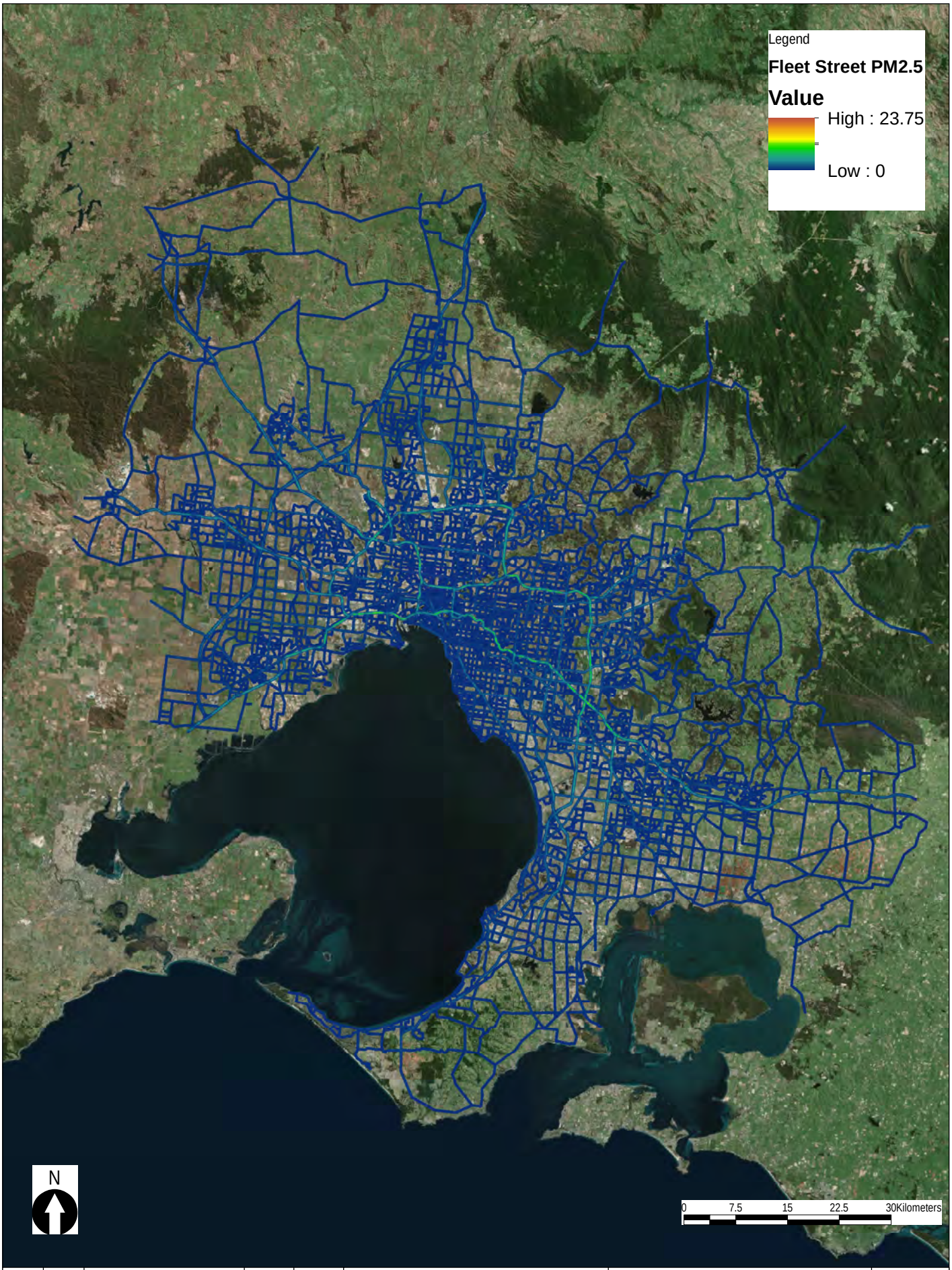

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Figure 6. - Fleet Street Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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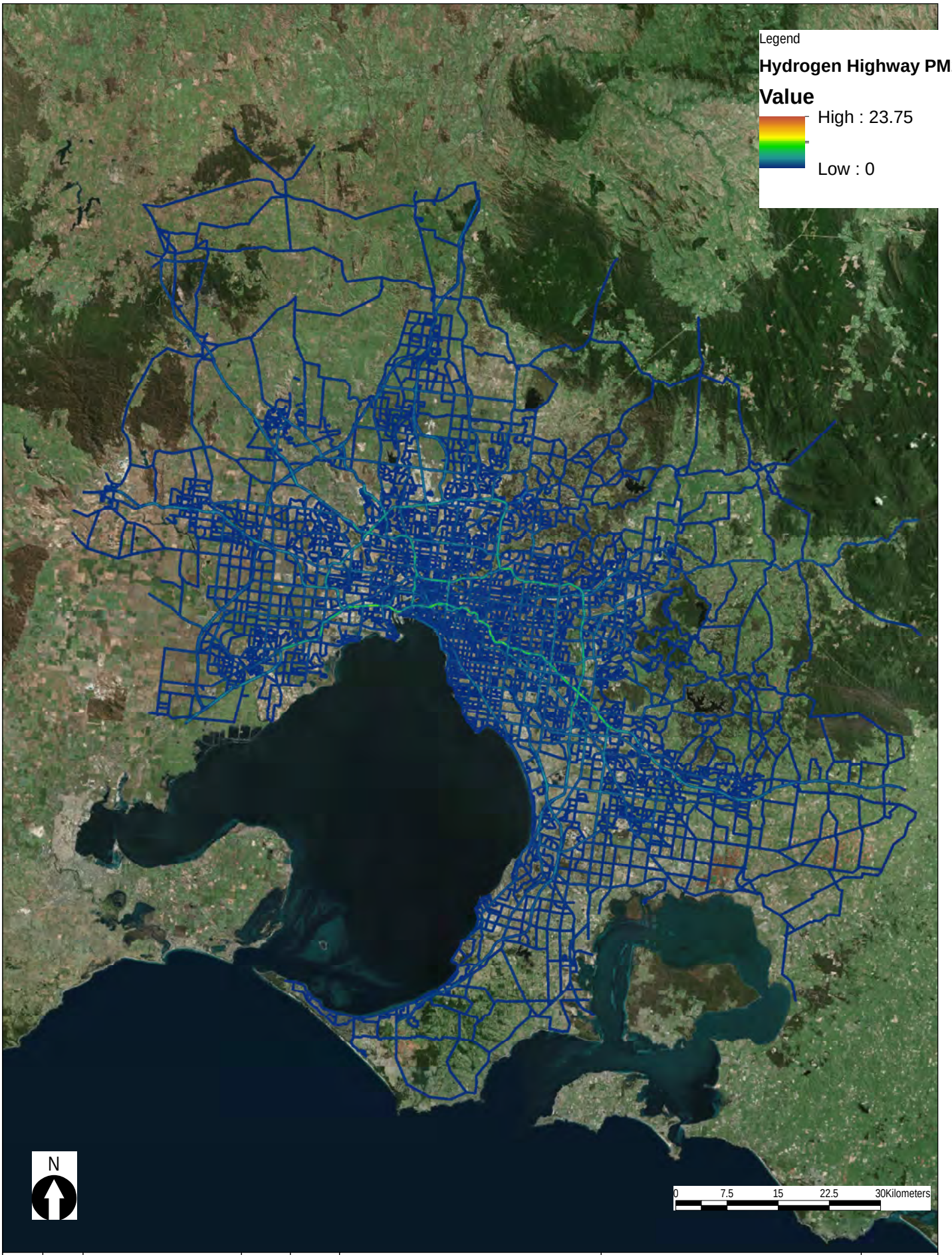

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Figure 7. - Hydrogen Highway Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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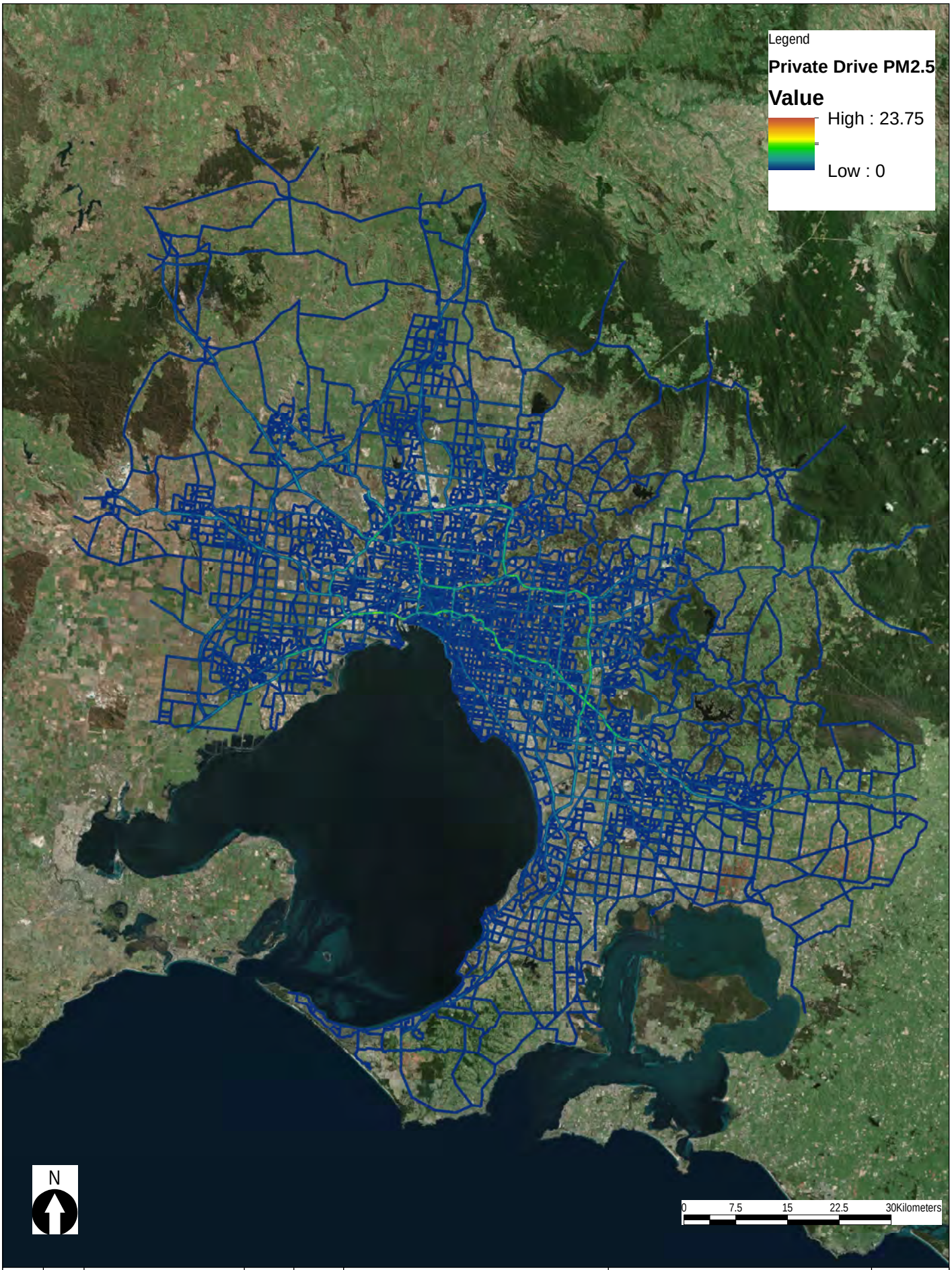

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Figure 8. - Private Drive Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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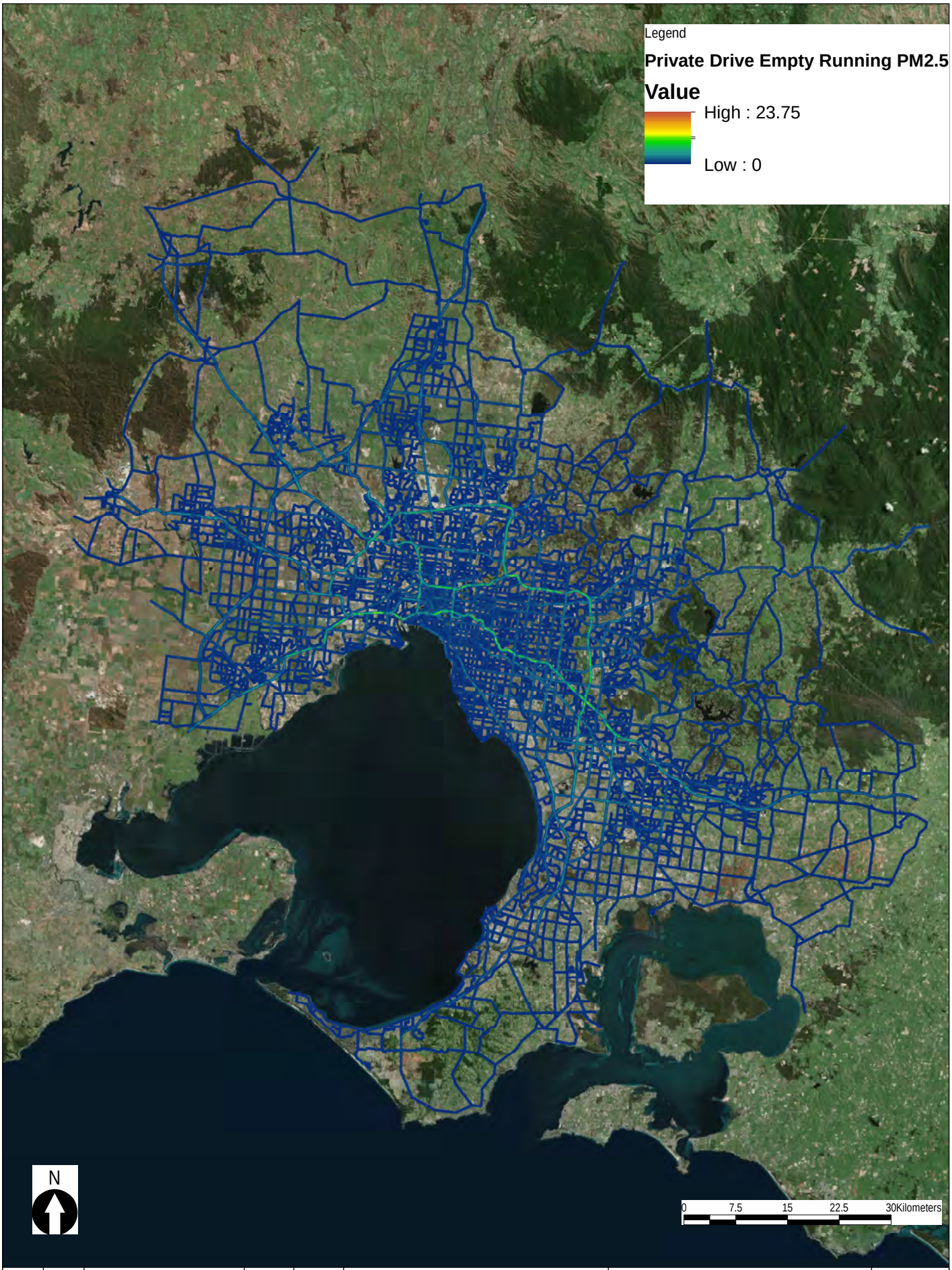

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Figure 9. - Private Drive Empty Running Annual Mean $PM_{2.5}$ concentrations (ug/m^3)

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