Technical Report No. 3

Air Emissions Inventory for the Greater Metropolitan Region in New South Wales

2008 Calendar Year

Commercial Emissions: Results

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

An air emissions inventory project for commercial sources has taken over 2 years to complete. The base year of the commercial inventory represents activities that took place during the 2008 calendar year and is accompanied by emission projections in yearly increments up to the 2036 calendar year. The area included in the inventory covers the greater Sydney, Newcastle and Wollongong regions, known collectively as the Greater Metropolitan Region (GMR).

The inventory region defined as the GMR measures 210 km (east–west) by 273 km (north–south). The inventory region is defined in Table ES-1 and shown in Figure ES-1.

Table ES-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

Region	South-west corner MGA1 coordinates		North-east corner MGA1 coordinates	
	Easting (km)	Northing (km)	Easting (km)	Northing (km)
Greater Metropolitan	210	6159	420	6432
Sydney	261	6201	360	6300
Newcastle	360	6348	408	6372
Wollongong	279	6174	318	6201

[1]Map Grid of Australia based on the Geocentric Datum of Australia 1994 (GDA94) (ICSM, 2006).

The commercial emissions inventory includes emissions from 5153 businesses. A total of 23,228 emission sources have been included in the commercial emissions inventory, consisting of 459 point sources and 22,769 fugitive sources. Table ES-2 presents the number and type of emission sources included in the commercial emissions inventory for each area considered.

Table ES-2: Emission source summary

Area	Point sources	Fugitive sources	Total sources
Sydney	330	16,089	16,419
Newcastle	32	1,436	1,468
Wollongong	15	867	882
Non Urban	82	4,377	4,459
GMR	459	22,769	23,228

The pollutants inventoried include criteria pollutants specified in the Ambient Air Quality NEPM (NEPC, 2003), air toxics associated with the National Pollutant Inventory NEPM (NEPC, 2008) and the Air Toxics NEPM (NEPC, 2004), and any other pollutants associated with state-specific programs, i.e. Load Based Licensing (Protection of the Environment Operations (General) Regulation 2009 (PCO, 2010)) and the Protection of the Environment Operations (Clean Air) Regulation 2010 (PCO, 2011).

Figure ES-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

The location of each emission source included in the commercial air emissions inventory is shown in Figure ES-2.

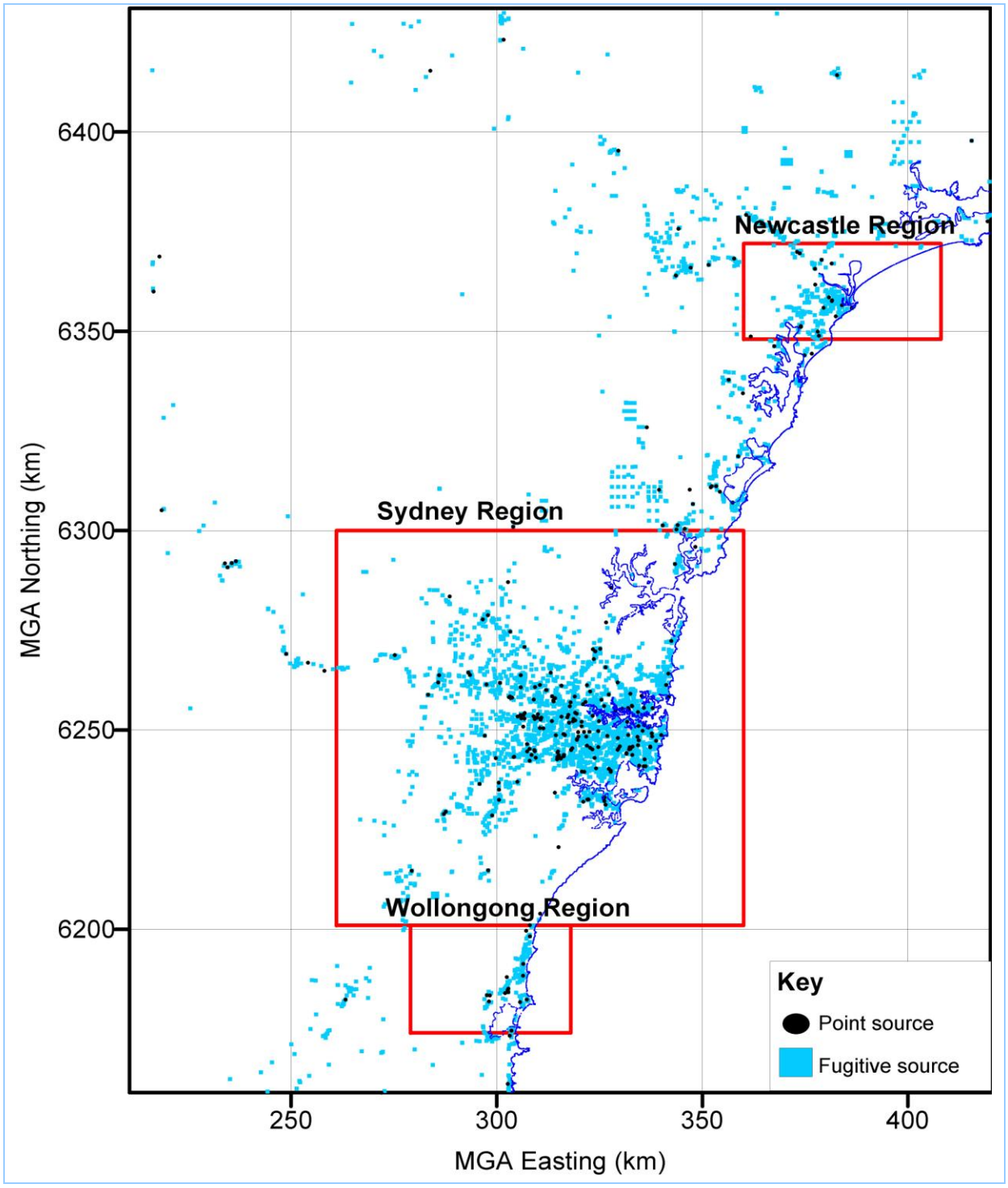

Figure ES-2: Commercial emission sources in the GMR

Table ES-3 shows the total estimated annual emissions (for selected substances) from all commercial sources in the GMR and in the Sydney, Newcastle, Wollongong and Non Urban regions.

Table ES-3: Total estimated annual emissions from commercial sources in each region

Substance	Emissions (tonne/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR
1,3 BUTADIENE	1.52	0.210	0.0637	0.323	2.12
ACETALDEHYDE	2.58	0.002	0.0007	0.0042	2.59
BENZENE	38.2	3.23	2.54	11.1	55.1
CARBON MONOXIDE	335	9.20	19.7	24.3	389
FORMALDEHYDE	48.4	0.110	0.168	0.50	49.2
ISOMERS OF XYLENE	87.9	4.70	2.77	47.7	143
LEAD AND COMPOUNDS	0.394	0.0045	0.0013	0.0362	0.436
OXIDES OF NITROGEN	344	38.5	12.1	106	501
PARTICULATE MATTER ≤ 10 µm	1,111	129	47.7	732	2,020
PARTICULATE MATTER ≤ 2.5 µm	485	30.0	13.9	167	695
POLYCYCLIC AROMATIC HYDROCARBONS	0.012	0.0001	0.0002	0.0004	0.013
SULFUR DIOXIDE	108	1.62	0.73	69.8	180
TETRACHLOROETHYLENE	358	21.4	16.9	59.7	456
TOLUENE	424	18.1	10.3	66.8	520
TOTAL SUSPENDED PARTICULATE	3,332	327	121	2,416	6,195
TOTAL VOLATILE ORGANIC COMPOUNDS	6,652	476	358	1,689	9,176
TRICHLOROETHYLENE	58.7	0.00004	0.0001	0.016	58.7

Figure ES-3 shows the proportion of total estimated annual emissions (for selected substances) from all commercial sources in the GMR and in the Sydney, Newcastle, Wollongong and Non Urban regions.

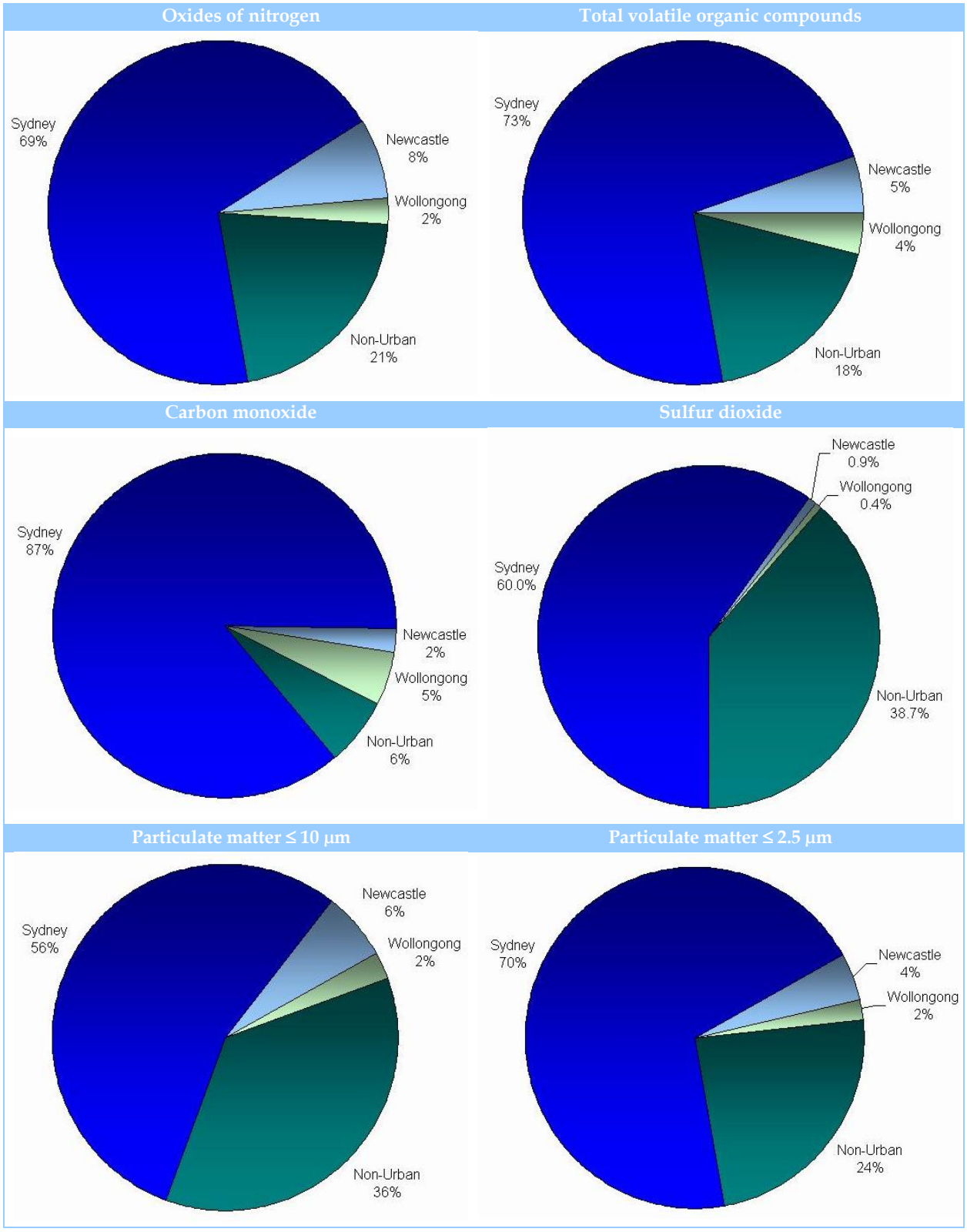

Figure ES-3: Proportion of total estimated annual emissions from commercial sources in each region

Table ES-4 shows total estimated annual emissions (for selected substances) from each commercial source type in the GMR.

Table ES-4: Total estimated annual emissions by commercial source type in the GMR

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Agricultural machinery manufacturing	0	0	0	0	0	0	0.00023
Aircraft manufacturing	2.35	2.8	0.213	0.213	0.213	0.0146	0.154
Aluminium rolling, drawing, extruding	0	0	0.0705	0.0705	0.0705	0	0
Automotive component manufacturing n.e.c.	0.21	0.251	1.21	0.25	0.0771	0.00131	14
Automotive fuel retailing	0	0	0	0	0	0	4,910
Basic iron and steel manufacturing	5.42	8.6	14.9	9.91	8.32	0.0337	12.3
Basic non-ferrous metal manufacturing n.e.c.	0.936	1.12	15.8	10	7.55	0.134	0.965
Beer and malt manufacturing	4.77	5.68	3.39	3.39	3.39	8.91	21.9
Biscuit manufacturing	6.94	8.26	0.628	0.628	0.628	0.0432	0.454
Bread manufacturing	13.3	15.8	2.25	1.53	1.39	0.0826	143
Cake and pastry manufacturing	1.34	1.59	0.121	0.121	0.121	0.00832	12.2
Ceramic product manufacturing	28.6	6.44	49.6	30.8	23.2	47.7	0.63
Ceramic product manufacturing n.e.c.	0.0048	0.0348	0.00111	0.00108	0.00107	0	0.00084
Chemical product manufacturing n.e.c.	4.54	5.54	30.8	9.52	1.92	29.6	520
Chemical wholesaling	0	0	7.9	1.52	0.367	0	81.4
Concrete slurry manufacturing	0	0	20.2	7.06	1.12	0	0.00006
Confectionery manufacturing	0.353	1.41	0.0746	0.0708	0.0702	0.00481	1.35
Construction material mining n.e.c.	0	0	106	50.3	10.3	0	0.00603
Corrugated paperboard container manufacturing	4.82	5.74	0.436	0.436	0.436	0.03	0.316
Electrical cable and wire manufacturing	0	0	3.33	1.22	0.722	0	84
Electrical and equipment manufacturing n.e.c.	0.0368	0.422	0.429	0.429	0.429	0.00023	4.18
Explosive manufacturing	0	0	0	0	0	0	0.0213
Fabricated metal product manufacturing n.e.c.	1.64	3.41	12.4	4.85	3.48	0.0101	105
Food manufacturing n.e.c.	13	29.2	2.37	1.65	1.37	17.8	6.21
Fruit and vegetable processing	2.49	1.48	0.225	0.225	0.225	0.0155	0.163
Funeral directors,	3.07	6.73	0.318	0.0955	0.0636	11.9	0.283

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
crematoria and cemeteries							
Furniture manufacturing n.e.c.	1.59	1.9	0.15	0.145	0.144	0.00991	7.24
Gas supply	3.09	3.68	0.28	0.28	0.28	0.0192	0.202
Glass and glass product manufacturing	3.72	3.92	8.58	8.41	8.26	0.176	2.86
Gravel and sand quarrying	0	0	5,080	1,390	306	0	0.105
Hospitals	54.2	66.5	5.01	5	5	0.469	3.79
Ice-cream manufacturing	0.294	2.08	0.11	0.0964	0.0938	0.00639	0.438
Industrial gas manufacturing	0.00188	0.0136	2.77	0.75	0.0868	0	5.82
Ink manufacturing	0	0	0.688	0.619	0.611	0	10.6
Laundries and dry-cleaners	3.87	4.68	0.356	0.356	0.356	0.0245	474
Lifting and material handling equipment manufacturing	0	0.124	0.0245	0.0245	0.0245	0	0.745
Log sawmilling	3.29	64.8	45.2	18.4	7.42	49.5	90
Medicinal and pharmaceutical product manufacturing	2.96	3.61	0.27	0.27	0.27	0.0183	2.04
Metal coating and finishing	5.16	32.4	25	14.6	12.5	0.0321	21.5
Milk and cream processing	1.03	1.22	0.093	0.093	0.093	0.0064	0.0673
Mining and construction machinery manufacturing	0	0	0.00508	0.00114	0.00043	0	1.28
Non-building construction n.e.c.	0.0236	0.171	2.47	0.477	0.119	0	0.00412
Non-ferrous metal casting	0.0072	0.0288	0.384	0.244	0.183	0.0217	0.00064
Non-metallic mineral product manufacturing n.e.c.	0.485	0.577	0.0439	0.0439	0.0439	0.00302	106
Oil and fat manufacturing	5.32	11.4	0.482	0.482	0.482	0.0331	0.349
Organic industrial chemical manufacturing n.e.c.	0.0251	0.0299	0.00227	0.00227	0.00227	0.00016	4.54
Paint manufacturing	0	0	34.3	29.3	28.3	0	124
Paper product manufacturing n.e.c.	1.22	1.73	0.13	0.129	0.129	0.0319	0.498
Petroleum product wholesaling	0	0	2.35	0.504	0.0988	0	125
Plaster product manufacturing	138	37.3	16.1	13.6	7.81	3.4	3.41
Plastic bag and film manufacturing	0	0	0.899	0.899	0.832	0	17.7
Plastic injection-moulded product manufacturing	2.96	3.54	20.3	5.96	0.839	0.0218	0.441

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Plastic product (rigid fibre reinforced) manufacturing	1.4	1.66	0.433	0.194	0.139	0.00869	43.4
Port operators	31.3	102	8.95	8.95	8.95	9.94	13.7
Poultry farming (eggs)	0	0	116	50.5	11.6	0	0
Poultry farming (meat)	1.16	1.38	303	132	30.3	0.00719	0.0757
Prepared animal and bird feed manufacturing	1.3	1.55	0.118	0.118	0.118	0.0101	0.0853
Printing	14.9	26	1.46	1.46	1.46	0.0933	1,320
Rail transport	0	0	0	0	0	0	0.00126
Railway equipment manufacturing	0	0	0	0	0	0	0.058
Road and bridge construction	0	0	12.7	3.5	0.407	0	0.0149
Rubber product Manufacturing n.e.c.	0.0072	0.0288	0.28	0.0769	0.0111	0.0102	0.00687
Scientific research	0.927	0.552	0.0839	0.0839	0.0839	0.00577	0.0607
Services to air transport	2.24	2.67	0.203	0.203	0.203	0.014	71.4
Smash repairing	0	0	0	0	0	0	393
Soap and other detergent manufacturing	0	0	2.35	0.665	0.0674	0	0.0289
Soft drink, cordial and syrup manufacturing	3.46	4.12	0.313	0.313	0.313	0.0215	2.24
Solid paperboard container manufacturing	0	0	0	0	0	0	15.3
Spirit manufacturing	0	0	0	0	0	0	66.8
Spring and wire product manufacturing	0.00512	0.781	5.48	1.16	0.383	0.00003	0.381
Steel pipe and tube manufacturing	0	0.744	5.81	4.78	4.56	0	0.00123
Structural metal product manufacturing n.e.c.	0	0	0.007	0.007	0.007	0	2.49
Structural steel fabricating	0	0	2.04	0.4	0.104	0	0
Synthetic resin manufacturing	1.46	1.73	212	191	189	0.00905	270
Waste disposal services	9.22	13	1.77	1.7	1.67	0.353	33.2
Wine manufacturing	0.00024	0.00175	0.00006	0.00005	0.00005	0	24.1
Wood product manufacturing n.e.c.	0.0005	0.0006	1.21	0.232	0.0561	0	5.42
Wooden furniture and upholstered seat manufacturing	0	0	0	0	0	0	1.77
Grand total	**389**	**501**	**6,190**	**2,020**	**695**	**180**	**9,180**

n.e.c., not elsewhere classified; $PM_{2.5}$, particulate matter ≤ 2.5 µm; PM_{10}, particulate matter ≤ 10 µm; TSP, total suspended particulate; VOC, volatile organic compounds

Figure ES-4 shows the proportion of total estimated annual emissions (for selected substances) from each commercial source type in the GMR.

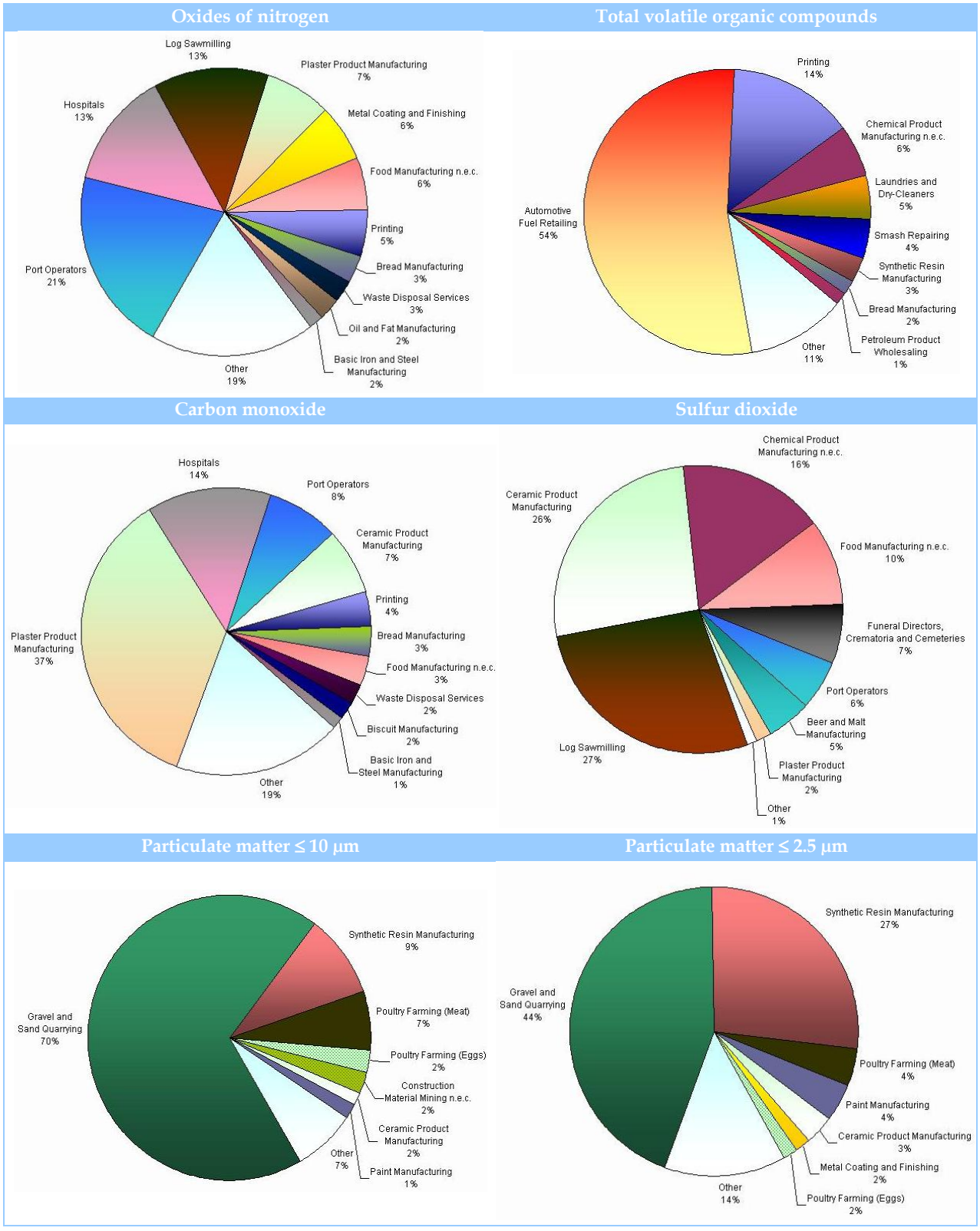

Figure ES-4: Proportion of total emissions by commercial source type in the GMR

Table ES-5 shows total estimated annual emissions (for selected substances) from each commercial source type in the Sydney region.

Table ES-5: Total estimated annual emissions by commercial source type in the Sydney region

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Agricultural machinery manufacturing	0	0	0	0	0	0	0.00023
Aircraft manufacturing	2.35	2.8	0.213	0.213	0.213	0.0146	0.154
Automotive component manufacturing n.e.c.	0.208	0.247	1.21	0.25	0.0768	0.00129	12.7
Automotive fuel retailing	0	0	0	0	0	0	2,940
Basic iron and steel manufacturing	0.853	3.16	14.4	9.45	7.86	0.0053	12
Basic non-ferrous metal manufacturing n.e.c.	0.936	1.12	15.8	10	7.55	0.134	0.965
Beer and malt manufacturing	4.77	5.68	3.39	3.39	3.39	8.91	21.9
Biscuit manufacturing	6.94	8.26	0.628	0.628	0.628	0.0432	0.454
Bread manufacturing	11.6	13.8	1.05	1.05	1.05	0.0721	132
Cake and pastry manufacturing	1.34	1.59	0.121	0.121	0.121	0.00832	12.2
Ceramic product manufacturing	15.7	2.57	41.6	23.3	21.3	47.5	0.153
Chemical product manufacturing n.e.c.	4.54	5.54	30.8	9.51	1.91	29.6	510
Chemical wholesaling	0	0	6.75	1.29	0.313	0	81.4
Concrete slurry manufacturing	0	0	13.2	4.52	0.716	0	0.00006
Confectionery manufacturing	0.353	1.41	0.0746	0.0708	0.0702	0.00481	1.35
Corrugated paperboard container manufacturing	4.82	5.74	0.436	0.436	0.436	0.03	0.316
Electrical and equipment manufacturing n.e.c.	0.0368	0.422	0.429	0.429	0.429	0.00023	4.18
Fabricated metal product manufacturing n.e.c.	0.87	2.08	11.9	4.54	3.21	0.00532	103
Food manufacturing n.e.c.	6.9	8.22	0.714	0.642	0.629	0.0429	5.72
Fruit and vegetable processing	2.49	1.48	0.225	0.225	0.225	0.0155	0.163
Funeral directors, crematoria and cemeteries	1.95	4.27	0.202	0.0605	0.0403	7.51	0.18
Furniture manufacturing n.e.c.	0	0	0.00086	0.00017	0.00004	0	2.84
Gas supply	3.09	3.68	0.28	0.28	0.28	0.0192	0.202
Glass and glass product manufacturing	3.71	3.88	8.57	8.4	8.25	0.174	2.86
Gravel and sand quarrying	0	0	2590	646	145	0	0.0477
Hospitals	38	45.6	3.44	3.44	3.44	0.256	2.62
Ice-cream manufacturing	0.294	2.08	0.11	0.0964	0.0938	0.00639	0.438

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Industrial gas manufacturing	0.00188	0.0136	2.77	0.75	0.0868	0	5.82
Ink manufacturing	0	0	0.688	0.619	0.611	0	10.6
Laundries and dry-cleaners	3.87	4.68	0.356	0.356	0.356	0.0245	372
Lifting and material handling equipment manufacturing	0	0.124	0.0245	0.0245	0.0245	0	0.745
Medicinal and pharmaceutical product manufacturing	2.44	2.99	0.223	0.223	0.223	0.0151	1.35
Metal coating and finishing	2.7	3.83	11.3	9.85	9.28	0.0168	20.9
Milk and cream processing	1.03	1.22	0.093	0.093	0.093	0.0064	0.0673
Non-building construction n.e.c.	0.0165	0.119	2.46	0.476	0.118	0	0.00288
Non-metallic mineral product manufacturing n.e.c.	0.485	0.577	0.0439	0.0439	0.0439	0.00302	106
Oil and fat manufacturing	5.32	11.4	0.482	0.482	0.482	0.0331	0.349
Organic industrial chemical manufacturing n.e.c.	0.0251	0.0299	0.00227	0.00227	0.00227	0.00016	4.54
Paint manufacturing	0	0	34.3	29.3	28.3	0	124
Paper product manufacturing n.e.c.	1.14	1.35	0.103	0.103	0.103	0.00707	0.471
Petroleum product wholesaling	0	0	1.78	0.341	0.0825	0	53
Plaster product manufacturing	138	37.3	16.1	13.6	7.81	3.4	3.41
Plastic bag and film manufacturing	0	0	0.899	0.899	0.832	0	17.7
Plastic injection-moulded product manufacturing	2.96	3.54	20.3	5.96	0.839	0.0218	0.441
Plastic product (rigid fibre reinforced) manufacturing	1.4	1.66	0.22	0.153	0.129	0.00869	20.4
Port operators	31.3	102	8.95	8.95	8.95	9.94	13.7
Poultry farming (eggs)	0	0	104	45.4	10.4	0	0
Poultry farming (meat)	1.16	1.38	147	64.1	14.8	0.00719	0.0757
Prepared animal and bird feed manufacturing	0.00144	0.00576	0.00032	0.00031	0.00031	0.00204	0.0001
Printing	14.9	26	1.46	1.46	1.46	0.0933	1,300
Railway equipment manufacturing	0	0	0	0	0	0	0.058
Road and bridge construction	0	0	12.6	3.44	0.394	0	0
Rubber product manufacturing n.e.c.	0	0	0.00191	0.00578	0	0	0.006
Scientific research	0.927	0.552	0.0839	0.0839	0.0839	0.00577	0.0607
Services to air transport	2.24	2.67	0.203	0.203	0.203	0.014	71.4
Smash repairing	0	0	0	0	0	0	308
Soap and other detergent manufacturing	0	0	2.35	0.665	0.0674	0	0.0289

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Soft drink, cordial and syrup manufacturing	3.46	4.12	0.313	0.313	0.313	0.0215	2.24
Solid paperboard container manufacturing	0	0	0	0	0	0	15.3
Spirit manufacturing	0	0	0	0	0	0	66.8
Spring and wire product manufacturing	0.00452	0.00538	0.242	0.0468	0.0116	0.00003	0.00051
Steel pipe and tube manufacturing	0	0.744	1.91	1.27	1.05	0	0.00123
Structural metal product manufacturing n.e.c.	0	0	0.007	0.007	0.007	0	2.49
Structural steel fabricating	0	0	2.04	0.4	0.104	0	0
Synthetic resin manufacturing	0.9	1.07	212	191	189	0.0056	268
Waste disposal services	9.22	13	1.77	1.7	1.67	0.353	17.3
Wine manufacturing	0.00024	0.00175	0.00006	0.00005	0.00005	0	3.18
Wood product manufacturing n.e.c.	0.0005	0.0006	1.07	0.206	0.0499	0	0.00003
Wooden furniture and upholstered seat manufacturing	0	0	0	0	0	0	1.77
Grand total	**335**	**344**	**3,330**	**1,110**	**485**	**108**	**6,650**

n.e.c., not elsewhere classified; $PM_{2.5}$, particulate matter ≤ 2.5 µm; PM_{10}, particulate matter ≤ 10 µm; TSP, total suspended particulate; VOC, volatile organic compounds

Figure ES-5 shows the proportion of total estimated annual emissions (for selected substances) from each commercial source type in the Sydney region.

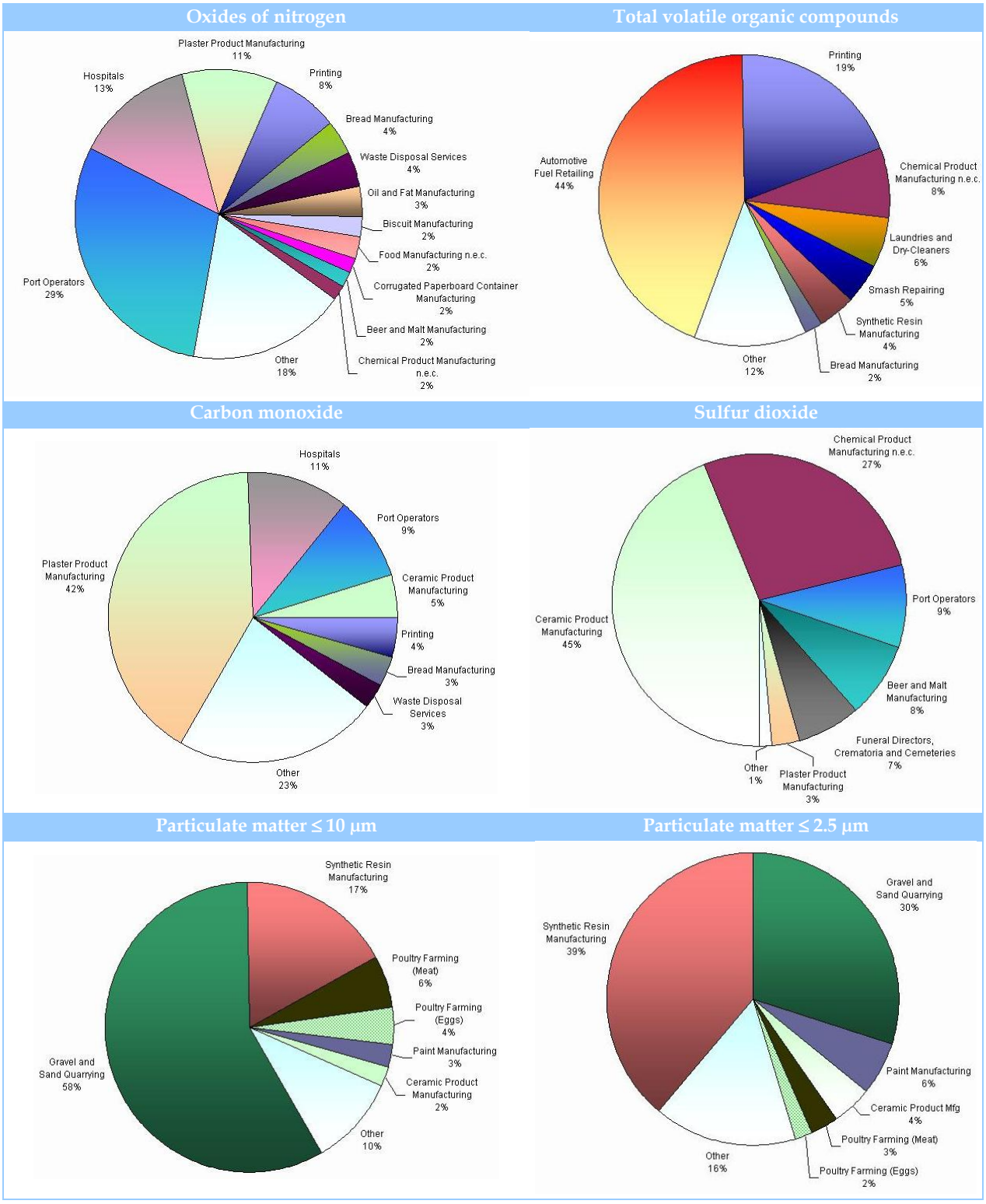

Figure ES-5: Proportion of total emissions by commercial source type in the Sydney region

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GLOSSARY/ABBREVIATIONS

Acronym	Definition
°C	Degrees Celsius
°R	Degrees Rankine. A thermodynamic (absolute) temperature scale where zero is absolute zero and one Rankine degree is defined as equal to one degree Fahrenheit.
µm	micrometre (1 x 10^{-6} metre)
ABARE	Australian Bureau of Agricultural and Resource Economics
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ADO	Automotive diesel oil
AECL	Australian Egg Corporation Limited
Ambient Air Quality NEPM	National Environment Protection (Ambient Air Quality) Measure
am	ante meridiem (indicating the time period from midnight to midday)
ANZSIC	Australian and New Zealand Standard Industrial Classification, 1993
APMF	Australian Paint Manufacturers Federation
ARB	Air Resources Board
ATL	Automotive Testing Laboratories
AVGAS	Aviation gasoline
AVTUR	Aviation turbine fuel
BOD	Biological oxygen demand
BoM	Bureau of Meteorology
BP	British Petroleum
CA	California
CARB	California Air Resources Board
CE	Control efficiency
CE-CERT	Center for Environmental Research and Technology
CEIDARS	California emission inventory and reporting system
chromium VI	Hexavalent chromium (i.e. Cr^{6+})
CO	Carbon monoxide
CO_2	Carbon dioxide
Combustion products	CO, NO_x, TSP, PM_{10}, $PM_{2.5}$, particulate matter, VOC, SO_2, SO_3, H_2SO_4, speciated metals, speciated organics, greenhouse gases, ammonia
CORINAIR	CO-oRdinated INformation on the Environment in the European Community - AIR.
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DCC	Australian Commonwealth Department of Climate Change
DCCEE	Australian Commonwealth Department of Climate Change and Energy Efficiency
DEC	Department of Environment and Conservation (NSW)
Dec	December
DECC	Department of Environment and Climate Change (NSW)
DECCW	Department of Environment, Climate Change and Water (NSW)
DEH	Australian Commonwealth Department of Environment and Heritage
DEW	Australian Commonwealth Department of Environment and Water
DEWHA	Australian Commonwealth Department of Environment, Water, Heritage and the Arts
DHA	Australian Commonwealth Department of Health and Aging
DITR	Australian Commonwealth Department of Industry, Tourism and Resources
DMR	NSW Department of Mineral Resources
DPI	NSW Department of Primary Industries
DRET	Australian Commonwealth Department of Resources, Energy and Tourism

Acronym	Definition
DSEWPC	Australian Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EA	Environment Australia
EEA	European Environment Agency
EET	Emission estimation technique
EI	Emissions inventory
EIIP	Emission Inventory Improvement Program
EMEP	Automotive Testing Laboratories
EPA	Environment Protection Authority
EPAV	Environment Protection Authority Victoria
ERG	Eastern Research Group
GDA	Geocentric Datum of Australia
GJ	Gigajoule (1 x 10^9 joule)
GMR	Greater Metropolitan Region
GPO	Government Post Office
H_2S	Hydrogen sulfide
ha	Hectare (one hectare equals 10,000 m^2)
HC	Hydrocarbons
HCl	Hydrochloric acid
HP	Horsepower
I.C.	Internal combustion
ICSM	Intergovernmental Committee on Surveying and Mapping
ID	Identification number
IPCC	Intergovernmental Panel on Climate Change
ISBN	International Standard Book Number
K	Kelvin. A thermodynamic (absolute) temperature scale where zero is absolute zero and one Kelvin is defined as equal to one degree Celsius.
kg	kilogram(1,000 gram)
kL	kilolitre (1,000 litre)
km	kilometre (1,000 metre)
kPa	kilopascal
kW	kilowatt (1,000 watt)
L	Litre
lb	Pound (avdp) (Avoirdupois)
LGA	Local government area
LPG	Liquefied Petroleum Gas
Ltd	Limited
m	metre
M	Moisture content
m/s	metre per second
m^2	Square metre
m^3	Cubic metre
mg	milligram (i.e. 1 thousandth of a gram, 1 millionth of a kilogram)
MGA	Map Grid of Australia based on the Geocentric Datum of Australia 1994 (GDA94)
Misc	Miscellaneous
MJ	Megajoule (1,000,000 joule)
ML	Megalitre (1,000,000 litre)
mm	millimetre (1,000th of a metre or 1x10^{-3} metre)
Mm^3	Mega cubic metre (i.e. 1,000,000 cubic metre)
Mt	Megatonne (1,000,000 tonne)
MVRIA	Motor Vehicle Repair Industry Authority

Acronym	Definition
MW	Megawatt (1,000,000 watt)
MWh	Megawatt hour (one million watt hour)
n.e.c.	Not elsewhere classified
N_2O	Nitrous oxide
NA	Not applicable
NaOH	Sodium hydroxide
ND	No data
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NGA	National Greenhouse Accounts
NGGIC	National Greenhouse Gas Inventory Committee
NICNAS	National Industrial Chemicals Notification & Assessment Scheme
NO	Nitric oxide
No.	Number
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen (sum of nitric oxide and nitrogen dioxide expressed as nitrogen dioxide equivalent)
NPI	National Pollutant Inventory
NPI NEPM	National Environment Protection (National Pollutant Inventory) Measure
NRM	National Resource Management Regions
NSW	New South Wales
NSWBDM	NSW Registry Births Deaths and Marriages
OEH	Office of Environment and Heritage (NSW)
OEHHA	Office of Environmental Health Hazard Assessment
OEM	Original equipment manufacturers
P	Power
PAE	Pacific Air & Environment
PAH	Polycyclic aromatic hydrocarbons
PCA	Pollution control approval
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dibenzo-p-dioxins
PCDD/F	Polychlorinated dibenzo-p-dioxins & polychlorinated dibenzo-p-furans (polychlorinated dioxins and furans)
PCDD/PCDF	Polychlorinated dibenzo-p-dioxins & polychlorinated dibenzo-p-furans (polychlorinated dioxins and furans)
PCDF	Polychlorinated dibenzo-p-furans
PCO	Parliamentary Counsel Office (New South Wales)
PM	Particulate matter (included in the air emissions inventory as TSP, PM_{10} and $PM_{2.5}$)
pm	post meridiem (indicating the time period from midday to midnight)
PM_{10}	Particulate matter with an aerodynamic diameter of less than or equal to 10 micrometres
$PM_{2.5}$	Particulate matter with an aerodynamic diameter of less than or equal to 2.5 micrometres
PO	Post Office
POEO	Protection of the Environment Operations
POP	Persistent Organic Pollutant
pp	pages
ppm	Parts per million (in mass) (e.g. gram/tonne)
Pty	Proprietary
PULP	Premium unleaded petrol
Qld	Queensland
RTA	Road and Traffic Authority
SO_2	Sulfur dioxide

Acronym	Definition
SO_3	Sulfur trioxide
SQL	Structured Query Language
Stat	Stationary
STP	Sewage treatment plant
t	tonne (1,000 kilogram)
TAPM	The Air Pollution Model
TDC	Transport Data Centre
TJ	Terajoule (1x 10^{12} joule)
TSP	Total suspended particulate matter
TTY	Text Telephone, Telephone typewriter, or telecommunication device for the Deaf
ULP	Unleaded petrol
UNEP	United Nations Environment Programme
USA	United States of America
USEPA	United States Environmental Protection Agency
VCE	Vapour collection efficiency
Vic	Victoria
VOC	Total volatile organic compounds
VRU	Vapour recovery unit
WEBFIRE	Internet based factor information retrieval (FIRE)

1 INTRODUCTION

An air emissions inventory project for commercial sources has taken over two years to complete. The base year of the commercial inventory represents activities that took place during the 2008 calendar year and is accompanied by emission projections in yearly increments up to the 2036 calendar year. The area included in the inventory covers greater Sydney, Newcastle and Wollongong regions, known collectively as the Greater Metropolitan Region (GMR).

The purpose of this document is to present the emission estimation methodologies and results of the commercial air emissions inventory. The information is structured as follows:

- A description of the commercial air emissions inventory specification (Section 2) including:
    - The inventory year (Section 2.1);
    - A description of the inventory region (Section 2.2);
    - A description of the grid coordinate system (Section 2.3);
    - A description of emission sources considered (Section 2.4);
    - A description of the pollutants evaluated (Section 2.5); and
    - A broad discussion of the methodology (Section 2.6).
- The emission estimation methodology presented by commercial source type for the GMR, Sydney, Newcastle, Wollongong and Non Urban regions (Section 3).
- An emission summary for selected substances presented by commercial source type for the GMR, Sydney, Newcastle, Wollongong and Non Urban regions (Section 3).
- An emissions summary for selected substances presented for all commercial sources for the GMR, Sydney, Newcastle, Wollongong and Non Urban regions (Section 4).
- A complete list of references (Section 5).
- Total commercial emissions of all substances emitted in the GMR, Sydney, Newcastle, Wollongong and Non Urban regions (Appendix A).

2 INVENTORY SPECIFICATIONS

2.1 The Inventory Year

The commercial air emissions inventory results presented in this report are based on activities that took place in the 2008 calendar year.

2.2 The Inventory Region

The inventory region defined as the GMR measures 210 km (east-west) by 273 km (north-south). The inventory region is defined in Table 2-1 and shown in Figure 2-2.

Table 2-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

Region	South-west corner MGA[1] co-ordinates		North-east corner MGA[1] co-ordinates	
	Easting (km)	Northing (km)	Easting (km)	Northing (km)
Greater Metropolitan	210	6159	420	6432
Sydney	261	6201	360	6300
Newcastle	360	6348	408	6372
Wollongong	279	6174	318	6201

[1]Map Grid of Australia based on the Geocentric Datum of Australia 1994 (GDA94) (ICSM, 2006).

2.3 Grid Coordinate System

The grid coordinate system used for the commercial air emissions inventory uses 1 km by 1 km grid cells. The grid coordinates start from the bottom left corner having index number with Easting (km) in the horizontal and Northing (km) in the vertical direction. The grid coordinate system is illustrated in Figure 2-1.

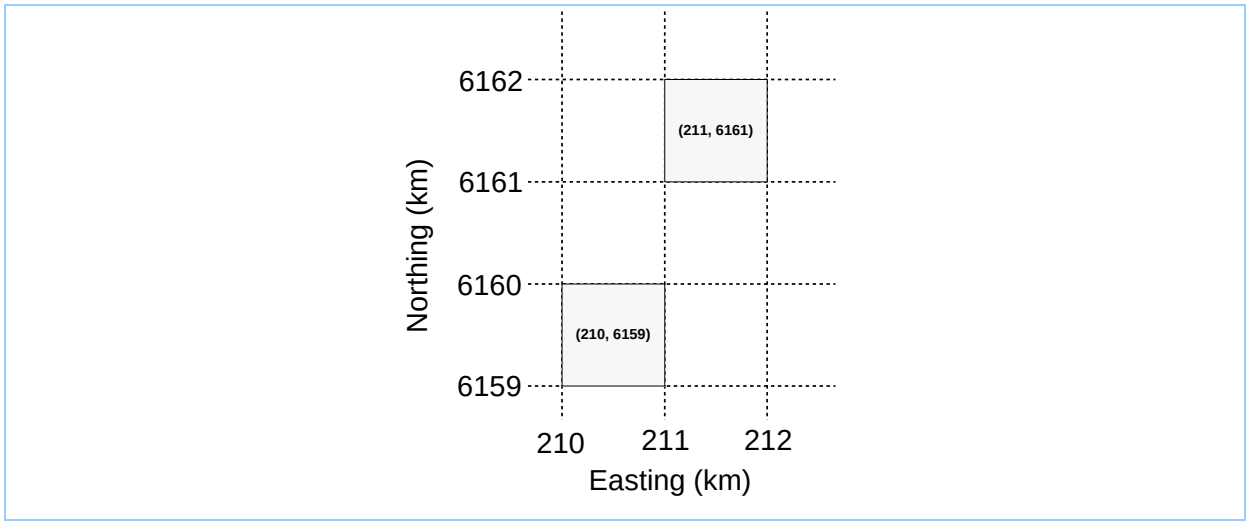

Figure 2-1: Grid coordinate system

Figure 2-2: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

2.4 Emission Sources Considered

The commercial sectors included in the commercial emissions inventory are outlined in Table 2-2.

Table 2-2: ANZSIC codes used to classify commercial businesses [a]

Subdivision/Description	Group/Description	Class/Description
01/Agriculture	014/Poultry farming	0141/Poultry farming (meat)
		0142/Poultry farming (eggs)
14/Other mining	141/Construction material mining	1411/Gravel and sand quarrying
		1419/Construction material mining n.e.c.
21/Food, beverage and tobacco	212/Dairy product manufacturing	2121/Milk and cream processing
		2122/Ice cream manufacturing
		2129/Dairy product manufacturing
	213/Fruit and vegetable processing	2130/Fruit and vegetable processing
	216/Bakery product manufacturing	2161/Bread manufacturing
		2162/Cake and pastry manufacturing
		2163/Biscuit manufacturing
	217/Other food manufacturing	2172/Confectionary manufacturing
		2174/Prepared animal and bird feed manufacturing
		2179/Food manufacturing n.e.c.
	218/Beverage and malt manufacturing	2181/Soft drink, cordial and syrup manufacturing
		2182/Beer and malt manufacturing
		2183/Wine manufacturing
		2184/Spirit manufacturing
22/Textile, clothing, footwear and leather manufacturing	221/Textile, fibre, yearn and woven fabric manufacturing	2214/Wool textile manufacturing
	224/Clothing manufacturing	2249/Clothing manufacturing n.e.c.
	226/Leather and leather product manufacturing	2261/Leather tanning and fur dressing
23/Wood and paper product manufacturing	232/Other wood product manufacturing	2321/Plywood and veneer manufacturing
		2322/Fabricated wood manufacturing
		2323/Wooden structural component manufacturing
		2329/Wood product manufacturing n.e.c.
		2332/Solid paperboard container manufacturing
		2339/Paper product manufacturing n.e.c.
24/Printing, publishing and recorded media	241/Printing and services to printing	2412/Printing
25/Petroleum, coal, chemical and associated product manufacturing	252/Petroleum and coal product manufacturing n.e.c.	2520/Petroleum and coal product manufacturing n.e.c.
	253/Basic chemical manufacturing	2531/Fertiliser manufacturing
		2532/Industrial gas manufacturing
		2533/Synthetic resin manufacturing
		2534/Organic industrial chemicals manufacturing n.e.c.
		2535/Inorganic industrial chemicals manufacturing n.e.c.
	254/Other chemical product manufacturing	2541/Explosive manufacturing
		2542/Paint manufacturing
		2543/Medicinal and pharmaceutical product manufacturing
		2545/Soap and other detergent manufacturing

Subdivision/Description	Group/Description	Class/Description
		2547/Ink manufacturing
		2549/Chemical product manufacturing n.e.c.
	255/Rubber product manufacturing	2559/Rubber product manufacturing
	256/Plastic product manufacturing	2563/Plastic bag and film manufacturing
		2564/Plastic product rigid fibre reinforced manufacturing
		2566/Plastic injection moulded product manufacturing
26/Non-metallic mineral product manufacturing	261/Glass and glass product manufacturing	2610/Glass and glass product manufacturing
		2621/Clay brick manufacturing
		2622/Ceramic product manufacturing
		2623/Ceramic tile and pipe manufacturing
		2629/Ceramic product manufacturing n.e.c.
		2631/Cement and lime manufacturing
		2632/Plaster product manufacturing
		2633/Concrete slurry manufacturing
		2634/Concrete pipe and box culvert manufacturing
27/Metal product manufacturing	271/Iron and steel manufacturing	2711/Basic iron and steel manufacturing
		2712/Iron and steel casting and forging
		2713/Steel pipe and tube manufacturing
		2729/Basic non ferrous metal manufacturing
	273/Non ferrous basic metal product manufacturing	2733/Nonferrous metal casting
	274/Structural metal product manufacturing	2742/Architectural aluminium product manufacturing
		2749/Structural metal product manufacturing n.e.c.
	275/Sheet metal product manufacturing	2751/Metal container manufacturing
	276/Fabricated metal product manufacturing	2762/Spring and wire product manufacturing
		2763/But, bolt, screw and rivet manufacturing
		2764/Metal coating and finishing
		2769/Fabricated metal product manufacturing n.e.c.
28/Machinery and equipment manufacturing	281/Motor vehicle and part manufacturing	2819/Automotive component manufacturing n.e.c.
	282/Other transport equipment manufacturing	2821/Shipbuilding
		2824/Aircraft manufacturing
		2829/Transport equipment manufacturing n.e.c.
	284/Electronic equipment manufacturing	2849/Electronic equipment manufacturing n.e.c.
	285/Electrical equipment manufacturing	2852/Electric cable and wire manufacturing
		2853/Battery manufacturing
		2859/Electrical equipment manufacturing n.e.c.
	286/Industrial machinery and equipment manufacturing	2862/Mining and construction machinery manufacturing
29/Other manufacturing	292/Furniture manufacturing	2921/Wooden furniture and upholstered seat

Subdivision/Description	Group/Description	Class/Description
		manufacturing
		2922/Sheet metal furniture manufacturing
		2929/Furniture manufacturing n.e.c.
41/General construction	412/Non building construction	4121/Road and bridge construction
		4122/Non building construction n.e.c.
45/Mineral, metal and chemical wholesaling	452/Mineral, metal and chemical wholesaling	4521/Petroleum product wholesaling
		4523/Chemical wholesaling
53/Motor vehicle services	532/Motor vehicle services	5321/Automotive fuel retailing
		5323/Smash repairing
57/Accommodation, cafes and restaurants	573/Cafes and restaurants	5730/Cafes and restaurants
66/Services to water transport	662/Services to water transport	6622/Water transport terminals
86/Health services	861/Hospitals and nursing homes	8611/Hospitals
		8613/Nursing homes
95/Personal services	952/Other personal services	9521/Laundries and dry cleaners
		9524/Funeral directors, crematoria and cemeteries

a n.e.c. = not elsewhere classified

Exhaust emissions from commercial off-road vehicles are included in the off-road mobile emissions inventory, while emissions from off-road vehicle specific processes (e.g. material loading by a front-end loader) and wheel generated dust emissions are included in the commercial emissions inventory. Emissions from wind erosion on unpaved roads are included in the biogenic and geogenic emissions inventory.

2.5 Pollutants Evaluated

The following pollutants have been considered:

- Substances included in the National Environment Protection (National Pollutant Inventory) Measure (NEPC, 2008);
- Pollutants included in the National Environment Protection (Ambient Air Quality) Measure (NEPC, 2003);
- Pollutants included in the National Environment Protection (Air Toxics) Measure (NEPC, 2004);
- Pollutants associated with the Protection of the Environment Operations (Clean Air) Regulation 2010 (PCO, 2011);
- Air pollutants associated with the Protection of the Environment Operations (General) Regulation 2009 (PCO, 2010);
- Speciation of oxides of nitrogen (i.e. NO and NO_2) for photochemical modelling (USEPA, 2003c)*;
- Speciated organic compounds for photochemical modelling sourced from Carter (2010);

* The default NO_x speciation profile used in the inventory is 95% NO and 5% NO_2.

- Speciated particulate emissions (i.e. TSP (total suspended particulate), PM_{10} (particulate matter with an aerodynamic diameter ≤ 10 µm) and $PM_{2.5}$ (particulate matter with an aerodynamic diameter ≤ 2.5 µm));
- Environment Protection Authority of Victoria air toxic pollutants sourced from Hazardous Air Pollutants - A Review of Studies Performed in Australia and New Zealand (EPAV, 1999);
- Commonwealth Government Air Toxics Program Technical Advisory Group (13 March 2000) priority air pollutants (EA, 2001b);
- U.S. Environmental Protection Agency list of 189 Hazardous Air Pollutants (USEPA, 2010);
- Air pollutants included in the Office of Environmental Human Health Assessment (OEHHA)/Air Resources Board (ARB) 'hot spots' list (CARB, 2011);
- EPA regulated pollutants with design ground level concentrations (DEC, 2005);
- USEPA 16 priority polycyclic aromatic hydrocarbons (PAH) (Keith et. al., 1979);
- WHO97 polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and polychlorinated biphenyls (PCB) (Van den Berg et. al., 1998); and
- Greenhouse gases (i.e. carbon dioxide, methane and nitrous oxide) included in the National Greenhouse Accounts (NGA) Factors (DCCEE, 2010).

2.6 Methodology Overview

This section contains a broad overview of the methodology used to develop the commercial air emissions inventory, while specific details are provided in Section 3.

The methodology used to develop the commercial air emissions inventory involves the following steps:

2.6.1 Commercial Business Identification

Commercial businesses are those defined in Section 2.4 with the potential for air emissions in the GMR that do not hold an environment protection licence under the NSW POEO Act (Protection of the Environment Operations Act 1997).

Businesses have been identified from a number of different sources including:

- NSW WorkCover database for hazardous materials;
- NSW telephone directory;
- Service station lists from major oil distributors (BP, Shell, Caltex/Ampol and Mobil);
- NSW Department of Primary Industries;
- NSW Health Services Directory; and
- The Environmental Health Branch of the NSW Government.

Business addresses have been geocoded to obtain the spatial location for each business. The geocoding process queried calibrated street map layers to search for the postcode, suburb, street name and street number in order to return the most accurate MGA (Map Grid of Australia) coordinates for the business (the datum used is GDA94). Where the street number could not be located the street centroid

coordinate was returned. Where the street name could not be found the suburb centroid was returned. The statistics from the geocoding process are presented in Table 2-3.

Table 2-3: Results from geocoding process

Geocoding Accuracy	Number of Businesses
Accurate to business street number	4,423
Accurate to business street	515
Accurate to business suburb	1,285
Total	**6,223**

a It should be noted that not all commercial businesses identified have been included in the commercial emissions inventory

The coordinates have been used to spatially allocate emission sources unless more accurate data have been provided. Where commercial businesses provided specific coordinates for emission sources, the default coordinates generated from geocoding have been overwritten.

2.6.2 Emission Source Identification

Once all businesses were located, all possible emission sources from each commercial type (separated into ANZSIC classes or groups) and the substances emitted from each emission source were identified.

2.6.3 Emission Estimation Technique Design

All emissions are calculated within a specifically designed database which stores facility details and emission sources and uses NPI and USEPA emission factors to estimate emission loads. In this project, source emission test data have been used to estimate emissions to air in preference to default methodologies that utilise emission factors.

In general, emissions have been estimated using Equation 1.

$$E_{i,j} = A_j \times EF_{i,j} \times CF_{i,j} \qquad \textbf{Equation 1}$$

where:

$E_{i,j}$	=	Emissions of substance i from process j	(kg/year)
$EF_{i,j}$	=	Emission factor for substance i from process j	(kg/activity unit)
A_j	=	Rate of activity for process j	(activity unit/year)
$CF_{i,j}$	=	Control factor for substance i for process j	(-)

2.6.4 Identification of Required Data to Estimate Emissions

Based on the designed emission estimation techniques the required data to estimate emissions from each source were identified.

2.6.5 Data Acquisition

Activity data were estimated using a combination of the following methods for each commercial business sector:

1) Where commercial businesses had responded to the survey conducted for the 2003 air emissions inventory (commercial businesses in the 2003 air emissions inventory and facilities that were

licensed under POEO in 2003 but have since been de-scheduled), activity data provided in returned questionnaire was used to estimate emissions for the 2008 calendar year.

2) Where commercial businesses reported to the NPI for the 2007/2008 reporting period, activity data was back calculated using a matrix of emission factors for common sources and the derived activity data was used to estimate emissions for the 2008 commercial air emissions inventory

3) Where activity data on a business level or sector level were available from government departments and other service providers, this data was used to estimate the relevant activity data on a business by business level for the 2008 commercial air emissions inventory.

A detailed discussion of the activity, spatial and temporal data acquired for each commercial source is presented in Section 3.

2.6.6 Deriving Commercial Type Specific Projection Factors

Projection factors have been derived based on energy (primary or final) projections published by ABARE (Australian Bureau of Agricultural and Resource Economics) national or state projection data (e.g. Australian Energy, National and State Projections to 2029/2030, ABARE, 2006) or population forecasts provided by TDC (TDC, 2009).

Projection factors have been developed for every year from 2009 to 2036 (emissions for the base year 2008 are based on emission estimation techniques).

The projection factors for each source are used to estimate emissions in future annual periods using Equation 2:

$$E_{i,j,k,n} = E_{i,j,k,2008} \times PF_{j,k,n} \qquad \textbf{Equation 2}$$

where:

$E_{i,j,k,n}$	=	Emission of substance i from location j for source type k for year n	(kg/year)
$E_{i,j,k,2008}$	=	Emission of substance i from location j for source type k for the base year, 2008	(kg/year)
$PF_{j,k,n}$	=	Projection factor for location j for source type k for year n (relative to the base year)	(-)

The methodology followed to assign projection factors to each commercial ANZSIC class was as follows:

- ABARE energy projection data for ANZSIC categories were obtained for 2004/2005 to 2030/2031 for primary and final energy consumption for NSW and by energy type (ABARE, 2006);
- Population forecasts were obtained for 2006 to 2036 from Transport Data Centre for the GMR (TDC, 2009).
- Energy usage for 2031/2032 to 2036/2037 were forecast based on ABARE data using linear regression (i.e. assuming linear growth rates out to 2036/2037);
- Calendar year energy usage was estimated based on the average of the two corresponding financial years (e.g. 2008 is the average energy usage from 2007/2008 and 2008/2009);

- ABARE energy projections or population projections were matched up with activities based on ANZSIC93 class generally. Some exceptions from this approach were forced in certain instances (e.g. Petroleum Wholesaling is matched with petroleum refining);
- Generally, either total primary or final energy consumption or population projections were chosen as the projection surrogate based on judgement for each ANZSIC class.

The basis for each commercial activity specific projection factors are provided in Table 2-4.

Table 2-4: Basis for commercial activity specific projection factors

Projection Basis	ABARE Category	ABARE ANZSIC Basis	Activity	Assigned ANZSIC93 Class
Final energy consumption	Agriculture (Section 3.1.6)	Division A	Dairy product manufacturing n.e.c.	2129
			Milk and cream processing	2121
			Poultry farming (eggs)	0142
			Poultry Farming (meat)	0141
			Prepared animal and bird feed manufacturing	2174
	Air transport (Section 3.23.6)	Subdivision 64	Aircraft manufacturing	2824
			Services to air transport	6630
	Basic chemicals (Section 3.15.6)	Group 253	Chemical product manufacturing n.e.c.	2549
			Chemical wholesaling	4523
			Fertiliser manufacturing	2531
			Inorganic industrial chemical manufacturing n.e.c.	2535
			Organic industrial chemical manufacturing n.e.c.	2534
			Synthetic resin manufacturing	2533
	Basic non-ferrous metals products (Section 3.23.6)	Group 272 and Group 273	Aluminium rolling, drawing, extruding	2731
			Architectural aluminium product manufacturing	2742
	Commercial and service (Section 3.2.6)	Sectors 37, 66 and 67; Divisions F, G, H, J, K, L, M, N, O, P and	Scientific research	7810
			Smash repairing	5323
			Waste disposal services	9634
	Iron and steel (Section 3.23.6)	Group 271	Iron and steel casting and forging	2712
	Mining (Section 3.7.6)	Division B	Construction material mining n.e.c.	1419
			Gravel and sand quarrying	1411
			Mining and construction machinery manufacturing	2862
	Non-metallic minerals (Section 3.11.6)	Subdivision 26	Ceramic product manufacturing	2622
			Ceramic product manufacturing n.e.c.	2629
			Ceramic tile and pipe manufacturing	2623
			Clay brick Manufacturing	2621
			Concrete slurry manufacturing	2633

Projection Basis	ABARE Category	ABARE ANZSIC Basis	Activity	Assigned ANZSIC93 Class
			Glass and glass product manufacturing	2610
	Other basic non ferrous metals (Section 3.23.6)	Classes 2720–2721, 2723–2729	Non-ferrous metal casting	2733
	Other industry (Section 3.10.6)	NA (but other industry within Division C)	Agricultural machinery manufacturing	2861
			Automotive component manufacturing n.e.c.	2819
			Battery manufacturing	2853
			Beer and malt manufacturing	2182
			Biscuit manufacturing	2163
			Bread manufacturing	2161
			Cake and pastry manufacturing	2162
			Clothing manufacturing n.e.c.	2249
			Confectionery manufacturing	2172
			Corrugated paperboard container manufacturing	2333
			Electric cable and wire manufacturing	2852
			Electrical and equipment manufacturing n.e.c.	2859
			Electronic equipment manufacturing n.e.c.	2849
			Explosive manufacturing	2541
			Fabricated metal product manufacturing n.e.c.	2769
			Food manufacturing n.e.c.	2179
			Fruit and vegetable processing	2130
			Furniture manufacturing n.e.c.	2929
			Ice cream manufacturing	2122
			Industrial gas manufacturing	2532
			Ink manufacturing	2547
			Leather tanning and fur dressing	2261
			Lifting and material handling equipment manufacturing	2865
			Medicinal and pharmaceutical product manufacturing	2543
			Metal coating and finishing	2764
			Metal container manufacturing	2751
			Non-metallic mineral product manufacturing n.e.c.	2640
			Oil and fat manufacturing	2140
			Paint manufacturing	2542
			Plaster product manufacturing	2632
			Plastic bag and film manufacturing	2563
			Plastic injection moulded product manufacturing	2566
			Plastic product, rigid fibre	2564

Projection Basis	ABARE Category	ABARE ANZSIC Basis	Activity	Assigned ANZSIC93 Class
			reinforced, manufacturing	
			Professional and scientific equipment manufacturing n.e.c.	2839
			Rubber product manufacturing n.e.c.	2559
			Soap and other detergent manufacturing	2545
			Soft drink, cordial and syrup manufacturing	2181
			Spirit manufacturing	2184
			Spring and wire product manufacturing	2762
			Steel pipe and tube manufacturing	2713
			Structural metal product manufacturing n.e.c.	2749
			Structural steel fabricating	2741
			Transport equipment manufacturing n.e.c.	2829
			Wooden furniture and upholstered seat manufacturing	2921
	Pipeline transport (Section 3.23.6)	Class 6501	Gas supply	3620
	Rail transport (Section 3.23.6)	Subdivision 62	Rail transport	6200
			Railway equipment manufacturing	2823
	Road transport (Section 3.23.6)	Subdivision 61	Non-building construction n.e.c.	4122
			Road and bridge construction	4121
	Water transport (Section 3.17.6)	Subdivision 63	Port operators	6623
			Shipbuilding	2821
	Wood, paper and printing (Section 3.9.6)	Subdivision 23 & Subdivision 24	Fabricated wood manufacturing	2322
			Log sawmilling	2311
			Paper product manufacturing n.e.c.	2339
			Printing	2412
			Solid paperboard container manufacturing	2332
			Wood product manufacturing n.e.c.	2329
			Wooden structural component manufacturing	2323
Population	NA (Section 3.3.6)	NA	Funeral directors, crematoria and cemeteries	9524
			Hospitals	8611
			Laundries and dry-cleaners	9521
			Nursing homes	8613
			Water supply	3701
			Wine manufacturing	2183
Primary energy consumption	Iron and steel (Section 3.12.6)	Group 271	Basic iron and steel manufacturing	2711
			Basic non-ferrous metal manufacturing n.e.c.	2729
	Petroleum refining	Group 251	Automotive fuel retailing	5321
			Petroleum product wholesaling	4521

Projection Basis	ABARE Category	ABARE ANZSIC Basis	Activity	Assigned ANZSIC93 Class
	(Section 3.1.6)			

The projection methodology for each commercial sector is presented in Section 3.

2.6.7 Emission Estimation

Emissions have been estimated using data sourced from Australian government agencies, peak body groups and supplied in commercial questionnaires. Generally emissions have been estimated using emission factors sourced from references provided in Table 2-5.

Table 2-5: Typical reference sources for emission factors

Substance	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	- USEPA AP42 Compilation of Air Pollutant Emission Factors (USEPA, 2011b) - NPI Emission Estimation Technique Manuals (DSEWPC, 2011)
$PM_{2.5}$, PM_{10} & TSP	- USEPA AP42 Compilation of Air Pollutant Emission Factors (USEPA, 2011b) - NPI Emission Estimation Technique Manuals (DSEWPC, 2011) - California Emissions Inventory and Reporting System (CEIDARS) Particulate Matter Size Profiles (CARB, 2008) - USEPA AP42 *Chapter 13.2.1 Paved Roads & Chapter 13.2.2 Unpaved Roads* (USEPA, 2006c; 2011a). A detailed description of wheel generated dust emission estimates is presented in Appendix B
Organic air toxics	- USEPA SPECIATE v4.2 software (USEPA, 2008e) - California Emissions Inventory and Reporting System Organic Speciation Profiles (CARB, 2005)
Metal air toxics	- California Emissions Inventory and Reporting System Particulate Matter Speciation Profiles (CARB, 2007) - USEPA SPECIATE v4.2 software (USEPA, 2008e)
Ammonia	- Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
Sulfuric or hydrochloric acid	- USEPA AP42 Compilation of Air Pollutant Emission Factors (USEPA, 2011b) - NPI Emission Estimation Technique Manuals (DSEWPC, 2011) - Mass balance - Raoult's law (Raoult, M, 1882a; 1882b, 1887a; 1887b), using chemical properties from Perry and Green (1997)
PAH	- USEPA AP42 Compilation of Air Pollutant Emission Factors (USEPA, 2011b) - USEPA SPECIATE v4.2 software (USEPA, 2008e) - NPI Emission Estimation Technique Manuals (DSEWPC, 2011)
PCDD/PCDF	- Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004) - Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases (UNEP, 2005)

Substance	Emission Factor Source
Speciated VOC & Methane	- USEPA SPECIATE v4.2 software (USEPA, 2008e) - California Emissions Inventory and Reporting System Organic Speciation Profiles (CARB, 2005) - USEPA TANKS 4.09D software (USEPA, 2006e)
Greenhouse gases (CO_2=and N_2O)	- National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009b)

Commercial source specific emission estimation techniques are detailed in Section 3.

2.6.8 Data Storage

All emissions have been calculated within the Commercial Emissions Inventory Database, which is a Microsoft® Access™ 2003 database with SQL back end. The Commercial Emissions Inventory Database was originally designed and configured for the 2003 NSW GMR air emissions inventory (PAE, 2007). The database facilitates the storage of all data required for estimating emissions to air from commercial sources, including: activity data; emission factors; volatile organic compound (VOC) speciation profiles; spatial allocation data; hourly, daily and monthly temporal variation data; and emission projection factors. The Commercial Emissions Inventory Database start-up form is shown in Figure 2-3.

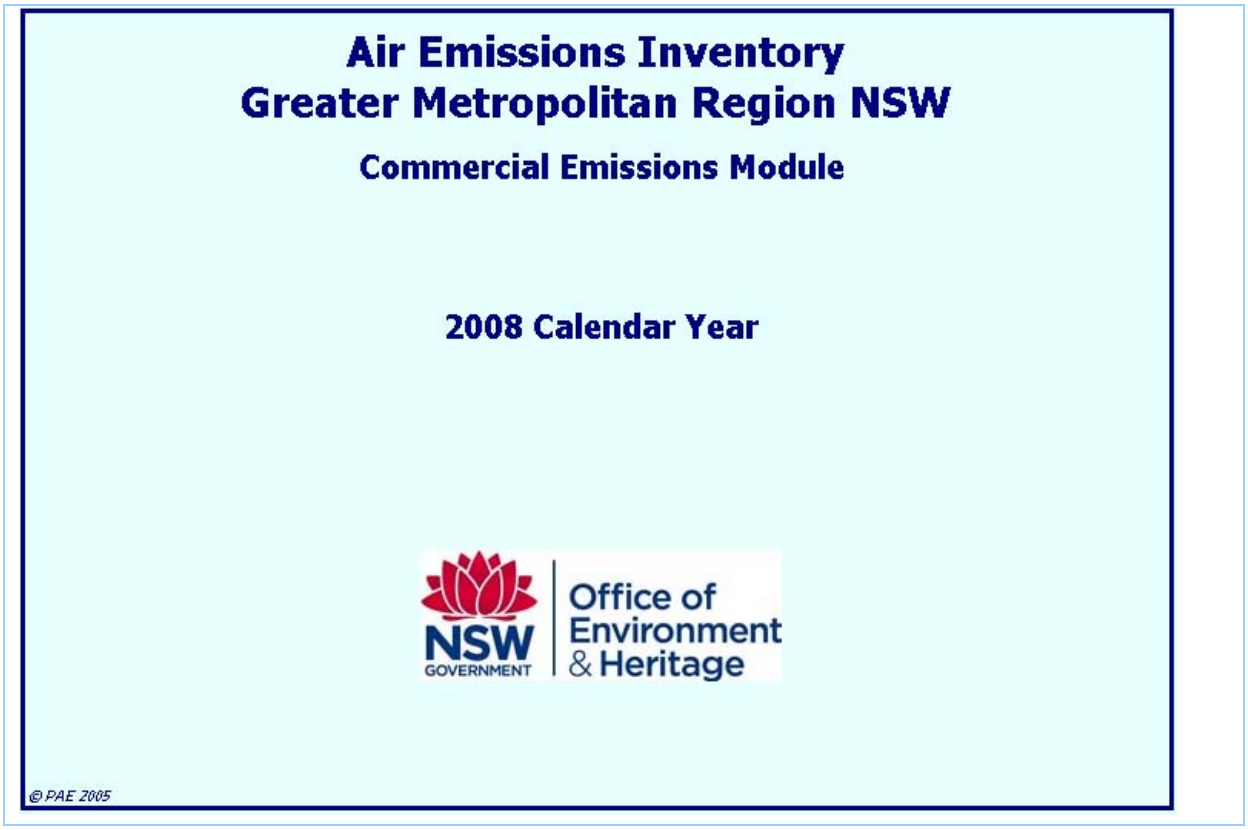

Figure 2-3: Commercial emissions inventory database start-up form

Users can enter and store facility details, including, facility name, address details as well as identified emission sources, locations of emission sources, and other facility details into the Facility Configuration Screen shown in Figure 2-4.

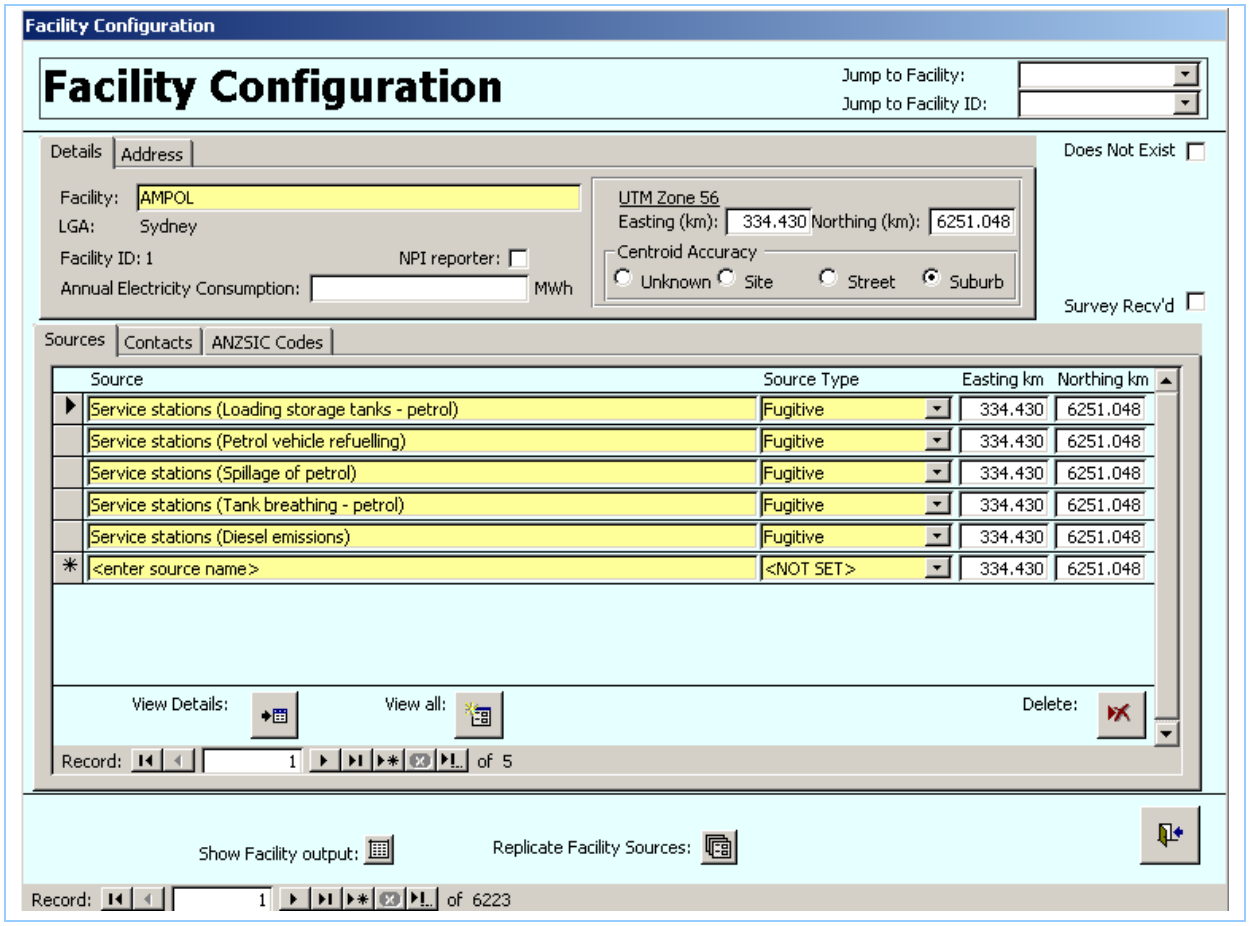

Figure 2-4: Facility configuration screen

Once emission sources have been identified, users can configure each emission source by selecting an appropriate EET from a library of techniques as well as select the most appropriate organic speciation profile using the Emission Source Configuration Screen shown in Figure 2-5. Users can also store source information such as stack parameters if required and temporal factors to describe how the emission source varies over time.

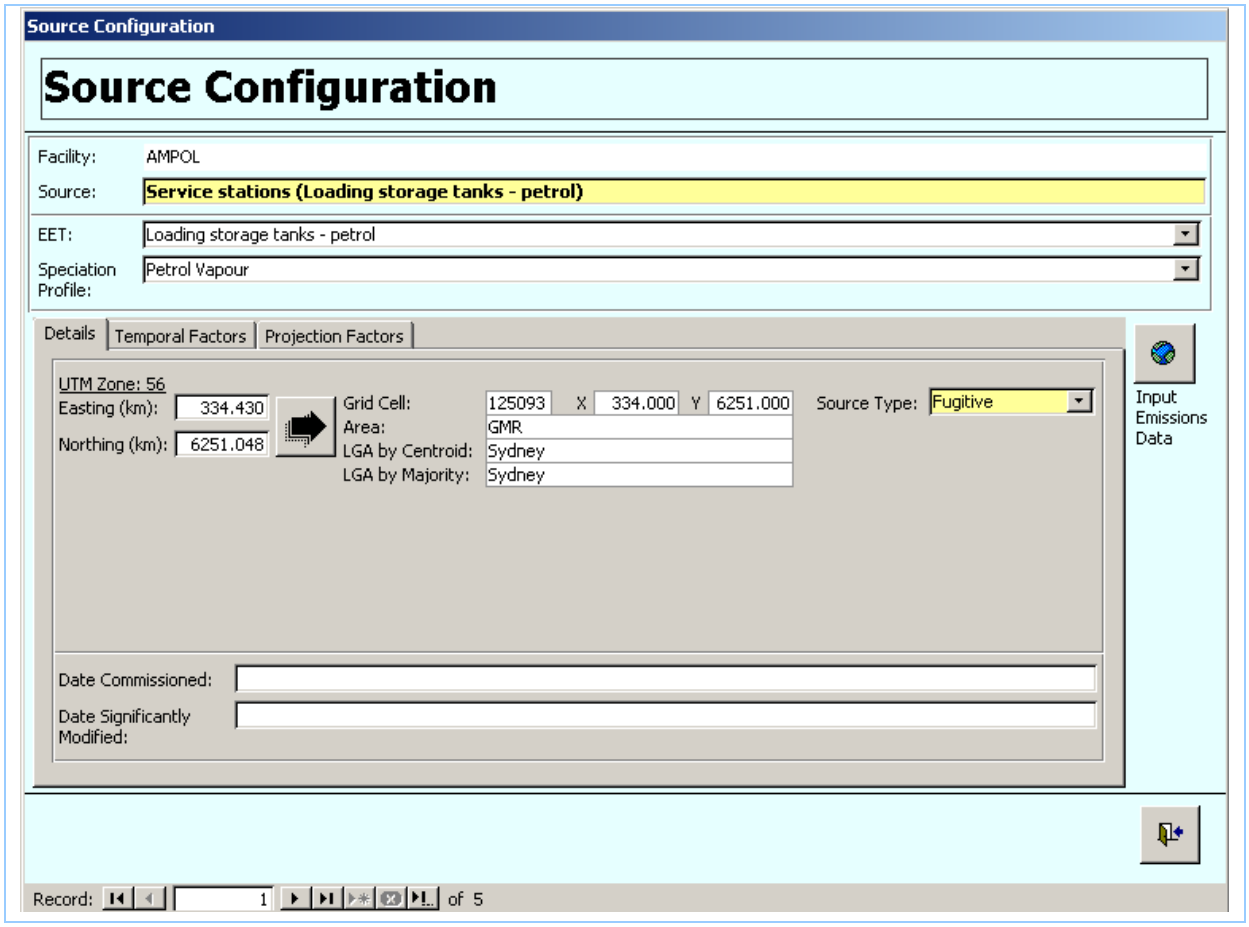

Figure 2-5: Emission source configuration screen

Emissions are estimated using the Emission Estimation Screen shown in Figure 2-6. Users are required to enter the required source activity data corresponding to the EET selected to estimate emissions. Substance specific emission control factors may be entered corresponding to site specific control technologies that may be in place.

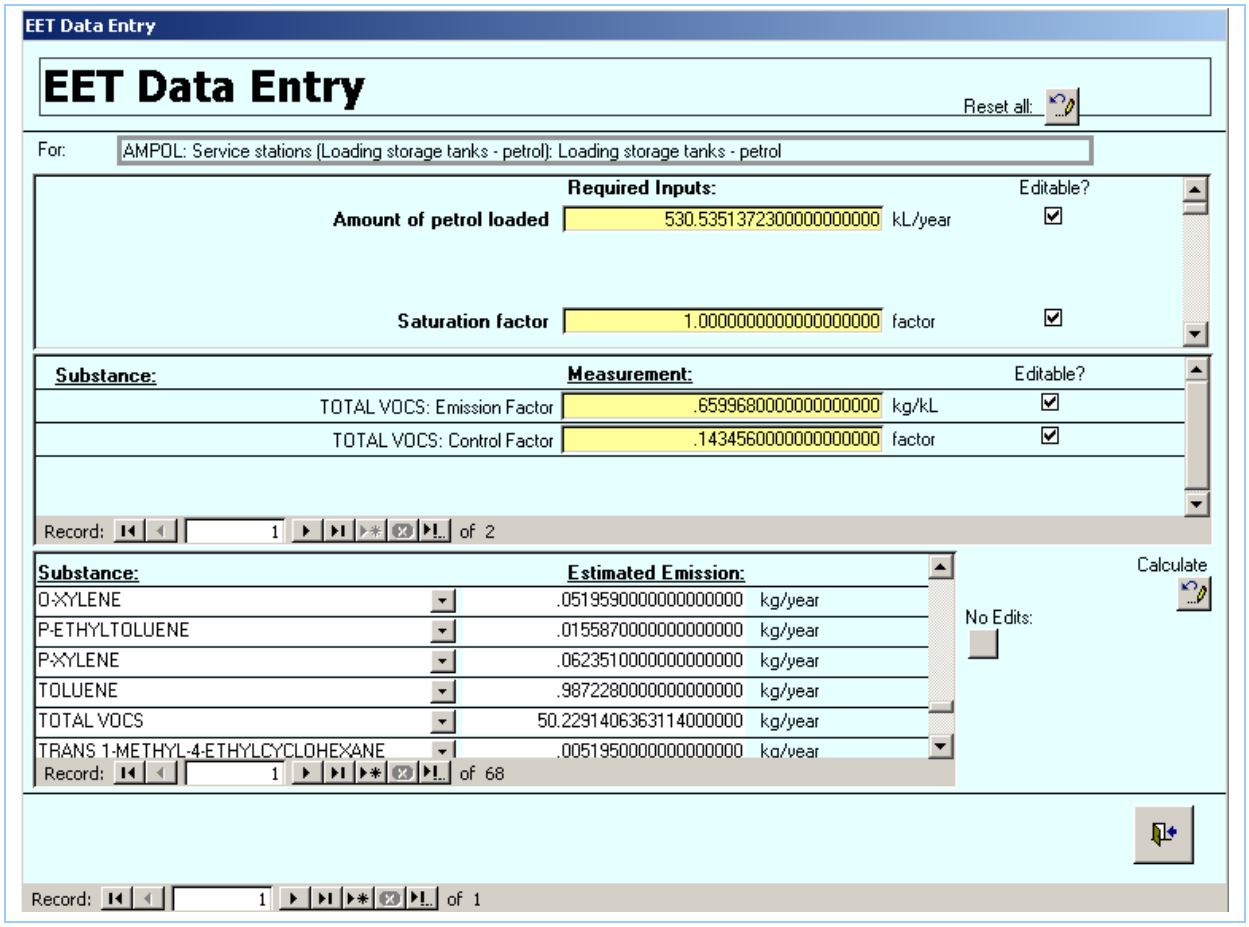

Figure 2-6: Emission estimation screen

3 DATA SOURCES AND RESULTS

Emissions have been calculated based on information supplied in the returned questionnaires, other data available from industry personnel, USEPA, CARB and NPI emission factors for various engineering and combustion processes. Where monitoring data or stack test data were available, this was used in preference to literature emission rates. All emissions are calculated by a specifically designed database which stores facility details and emission sources and uses NPI and USEPA emission factors to estimate emission loads.

In this section the term "combustion products" is intended to include TSP, PM_{10}, $PM_{2.5}$, SO_2, CO, NO_x and VOC (total and speciated). The term "particulate matter" (PM) refers to TSP, PM_{10} and $PM_{2.5}$.

In this section total emissions are presented for each NSW Activity Type for the GMR, Sydney, Newcastle and Wollongong regions in all cases and emissions released in the "Non Urban" region for Activity types where emissions in this area are significant. The "Non Urban" region is defined as the area within the GMR that is not bounded by Sydney, Newcastle or Wollongong. Emissions are presented for the following pollutants only:

- 1,3-butadiene
- Acetaldehyde
- Benzene
- Carbon monoxide (CO)
- Formaldehyde
- Isomers of xylene
- Lead & compounds
- Oxides of nitrogen (NO_x)
- Particulate matter ≤ 10 µm (PM_{10})
- Particulate matter ≤ 2.5 µm ($PM_{2.5}$)
- Perchloroethylene
- Polycyclic aromatic hydrocarbons (PAH)
- Sulfur dioxide (SO_2)
- Toluene
- Total suspended particulate (TSP)
- Total volatile organic compounds (VOC)
- Trichloroethylene

These substances have been selected since they are:

- The most common air pollutants found in airsheds according to the National Pollutant Inventory (NEPC, 2008);

- Referred to in National Environment Protection Measures (NEPMs) for ambient air quality (NEPC, 2003) and air toxics (NEPC, 2004); and
- They have been classified as priority air pollutants (NEPC, 2006).

Total commercial emissions of all substances emitted in the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are presented in Appendix A.

In total, individual business emissions represented by 97 commercial ANZSIC classes are included in the commercial emissions inventory. However, over 93% of businesses (i.e. 4,841 businesses) are within the following 11 ANZSIC classes:

- Automotive Fuel Retailing
- Smash Repairing
- Laundries & Dry Cleaners
- Poultry Farming
- Hospitals
- Wine Manufacturing
- Construction Material Mining
- Funeral Directors, Crematoria & Cemeteries
- Printing, Publishing and Recorded Media
- Plastic Product Rigid Fibre Reinforced Manufacturing
- Concrete Product Manufacturing

Emissions from these 11 ANZSIC classes are presented separately in this section along with emissions from all ANZSIC classes that have been identified to be significant commercial contributors to emissions of criteria pollutants (i.e. NO_x, VOC, PM_{10}, CO or SO_2). The ANZSIC classes that have been identified to be significant contributors to emissions of criteria pollutants are:

- Basic Iron and Steel Manufacturing
- Bread Manufacturing
- Ceramic Product Manufacturing
- Chemical Product Manufacturing n.e.c.
- Food Product Manufacturing n.e.c.
- Port Operators
- Plaster Product Manufacturing
- Glass and Glass Product Manufacturing
- Paint Manufacturing
- Steel Pipe and Tube Manufacturing
- Metal Coating and Finishing

Summary emissions for the remaining 74 ANZSIC classes are presented in Section 3.23.

Summary statistics on the coverage of the 2008 commercial air emissions inventory are presented in Table 3-1.

Table 3-1: Summary statistics for commercial facility coverage in the 2008 air emissions inventory

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Automotive fuel retailing	2087	2089	199	0	2,087	100%
Smash repairing	1258	126	3	0	1,258	100%
Laundries and dry-cleaners	563	56	6	2	563	100%
Poultry farming (Eggs)	50	0	0	0	50	100%
Poultry farming (Meat)	325	0	0	1	325	100%
Hospitals	141	146	41	0	141	100%
Wine manufacturing	106	129	16	1	106	100%
Construction material mining [f]	60	64	3	1	60	100%
Funeral directors, crematoria and cemeteries	21	21	9	0	21	100%
Printing	84	70	25	1	84	100%
Plastic product, rigid fibre reinforced, manufacturing	88	87	8	3	88	100%
Concrete slurry manufacturing	58	57	3	0	58	100%
Agricultural machinery manufacturing	1	1	1	0	1	100%
Aircraft manufacturing	6	6	0	1	1	17%
Aluminium rolling, drawing, extruding	2	0	0	2	2	100%
Architectural aluminium product manufacturing	3	3	0	0	0	0%
Automotive component manufacturing n.e.c.	11	11	4	0	4	36%
Basic iron and steel manufacturing	11	10	6	1	7	64%
Basic non-ferrous metal manufacturing n.e.c.	6	5	3	0	3	50%
Battery manufacturing	4	4	1	0	1	25%
Beer and malt manufacturing	3	0	0	3	3	100%
Biscuit manufacturing	2	2	0	2	2	100%
Bread manufacturing	8	6	1	4	5	63%
Cake and pastry manufacturing	2	2	1	0	1	50%

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Ceramic product manufacturing	5	4	0	3	3	60%
Ceramic product manufacturing n.e.c.	7	7	1	0	1	14%
Ceramic tile and pipe manufacturing	2	2	0	0	0	0%
Chemical product manufacturing n.e.c.	72	69	15	2	17	24%
Chemical wholesaling	30	27	6	0	6	20%
Clay brick manufacturing	4	4	0	0	0	0%
Clothing manufacturing n.e.c.	4	4	0	0	0	0%
Confectionery manufacturing	7	5	4	1	5	71%
Corrugated paperboard container manufacturing	2	1	0	2	2	100%
Dairy product manufacturing n.e.c.	1	1	0	0	0	0%
Electric cable and wire manufacturing	2	2	1	0	1	50%
Electrical and equipment manufacturing n.e.c.	20	20	3	0	3	15%
Electronic equipment manufacturing n.e.c.	4	4	1	0	1	25%
Explosive manufacturing	5	3	0	2	2	40%
Fabricated metal product manufacturing n.e.c.	46	32	22	0	22	48%
Fabricated wood manufacturing	1	1	0	0	0	0%
Fertiliser manufacturing	1	1	0	0	0	0%
Food manufacturing n.e.c.	59	58	6	5	11	19%
Fruit and vegetable processing	3	3	1	0	1	33%
Furniture manufacturing n.e.c.	38	38	4	0	4	11%
Gas supply	6	6	0	6	6	100%
Glass and glass product manufacturing	6	5	2	1	3	50%
Ice cream manufacturing	1	1	1	0	1	100%
Industrial gas manufacturing	10	10	2	0	2	20%
Ink manufacturing	7	7	2	0	2	29%
Inorganic industrial chemical manufacturing n.e.c.	2	1	0	1	1	50%
Iron and steel casting and forging	1	1	0	0	0	0%

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Leather tanning and fur dressing	2	2	0	0	0	0%
Lifting and material handling equipment manufacturing	1	1	1	0	1	100%
Log sawmilling	1	0	1	0	1	100%
Medicinal and pharmaceutical product manufacturing	15	15	3	0	3	20%
Metal coating and finishing	111	96	34	1	35	32%
Metal container manufacturing	3	3	0	0	0	0%
Milk and cream processing	1	1	1	0	1	100%
Mining and construction machinery manufacturing	9	9	2	0	2	22%
Non-building construction n.e.c.	13	13	2	0	2	15%
Non-ferrous metal casting	1	1	1	0	1	100%
Non-metallic mineral product manufacturing n.e.c.	1	0	1	0	1	100%
Nursing homes	373	0	0	0	0	0%
Oil and fat manufacturing	1	0	1	0	1	100%
Organic industrial chemical manufacturing n.e.c.	2	1	1	0	1	50%
Paint manufacturing	24	23	6	0	6	25%
Paper product manufacturing n.e.c.	5	5	2	1	3	60%
Petroleum product wholesaling	86	80	11	20	31	36%
Plaster product manufacturing	2	2	1	0	1	50%
Plastic bag and film manufacturing	10	10	3	0	3	30%
Plastic injection moulded product manufacturing	155	153	13	1	14	9%
Port operators	1	1	1	0	1	100%
Prepared animal and bird feed manufacturing	4	3	1	2	3	75%
Professional and scientific equipment manufacturing n.e.c.	1	0	0	1	1	100%
Rail transport	1	1	1	0	1	100%
Railway equipment manufacturing	1	0	0	1	1	100%
Road and bridge construction	26	23	9	0	9	35%
Rubber product manufacturing n.e.c.	8	8	6	0	6	75%

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Scientific research	1	0	0	1	1	100%
Services to air transport	1	0	1	0	1	100%
Shipbuilding	1	1	0	0	0	0%
Soap and other detergent manufacturing	7	7	2	0	2	29%
Soft drink, cordial and syrup manufacturing	4	3	1	2	3	75%
Solid paperboard container manufacturing	3	3	2	0	2	67%
Spirit manufacturing	3	3	1	1	2	67%
Spring and wire product manufacturing	13	13	5	1	6	46%
Steel pipe and tube manufacturing	7	7	3	0	3	43%
Structural metal product manufacturing n.e.c.	4	3	2	1	3	75%
Structural steel fabricating	1	1	1	0	1	100%
Synthetic resin manufacturing	7	3	5	0	5	71%
Transport equipment manufacturing n.e.c.	1	1	0	0	0	0%
Waste disposal services	23	0	23	0	23	100%
Water supply	3	0	0	3	3	100%
Water transport terminals	2	2	0	0	0	0%
Wood product manufacturing n.e.c.	13	13	2	0	2	15%
Wooden furniture and upholstered seat manufacturing	11	11	1	0	1	9%
Wooden structural component manufacturing	14	14	1	0	1	7%
TOTAL	**6,223**	**3,748**	**553**	**81**	**5153**	**83%**

a The number of businesses identified indicates the number of identified businesses operating in 2008.

b The number of businesses surveyed indicates the number of businesses surveyed for the 2003 air emissions inventory and includes facilities that have been 'de-scheduled' between 2003 and 2008 that were moved from the industrial emissions inventory to the commercial emissions inventory

c Indicates the number of businesses that responded to a questionnaire during the 2003 air emissions inventory. This includes businesses that were included in the 2003 industrial air emissions inventory that have been de-scheduled between 2003 and 2008 (and hence moved to from the 2003 industrial air emissions inventory to the 2008 commercial air emissions inventory

d Indicates the number of non-respondent NPI businesses based on NPI data published for the 2007/2008 NPI reporting period.

e Includes the number of businesses that were included in the 2003 commercial air emissions inventory based on either (i) response to the 2003 air emissions inventory questionnaire, (ii) reported air emissions to the NPI based on the 2007/2008 NPI reporting period; or (iii) based on a top-down approach detailed in this report (e.g. regional based activity data for the 2008 calendar year was used to estimate activity data for each commercial business).

f Construction material mining includes ANZSIC classes 'Gravel and Sand Quarrying' and 'Construction Material Mining n.e.c.'.

3.1 Automotive Fuel Retailing

3.1.1 Emission Sources and Associated Releases to Air

Service stations were identified during the 2003 air emissions inventory and were identified using the following sources:

- NSW WorkCover database for hazardous materials;
- NSW telephone directory;
- Service station lists from major oil distributors (BP, Shell, Caltex/ Ampol and Mobil); and
- Survey of commercial facilities performed by NSW DECC (DECC, 2007).

From these sources a total of 2,039 service stations were identified to be within the GMR.

The emissions sources and associated releases to air from service stations are outlined in Table 3-2.

Table 3-2: Service stations – emission sources

Process	Emissions to Air
Loading storage tanks with petrol	VOC
Petrol vehicle refuelling	VOC
Spillage of petrol	VOC
Petrol storage tank breathing losses	VOC
Emissions from diesel transfer and storage operations	VOC

The locations of service stations within the GMR are shown in Figure 3-1.

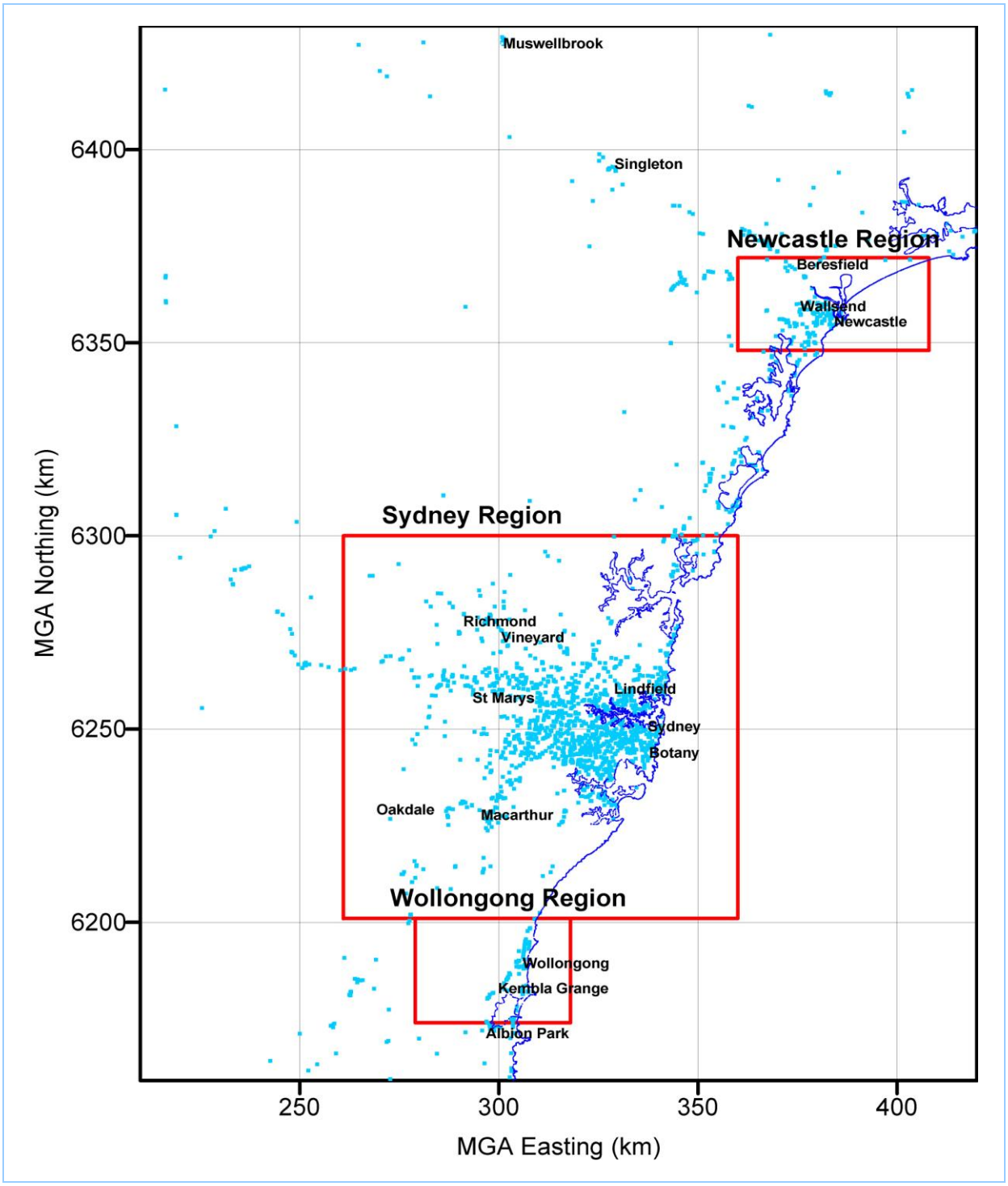

Figure 3-1: Service stations within the GMR

3.1.2 Emission Estimation Methodology

3.1.2.1 Transfer of petrol to tanks for storage

When petrol is transferred to stationary storage tanks, VOC emissions result from the loading operation when vapours present in the empty storage tank are displaced by the added petroleum. Evaporative loss during emptying occurs when air drawn into the tank during liquid removal becomes saturated with organic vapour and expands, thus exceeding the capacity of the vapour space.

VOC emissions from the transfer of petrol to tanks for storage were estimated using the following technique (Equation 3) from USEPA AP42 *Chapter 5.2 Transportation and Marketing of Petroleum Liquids* (USEPA, 2008b):

$$E = EF_i \times A \times 10^{-6} \times CF \qquad \textbf{Equation 3}$$

where:

E	=	VOC emissions from transfer of petrol to tanks for storage	(kg/year)
EF_i	=	Emission factor for petrol transfer	(mg/L)
A	=	Amount of petrol dispensed	(L/year)
CF	=	Control factor of transfer of petrol to storage	(%)

The emission factor for the transfer of petrol to storage was estimated using the following technique (Equation 4) from USEPA AP42 *Chapter 5.2 Transportation and Marketing of Petroleum Liquids* (USEPA, 2008b):

$$EF_{i,VOC} = 12.46 \times \frac{S_i \times P \times M}{T} \times \left(1 - \frac{CE_{VRU}}{100} \times \frac{CE_{VCE}}{100}\right) \times \frac{1000}{(2.20462 \times 3.785412)} \qquad \textbf{Equation 4}$$

where:

$EF_{i,VOC}$	=	VOC emission factor from loading petrol to tanks for storage for loading type i	(mg/L)
S	=	Saturation factor for loading type i ($S_{\text{Submerged loading: dedicated normal service}}$ = 0.60; $S_{\text{Submerged loading: dedicated vapour balance}}$ = 1.00 Source: Table 5.2-1: AP42 Chapter 5.2 (USEPA, 2008b)).	(-)
P	=	True vapour pressure of liquid loaded	(psia)
M	=	Molecular weight of vapour	(lb/lb-mole)
T	=	Temperature of bulk liquid loaded	(°R)
CE_{VRU}	=	Control efficiency of vapour recovery unit	(%)
CE_{VCE}	=	Vapour collection efficiency	(%)
i	=	Loading type (either "submerged loading: dedicated normal service" or "submerged loading: dedicated vapour balance")	(-)

The stock true vapour pressure of the bulk liquid loaded is estimated using the following technique (Equation 5) published in USEPA AP42 *Chapter 7.1 Organic Liquid Storage Tanks* (USEPA, 2006a):

$$P = \exp\left\{\left[0.7553 - \left(\frac{413.0}{T + 459.6}\right)\right] \times S^{0.5} \log_{10}(RVP) - \left[1.854 - \left(\frac{1{,}042}{T + 459.6}\right)\right] \times S^{0.5} + \left[\left(\frac{2{,}416}{T + 459.6}\right) - 2.013\right] \times \log_{10}(RVP) - \left(\frac{8{,}742}{T + 459.6}\right) + 15.64\right\} \qquad \textbf{Equation 5}$$

where:

P	=	Stock true vapour pressure of liquid loaded	(psia)
T	=	Stock temperature of liquid loaded	(°F)
RVP	=	Reid vapour pressure of liquid loaded	(psi)
S	=	Slope of the ASTM distillation curve at 10% evaporated, in degrees Fahrenheit per percent, (S = 3.0, Table 7.1.4 (USEPA, 2006a)	(°F/%)

The stock temperature of the liquid loaded is estimated using the following equation (Equation 6) from USEPA Chapter 7.1 *Organic Liquid Storage Tanks* (USEPA, 2006a):

$$T_B = T_A + 6 \times \alpha - 1 \qquad \textbf{Equation 6}$$

where:

T_B	=	Stock temperature of liquid loaded	(°R)
T_A	=	Ambient temperature	(°R)
α	=	Tank paint solar absorptance, dimensionless (α = 0.17, Table 7.1-6 (USEPA, 2006a).	(-)

USEPA recommends that a vapour collection efficiency of 98.7% should be used for trucks passing the New Source Performance Standard (NSPS) level annual test (USEPA, 2008b). As no other data are available relating the vapour collection efficiency for service stations in NSW, this collection efficiency has been assumed.

The control efficiency of vapour recovery units in NSW has been estimated at 96%. This correlates to an emission rate of 30 mg VOC released per litre of fuel input (or 30 mg VOC per litre of air displaced).

Controlled emission factors were also adjusted to account for the rate of non-compliance with vapour recovery stage one control equipment. A recent compliance assessment completed by DECCW in the GMR indicates that 94% of service stations within the GMR are compliant with vapour recovery stage one control equipment (PAE, 2004). Therefore, the adjusted vapour balance emission factors were adjusted using Equation 7:

$$EF_{C,CP} = EF_C \times \frac{CP}{100} + EF_{UC} \times \left[\left(\frac{100 - CP}{100} \right) \right] \qquad \textbf{Equation 7}$$

where:

$EF_{C,CP}$	=	Emission factor (controlled with vapour balance with compliance adjustment)	(mg/L)
EF_C	=	Controlled emission factor due to dedicated vapour balance	(mg/L)
CP	=	Rate of compliance with vapour recovery stage one standards (CP = 94%, PAE, 2004)	(%)
EF_{UC}	=	Uncontrolled emission factor from loading petrol to storage	(mg/L)

Derived emission factors for transfer of petrol to tanks for storage are presented in Table 3-3.

Table 3-3: Derived emission factors for petrol loading to storage

Month	RVP [a] (kPa)	T_a [b] (°C)	Loading Loss VOC Emission Factor (Submerged Loading - Dedicated Normal Service) (mg/L)	Loading Loss VOC Emission Factor (Submerged Loading - Dedicated Vapour Balance) (mg/L)	Loading Loss VOC Emission Factor (Submerged Loading - Dedicated Vapour Balance, with Compliance Factor) (mg/L)
January	62	25.3	723	64	104
February	62	24.7	711	63	102
March	69	21.4	707	63	101
April	75	18.0	693	61	99
May	75	15.2	636	56	91
June	75	12.9	592	53	85
July	75	11.5	565	50	81
August	75	12.1	577	51	83
September	75	15.1	633	56	91
October	75	17.4	681	60	98
November	69	20.8	694	62	100
December	62	24.6	709	63	102
Annual Average:			**660**	**-**	**94.7**

[a] RVP: Reid Vapour Pressure

[b] T_a: Average daily temperature at locations within the GMR where service stations are located (estimated from TAPM predictions)

3.1.2.2 *Vehicle Refuelling*

When petrol is transferred from a service station's storage tank to the tank of an automobile, emissions occur due to displaced vapours from the automobile's tank by dispensed petrol. VOC emissions from petrol vehicle refuelling will be estimated using the following technique (Equation 8) from the *NPI EET Manual for Aggregated Emissions from Service Stations* (EA, 1999c):

$$E = EF_i \times A \times 10^{-6} \times CF \qquad \textbf{Equation 8}$$

where:

E	=	VOC emissions from vehicle refuelling	(kg/year)
EF_i	=	Emission factor for fuel type i	(mg/L)
A	=	Amount of fuel type i dispensed	(L/year)
CF	=	Control factor of vehicle refuelling technology	(%)

Baseline emission factors are estimated using an equation developed by the Automotive Testing Laboratories Inc (ATL) (ATL, 1988). It is noted that the USEPA also developed a refuelling emissions equation (USEPA, 1993). However, the USEPA equation was based on testing conducted on only eight vehicles, compared with 22 vehicles for the ATL equation. The USEPA concluded that as the ATL equation is based on a broader mix of domestic and import vehicles and contains a larger number of trucks, that the ATL equation is the best available predictor of emission factors from vehicle refuelling. It is noted that this technique is utilised by the USEPA in the NONROAD 2002 model and in the Onboard Refueling Vapor Recovery Rule (USEPA, 1993). The ATL emission factor equation (Equation 9) is as follows:

$$EF_i = \left(e^{(-1.2798-0.0049\times(\Delta T)+0.0203\times T_d+0.1315\times RVP)}\right)\times\frac{1{,}000}{3.785}$$ **Equation 9**

where:

EF_i	=	VOC emission factor for vehicle refuelling fuel type i	(mg/L)
T_d	=	Dispensed fuel temperature	(°F)
ΔT	=	Difference in temperature between dispensed fuel and fuel onboard vehicle	(°F)
RVP_i	=	Reid Vapour Pressure (RVP) of fuel type i	(psia)

The temperature of the dispensed fuel is estimated as follows (USEPA, 2006a) (Equation 10):

$$T_d = 62 + 0.6\times(T_a - 62)$$ **Equation 10**

where:

T_d	=	Dispensed fuel temperature	(°F)
T_a	=	Ambient temperature	(°F)

The temperature of the fuel on-board vehicles is estimated as follows (USEPA, 2006a) (Equation 11):

$$T_v = T_d + (0.418T_d - 16.6)$$ **Equation 11**

where:

T_v	=	Temperature of fuel on-board vehicle	(°F)
T_d	=	Dispensed fuel temperature	(°F)

Derived emission factors for petrol vehicle refuelling are provided in Table 3-4.

Table 3-4: Vehicle refuelling emission factors

Month	RVP [a] (kPa)	Ta [b] (°C)	Td [c] (°C)	Tv [d] (°C)	Refuelling VOC Emission Factor (mg/L)
January	62	25.3	21.9	29.2	956
February	62	24.7	21.5	28.7	945
March	69	21.4	19.5	25.9	1,002
April	75	18.0	17.5	23.0	1,060
May	75	15.2	15.8	20.6	1,004
June	75	12.9	14.4	18.7	960
July	75	11.5	13.6	17.4	933
August	75	12.1	13.9	18.0	944
September	75	15.1	15.7	20.5	1,001
October	75	17.4	17.1	22.5	1,049
November	69	20.8	19.1	25.4	990
December	62	24.6	21.4	28.6	943
				Annual Average	**982**

a RVP: Reid Vapour Pressure
b T_a: Average daily temperature at locations within the GMR where service stations are located (estimated from TAPM predictions)
c T_d: Dispensed fuel temperature
d T_v: Temperature of fuel on-board vehicle

3.1.2.3 Spillage

Spillage losses are made up of contributions from prefill and postfill nozzle drip and from spit-back and overflow from the vehicle's fuel tank filler pipe during refuelling. The amount of spillage loss can depend on several variables, including service station business characteristics, tank configuration, and operator techniques. As spillage losses are relatively small compared to other service station VOC emission sources and dependent upon operator techniques rather than only service station operations, a default spillage emission factor was used for all service stations. VOC emissions from spillages were estimated using the emission factor presented in the *NPI EET Manual for Aggregated Emissions from Service Stations* (EA, 1999c) (Equation 12):

$$E = EF_i \times A \times 10^{-6}$$ **Equation 12**

where:

E_i	=	VOC emissions from spillages of petrol	(kg/year)
EF_i	=	Default emission factor for spillages of petrol (88 mg/L)	(mg/L)
A	=	Amount of petrol dispensed	(L/year)

No control factor is present in this equation as spillages are an uncontrolled process.

3.1.2.4 Storage Tank Breathing Losses

VOC emissions from storage tanks containing petrol occur as a result of both standing and working losses. Standing loss is the expulsion of vapour from a tank through vapour expansion and contraction, which are the results of changes in temperature, fuel Reid vapour pressure and atmospheric pressure. This loss occurs without any liquid level change in the tank. The combined loss from filling and emptying is called working loss and is not detailed in this section (see Section 3.1.2.1). VOC breathing loss emissions from stationary petroleum and/or petroleum product storage tanks were estimated using the following technique from the *EMEP/CORINAIR Emission Inventory Guidebook – 2006* (EEA, 2006) (Equation 13):

$$E_i = EF_i \times A$$ **Equation 13**

where:

E_i	=	VOC emissions from storage tank breathing losses	(kg/year)
EF_i	=	Default emission factor for storage tank breathing	(mg/L)
A	=	Amount of fuel type dispensed	(L/year)

The emission factor for storage tank breathing losses is estimated using the following equation (EEA, 2006) (Equation 14):

$$EF_{VOC} = 3.3 \times \rho \times RVP \times 10^{((0.0000707 \times RVP + 0.0132) \times T + (0.000231 \times RVP - 0.5236))}$$ **Equation 14**

where:

EF_{VOC}	=	Emission factor for underground tank breathing	(mg/L)
ρ	=	Density of petrol (ρ = 0.735 kg/L Source: ABARE, 2009)	(kg/L)
RVP	=	Reid vapour pressure of liquid loaded	(kPa)
T	=	Temperature of fuel loaded	(°C)

Derived petrol tank breathing emission factors are presented in Table 3-5.

Table 3-5: Tank breathing emission factors

Month	RVP [a] (kPa)	T_d [b] (°C)	Tank Breathing VOC Emission Factor (mg/L)
January	62	21.9	92
February	62	21.5	92
March	69	19.5	95
April	75	17.5	99
May	75	15.8	93
June	75	14.4	90
July	75	13.6	87
August	75	13.9	88
September	75	15.7	93
October	75	17.1	97
November	69	19.1	94
December	62	21.4	91
Annual Average			**93**

[a] RVP: Reid Vapour Pressure
[b] T_d: Dispensed fuel temperature

3.1.2.5 Emissions from diesel transfer and storage operations

When diesel is transferred in similar operations as petrol VOC emissions also occur. The *NPI EET Manual for Aggregated Emissions from Service Stations* (EA, 1999c) reports the following equation to adjust petrol emission factors to diesel emission factors based on the difference in the relative Reid vapour pressures between the fuels (Equation 15):

$$EF_d = EF_p \times \frac{P_d}{P_p}$$ **Equation 15**

where:

EF_d	=	Emission factor for the handling of diesel	(mg/L)
EF_p	=	Emission factor for the handling of petrol	(mg/L)
P_d	=	Typical vapour pressure of diesel	(kPa)
P_p	=	Typical vapour pressure of petrol	(kPa)

The Reid vapour pressure of diesel has been estimated to be 3.5 kPa. Derived diesel emission factors are provided in Table 3-6.

Table 3-6: Diesel handling and storage emission factors

Month	Spillage VOC Emission Factor (mg/L)	Refuelling VOC Emission Factor (mg/L)	Loading Loss VOC Emission Factor (Submerged Loading - Dedicated Normal Service) (mg/L)	Tank Breathing VOC Emission Factor (mg/L)	Total VOC Emission Factor (mg/L)
January	4.36	54.0	40.8	5.22	104.38
February	4.36	53.4	40.1	5.17	103.03
March	4.36	51.2	36.1	4.88	96.57
April	4.36	49.5	32.3	4.60	90.76
May	4.36	46.8	29.7	4.36	85.22
June	4.36	44.8	27.6	4.18	80.97
July	4.36	43.5	26.4	4.06	78.32
August	4.36	44.1	26.9	4.11	79.45
September	4.36	46.7	29.5	4.35	84.93
October	4.36	48.9	31.8	4.55	89.60
November	4.36	50.6	35.5	4.82	95.24
December	4.36	53.2	40.0	5.15	102.77
Annual Average	**4.36**	**48.9**	**33.1**	**4.62**	**90.94**

Emissions from petrol and diesel vapours emitted from service stations have been estimated using vapour phase speciation profiles supplied by BP. The vapour phase speciation profiles used to estimate speciated organic emissions from petrol and diesel emission from service stations are shown in Table 3-7 and Table 3-8 respectively.

Table 3-7: Petrol vapour phase organic speciation profile [a]

Substance	Mass fraction (kg i/kg Total Organic Compound)
ISOMERS OF PENTANE	0.4955
N-BUTANE	0.1333
2-METHYLPENTANE	0.0478
2-METHYL-2-BUTENE	0.0443
2-METHYLPROPANE; ISOBUTANE	0.0305
TRANS-2-PENTENE	0.0294
TRANS-2-BUTENE	0.0283
3-METHYLPENTANE	0.0234
TOLUENE	0.0190
CIS-2-PENTENE	0.0162
2-METHYL-1-BUTENE	0.0113
2,3-DIMETHYLBUTANE	0.0081
BENZENE	0.0078
3-METHYLHEXANE	0.0063
1-PENTENE	0.0055
2-METHYLHEXANE	0.0051
2,2,4-TRIMETHYLPENTANE	0.0049
1-BUTENE	0.0046

Substance	Mass fraction (kg i/kg Total Organic Compound)
N-HEPTANE	0.0039
M-XYLENE	0.0033
CIS-2-BUTENE	0.0030
METHYLCYCLOPENTANE	0.0029
N-HEXANE	0.0022
CIS-1,3-DIMETHYLCYCLOPENTANE	0.0022
2,3-DIMETHYLPENTANE	0.0018
2,4-DIMETHYLPENTANE	0.0016
2,2-DIMETHYLBUTANE	0.0015
2-METHYLHEPTANE	0.0015
CIS-1-2-DIMETHYLCYCLOPENTANE	0.0014
2,4-DIMETHYLHEXANE	0.0014
CIS-1,CIS-2,4-TRIMETHYLCYCLOPENTANE	0.0014
3-METHYLHEPTANE	0.0014
P-XYLENE	0.0012
1,4-PENTADIENE	0.0010
3-ETHYLPENTANE	0.0010
ETHYLBENZENE	0.0010
O-XYLENE	0.0010
2,3-DIMETHYLHEXANE	0.0008
4-METHYLHEPTANE	0.0008
TRANS-1,3-DIMETHYLCYCLOPENTANE	0.0007
2,5-DIMETHYLHEXANE	0.0007
3,3-DIMETHYLPENTANE	0.0006
M-ETHYLTOLUENE	0.0006
2,2-DIMETHYLPENTANE	0.0005
CYCLOHEXANE	0.0005
TRANS-1-2-DIMETHYLCYCLOPENTANE	0.0005
2,3,4-TRIMETHYLPENTANE	0.0005
2,3,3-TRIMETHYLPENTANE	0.0005
TRANS-1,CIS-2,3-TRIMETHYLCYCLOPENTANE	0.0004
3-METHYL-1-BUTENE	0.0003
CYCLOPENTENE	0.0003
ETHYLCYCLOPENTANE	0.0003
TRANS-1,2-CIS-4-TRIMETHYLCYCLOPENTANE	0.0003
TRANS-2-ETHYLMETHYLCYCLOPENTANE	0.0003
P-ETHYLTOLUENE	0.0003
1,2,4-TRIMETHYLBENZENE	0.0003
2,2,3-TRIMETHYLBUTANE	0.0002
2,2-DIMETHYLHEXANE	0.0002
3-METHYLOCTANE	0.0002
N-PROPYLBENZENE	0.0002
2,2,3,TRIMETHYLHEXANE	0.0001
4-METHYLOCTANE	0.0001
2-METHYLOCTANE	0.0001
TRANS 1-METHYL-4-ETHYLCYCLOHEXANE	0.0001
N-NONANE	0.0001
2-METHYLNONANE	0.0001

Substance	Mass fraction (kg i/kg Total Organic Compound)
N-DECANE	0.0001

[a] Source: BP (2001b)

Table 3-8: Diesel vapour phase organic speciation profile [a]

Substance	Mass fraction (kg i/kg Total Organic Compound)
P-ETHYLTOLUENE	0.1976
1,2,3-TRIMETHYLBENZENE	0.1402
M-ETHYLTOLUENE	0.1200
1,3,5-TRIMETHYLBENZENE	0.1056
O-ETHYLTOLUENE	0.1031
1,2,4-TRIMETHYLBENZENE	0.0752
N-PROPYLBENZENE	0.0613
CUMENE (1-METHYLETHYLBENZENE)	0.0504
O-XYLENE	0.0469
M-XYLENE	0.0433
TOLUENE	0.0277
N-DODECANE	0.0082
ETHYLBENZENE	0.0059
N-TRIDECANE	0.0055
N-TETRADECANE	0.0040
N-UNDECANE	0.0027
N-PENTADECANE	0.0014
HEXADECANE	0.0003
N-HEPTADECANE	0.0001

[a] Source: BP (2001a)

3.1.3 Activity Data

During the 2003 air emissions inventory, all service stations were sent commercial survey questionnaires to collect site specific activity data. Responses were received from 239 facilities (i.e. a response rate of approximately 11%).

Total petroleum product sale data by state has been obtained from the Department of Resources Energy and Tourism (DRET, 2009). Data obtained from DRET includes:

- Total petrol fuel sold in 2008 in NSW (including ACT) (to petrol retailers) = 4,713,748 kL;
- Total diesel fuel sold in 2008 in NSW (including ACT) (to diesel retailers) = 1,320,316 kL; and
- Total LPG fuel sold in 2008 in NSW (including ACT) = 674,078 kL.

The total fuel sold in the GMR has been estimated using the population of NSW and ACT and the GMR, assuming that petrol throughput is proportional to population. The total population of the GMR accounts for approximately 71.2% of the total population of NSW and ACT. Therefore the estimated amounts of fuel types sold in the GMR are:

- Total petrol sold in 2008 = 3,537,665 kL;
- Total diesel fuel sold in 2008 = 990,896 kL; and

- Total LPG fuel sold in 2008 = 505,895 kL.

As commercial survey questionnaires were not sent out for the 2008 air emissions inventory , it was assumed that the location and the magnitude of total fuel throughput (when compared to total fuel throughput for the GMR) was consistent for the 2008 air emissions inventory as it was for the 2003 air emissions inventory. Therefore, activity data for petrol stations was scaled in accordance with the change in total fuel throughput between inventory years. The required data to scale activity data are shown in Table 3-9.

Table 3-9: Derived service station activity data

Fuel	Throughput (kL/year)			Ratio (2008/2003 Data)
	NSW	GMR 2008 [a]	GMR 2003 [b]	
Petrol	4,713,748	3,537,665	3,733,100	0.95
Diesel	1,320,316	990,896	723,000	1.37
LPG	674,078	505,895	337,400	1.50

[a] Source: DRET (2009) Australian Petroleum Statistics, 2008
[b] Source: DITR (2005) Australian Petroleum Statistics, 2003

Further detail on how activity data was allocated to service station facilities is presented in DECC (2007).

LPG loss at service stations is estimated to be 0.04 kg/ML (EA, 1999c). Therefore, the total estimated emissions from LPG distribution at service stations in the GMR are 27 kg per year or 0.01 kg per business per year. Consequently, emissions from LPG distribution at service stations are deemed to be negligible in this study.

3.1.4 Temporal Variation of Emissions

3.1.4.1 Loading Storage Tanks with Petrol

Monthly temporal factors have been determined based on the difference in petrol RVP and fuel temperature for each month of the year and the monthly petrol throughput for NSW (DITR, 2009). Temperatures at service station locations within the GMR were derived from TAPM. The derived monthly temporal factors for petrol fuel loading are shown in Table 3-10.

Table 3-10: Monthly temporal factors for loading storage tanks with petrol

Month	Temporal Factor
January	1.05
February	1.07
March	1.06
April	1.03
May	0.94
June	0.86
July	0.69
August	0.93
September	0.98
October	1.11
November	1.06
December	1.21

Loading of fuel to storage tanks from delivery tankers have been determined to occur approximately 3 to 4 times a week, with the ratio between weekday and weekend being approximately 4:1. The variations of emissions by day of week are provided in Table 3-11.

Table 3-11: Daily temporal factors for service station fuel loading

Day	Temporal Factor
Monday	1
Tuesday	1
Wednesday	1
Thursday	1
Friday	1
Saturday	0.25
Sunday	0.25

Emissions resulting from the transfer of petrol to storage tanks over a day are generally dependent on delivery schedules of tankers. Data provided in returned commercial survey questionnaires for the 2003 air emissions inventory has been analysed to determine the delivery times of tankers for service stations. While there are no set times restricted for tankers to deliver fuel to service stations, there are common time phases at which tankers delivered fuel to service stations determined from returned commercial survey questionnaires.

Results from the analysis show that:

- 72% of deliveries occur between the hours of 12 am and 12 pm with 50% of these deliveries occurring between 12 am and 4 am;
- 4% of deliveries occur between the hours of 12 pm and 6 pm; and
- 24% of deliveries occur between the hours of 6 pm and 12 am with 82% of these deliveries occurring between the hours of 9 pm and 12 am.

This analysis allows for the derivation of the diurnal temporal profile shown in Table 3-12.

Table 3-12: Diurnal temporal factors from the loading of fuel to storage tanks at service stations

Time Phase	Hour	Temporal Factor
Morning	1	1.00
	2	1.00
	3	1.00
	4	1.00
	5	0.46
	6	0.46
	7	0.46
	8	0.46
	9	0.46
	10	0.46
	11	0.46
	12	0.46
Afternoon	13	0.07
	14	0.07
	15	0.07

Time Phase	Hour	Temporal Factor
	16	0.07
	17	0.07
	18	0.07
Evening	19	0.15
	20	0.15
	21	0.15
	22	0.70
	23	0.70
	24	0.70

3.1.4.2 Petrol Storage Tank Breathing Losses

Breathing losses from petrol storage tanks vary according to temperature fluctuation of tanks, Reid vapour pressure of fuel and pressure differences in the atmosphere. Monthly and hourly temporal factors were estimated using the emission factor equation presented in *EMEP/CORINAIR Emission Inventory Guidebook – 2006* (EEA, 2006).

The derived monthly temporal factors are shown in Table 3-15.

Table 3-13: Monthly temporal factors for tank breathing losses

Month	Temporal Factor
January	1.00
February	0.99
March	1.03
April	1.06
May	1.01
June	0.97
July	0.94
August	0.95
September	1.01
October	1.05
November	1.02
December	0.98

There is no variation in tank breathing emissions between days. The derived hourly temporal factors are shown in Table 3-14.

Table 3-14: Diurnal temporal factors for tank breathing

Hour	Temporal Factor
1	0.900
2	0.894
3	0.890
4	0.887
5	0.884
6	0.889
7	0.920
8	0.981
9	1.052

Hour	Temporal Factor
10	1.110
11	1.147
12	1.166
13	1.173
14	1.167
15	1.149
16	1.119
17	1.077
18	1.023
19	0.974
20	0.942
21	0.926
22	0.916
23	0.909
24	0.904

3.1.4.3 *Petrol Vehicle Refuelling*

Monthly temporal factors have been determined based on the difference in petrol Reid Vapour Pressure (RVP) and monthly temperature variations. Temperatures at service station locations within the GMR were derived from TAPM. The derived monthly temporal factors are shown in Table 3-15.

Table 3-15: Monthly temporal factors for vehicle refuelling

Month	Temporal Factor
January	0.93
February	0.96
March	1.01
April	1.06
May	0.99
June	0.94
July	0.76
August	1.02
September	1.05
October	1.15
November	1.02
December	1.09

It was assumed that variations between emissions from vehicle refuelling on weekdays versus weekend days are proportional to vehicle traffic on each day type. Therefore, weekly temporal factors have been estimated based on weekday versus weekend traffic flow (TDC, 2009). The daily temporal factors for vehicle refuelling are provided in Table 3-16.

Table 3-16: Daily temporal factors for petrol vehicle refuelling

Day Type	Temporal factor
Monday	1
Tuesday	1
Wednesday	1

Day Type	Temporal factor
Thursday	1
Friday	1
Saturday	0.875
Sunday	0.875

Emissions during the day vary according to changes in temperature and vehicle traffic. The distribution of vehicles travelling by time of the day on weekends was derived from *Car Travel in Sydney: Changes in the Last Decade* (TDC, 2005). The derived temporal factors for petrol vehicle refuelling are provided in Table 3-17. It has been assumed that all petrol stations operate 24 hours per day as emissions between 10 pm and 6 am account for only 5% of total petrol vehicle refuelling emissions.

Table 3-17: Diurnal temporal factors for petrol vehicle refuelling

Hour	Weekday Temporal Factor	Weekend Temporal Factor
1	0.097	0.062
2	0.055	0.030
3	0.047	0.022
4	0.051	0.022
5	0.151	0.061
6	0.484	0.153
7	0.985	0.350
8	1.855	0.715
9	2.300	1.282
10	1.547	2.189
11	1.337	2.247
12	1.429	2.287
13	1.342	2.175
14	1.385	2.001
15	1.549	1.689
16	2.024	1.643
17	2.006	1.614
18	1.952	1.459
19	1.315	1.304
20	0.761	0.981
21	0.451	0.642
22	0.350	0.412
23	0.349	0.346
24	0.178	0.313

3.1.4.4 Spillage of Petrol

As spillages are often associated with nozzle drip and spit back during vehicle refuelling, temporal variation of emissions from spillage of petrol are assumed to be proportional to the relative VKT for any hour in a day (i.e. the same diurnal and 'week day/weekend day' temporal factors as for petrol vehicle refuelling). The derived temporal factors are provided in Table 3-16 and Table 3-17.

It has been assumed that the monthly vehicle travel is consistent throughout the year. Therefore, monthly emissions (per day) from the spillage of petrol have been assumed to be constant.

3.1.4.5 Diesel Emissions

Emissions from diesel transfer and storage operations have been estimated using a constant emission factor from the *NPI EET Manual for Aggregated Emissions from Service Stations* (EA, 1999c). The default emission factor estimates emissions from tank filling, vehicle refuelling losses and tank breathing. Each diesel emission source would have a different temporal profile and contribute different amounts to total diesel emissions. Therefore composite temporal profiles were derived based on the magnitude of emissions from each source due to petrol handling at service stations.

Temporal profiles for diesel emissions from service stations are shown in Table 3-18, Table 3-19 and Table 3-20.

Table 3-18: Monthly temporal factors for diesel emissions

Month	Temporal Factor
January	1.047
February	1.099
March	1.036
April	1.016
May	0.969
June	0.822
July	0.902
August	0.901
September	0.967
October	1.038
November	1.047
December	1.157

Table 3-19: Daily temporal factors for diesel emissions

Day Type	Temporal Factor
Monday	1
Tuesday	1
Wednesday	1
Thursday	1
Friday	1
Saturday	0.655
Sunday	0.655

Table 3-20: Diurnal temporal factors for diesel emissions

Hour	Weekday Temporal Factor	Weekend Temporal Factor
1	0.384	0.376
2	0.374	0.368
3	0.372	0.366
4	0.373	0.366
5	0.213	0.191
6	0.296	0.214
7	0.420	0.263
8	0.633	0.354
9	0.740	0.493
10	0.556	0.713
11	0.505	0.727

Hour	Weekday Temporal Factor	Weekend Temporal Factor
12	0.528	0.736
13	0.373	0.576
14	0.384	0.534
15	0.424	0.458
16	0.539	0.447
17	0.535	0.441
18	0.523	0.403
19	0.395	0.393
20	0.259	0.313
21	0.182	0.230
22	0.345	0.360
23	0.344	0.344
24	0.302	0.336

It is noted that diesel is much less volatile than petrol and generally accounts for less than 5% of VOC emissions from a service station.

3.1.4.6 Summary

Summary temporal variation for service station VOC emission sources over months, days and hours in the day are shown in Figure 3-2, Figure 3-3 and Figure 3-4.

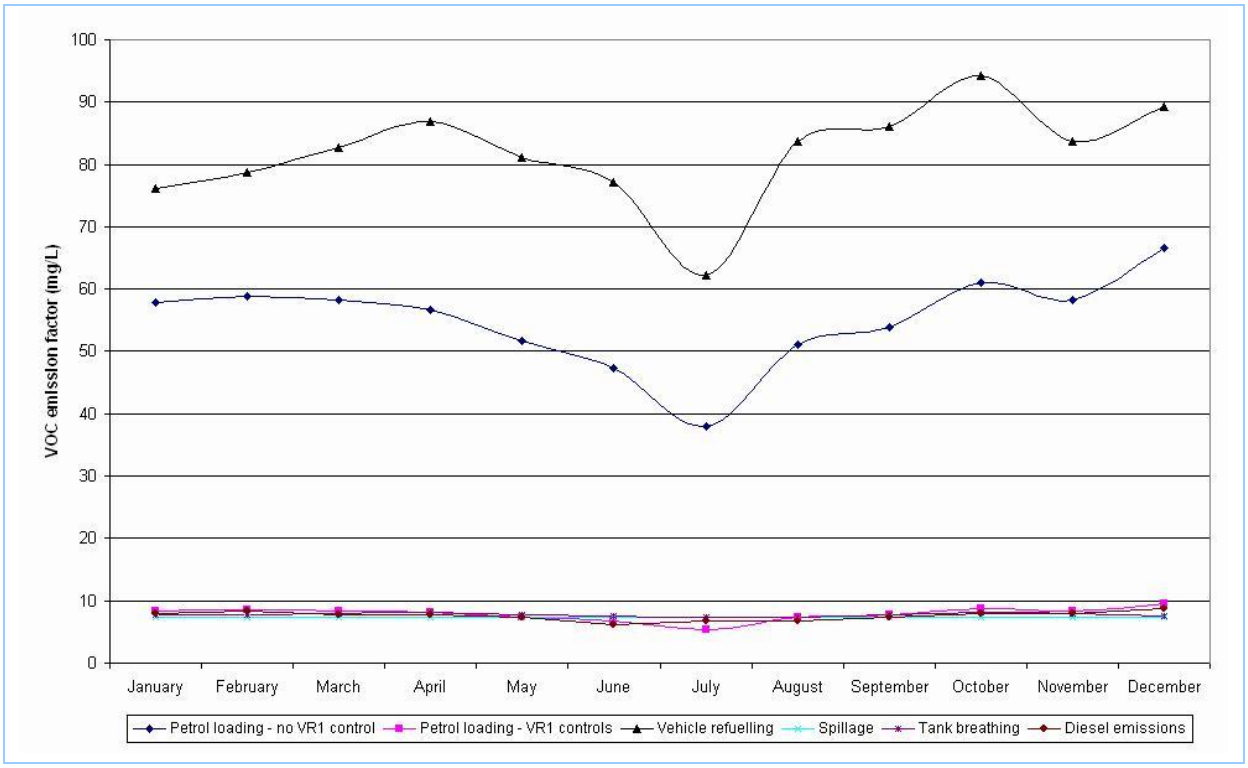

Figure 3-2: Summary monthly temporal variation of service station emission sources

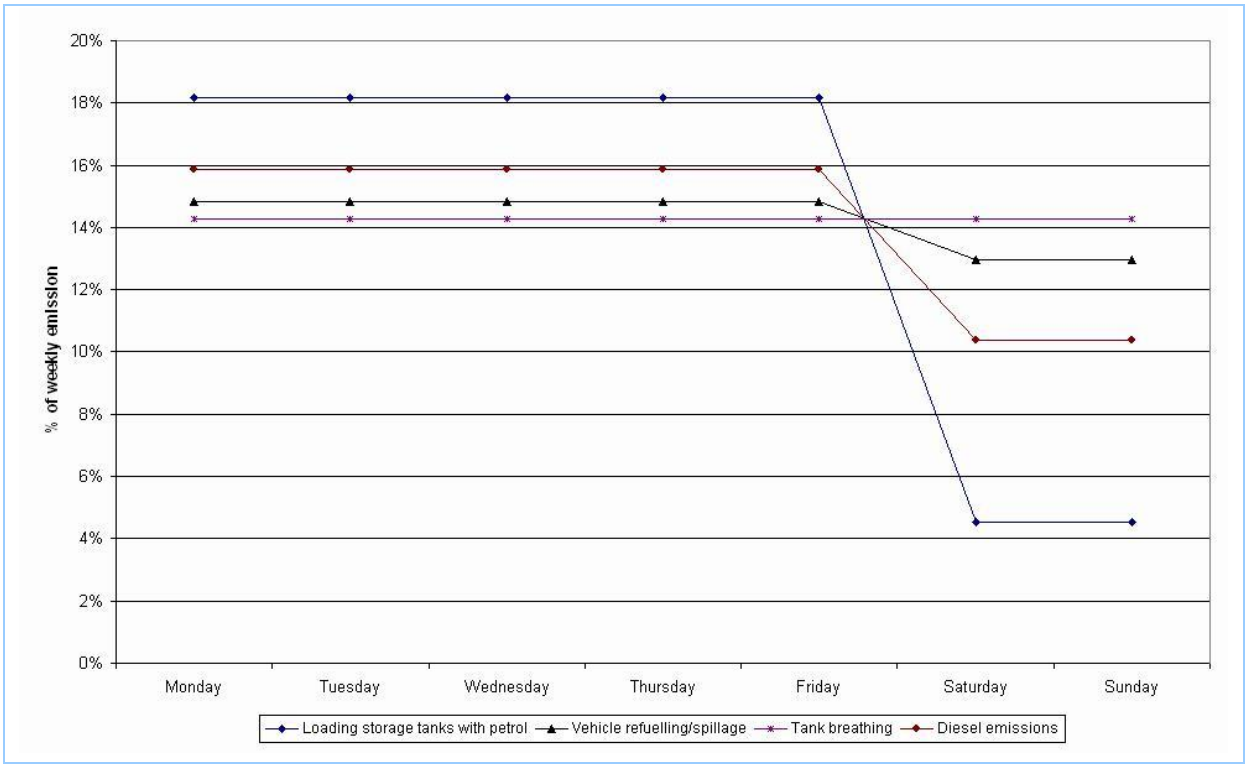

Figure 3-3: Summary daily temporal variation of service station emission sources

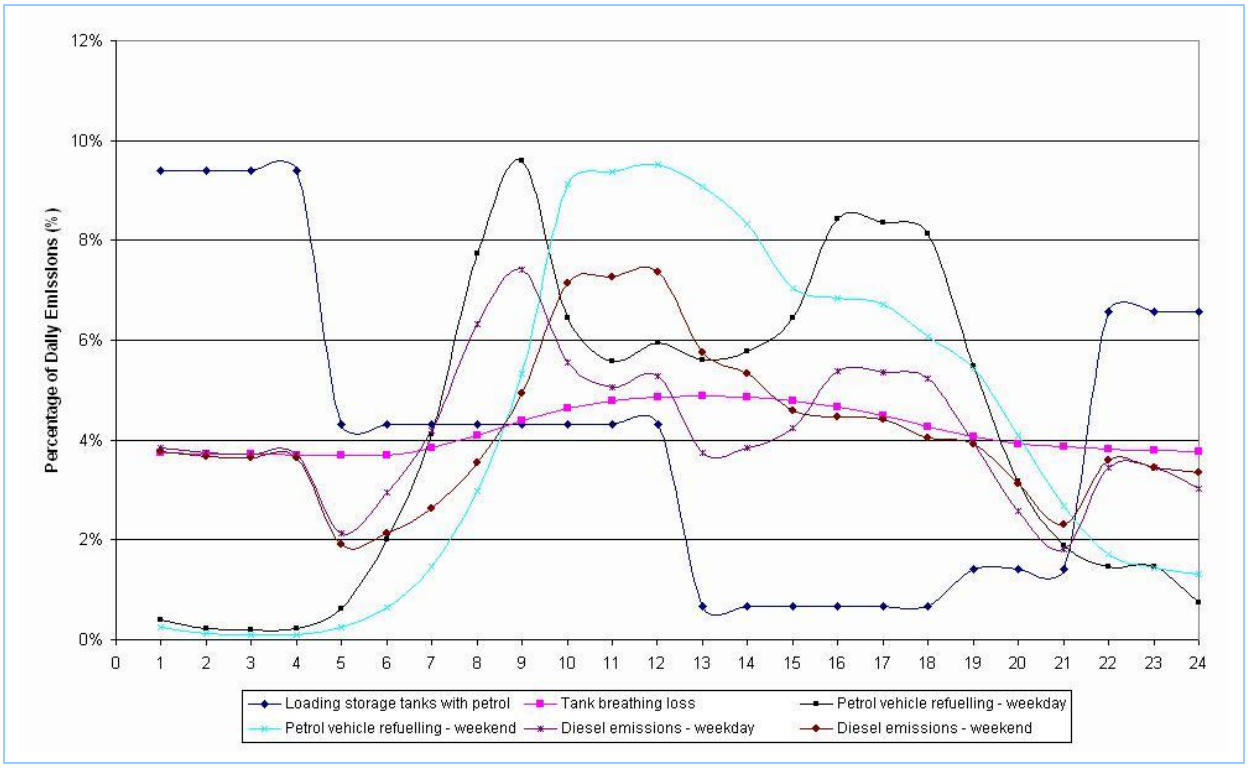

Figure 3-4: Summary hourly temporal variation of service station emission sources

3.1.5 Emission Estimates

Estimated emissions from service station businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-21.

Table 3-21: Estimated emissions from service stations

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	23,700	3,140	2,360	10,400	39,600
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	16,800	2,220	1,670	7,360	28,000
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	57,700	7,640	5,740	25,400	96,500
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	2,940,000	389,000	292,000	1,290,000	4,910,000
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.1.6 Emission Projection Methodology

Projection factors for automotive fuel retailing have been derived based on primary energy consumption projections for petroleum refining in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-22 and illustrated in Figure 3-5.

Table 3-22: Projection factors for petroleum refining related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0156	2023	1.1680
2010	1.0301	2024	1.1792
2011	1.0420	2025	1.1905
2012	1.0520	2026	1.2018
2013	1.0620	2027	1.2133
2014	1.0722	2028	1.2249
2015	1.0824	2029	1.2367
2016	1.0927	2030	1.2467
2017	1.1032	2031	1.2562
2018	1.1137	2032	1.2671
2019	1.1244	2033	1.2780
2020	1.1352	2034	1.2888
2021	1.1460	2035	1.2997
2022	1.1570	2036	1.3106

Source: ABARE (2006)

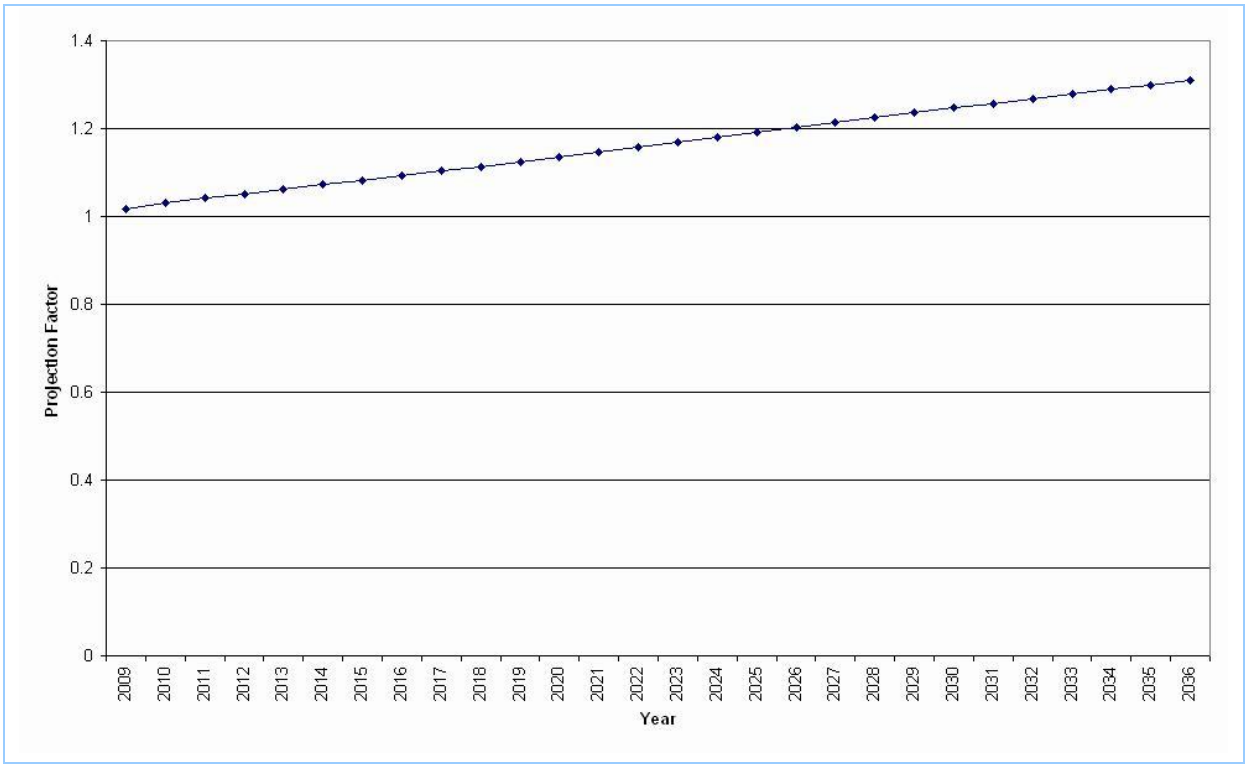

Figure 3-5: Projection factors for petroleum refining related sources

3.2 Smash Repairing

3.2.1 Emission Sources and Associated Releases to Air

Motor vehicle refinishing consists of applying primer, a topcoat and hardener to motor vehicle surfaces and aims to protect the substrates (usually metal) to which they are applied from corrosion, abrasion and decay, and damage from ultraviolet light and water. VOC are emitted during the application of coatings, the drying phase, and the cleaning equipment such as spray guns. Chemical reactions may also cause emissions to occur during the refinishing, drying, curing and hardening phases (EA, 1999a).

Most surface coatings consist of resin, solvent and pigments. The resin component forms the final paint film after application and drying of the coating. The solvent acts as a carrier for the resins and pigments and evaporates as the paint film forms during the drying process (EA, 1999a).

A brief description of the operations and equipment that give rise to VOC emissions in a smash repair facility are provided in Table 3-23.

Table 3-23: Typical VOC source points in smash repair operations

VOC Emission Source	Description[a]
Vehicle preparation	The preparation of a vehicle for refinishing involves chemical cleaning to remove existing coatings. VOC are emitted through the use of paint stripping solvents that may be applied using solvent-soaked materials.
Paint mixing	VOC are emitted when paints are mixed with thinners in order to achieve the final product for refinishing. Thinners typically have the highest VOC content per litre of coatings used in the smash repair industry.
Vehicle refinishing	The refinishing process is the point where the majority of VOC are emitted from a smash repair facility. Primers, fillers, paints (base coats and top coats) and clear coats are applied, each with varying VOC content. As the coats dry, the volatile solvents evaporate and are released to atmosphere. The application of coatings in the vehicle refinishing process is predominantly via spray guns. The transfer efficiency of the spray gun used or the amount of coating used is directly correlated to the magnitude of VOC emissions. HVLP (High volume low pressure) spray guns typically offer transfer efficiencies of greater than 65% whereas electrostatic spray guns offer up to 95% compared with conventional guns with transfer efficiencies between 20 – 40%.
Clean up	The post-refinishing clean-up stage involves the cleaning of spray guns and any other finishing equipment. Cleaning solvents are usually high in VOC content and unless applied in an enclosed device and captured are released to atmosphere during the clean up phase.
Disposal and waste	Leftover coatings and used cleaning solvents if left in open containers will be released to atmosphere. It is noted that leftover coatings and solvents are required under the Protection of the Environment Operations Act 1997) to be disposed of via a licensed waste facility.

[a] Source: RARE, 2009

The location of smash repair facilities were identified during the compilation of the 2003 air emissions inventory for commercial sources (DECC, 2007). Smash repair businesses were identified using the following sources (DECC, 2007):

- NSW WorkCover database for hazardous materials; and
- NSW telephone directory.

The businesses were cross checked against a list of approved smash repairers provided by the Motor Vehicle Repair Industry Authority (MVRIA). In total, 1,258 smash repair businesses have been identified to be within the GMR.

Emissions from smash repair businesses are generally due to the use of automotive surface coatings of namely primer, lacquers, paint, thinners, adhesives and enamel. The emission sources and associated releases to air for smash repairing are outlined in Table 3-24.

Table 3-24: Smash repairing - emission sources

Operation	Emissions to Air
Motor vehicle refinishing	VOC

The locations of smash repairers within the GMR are shown in Figure 3-6.

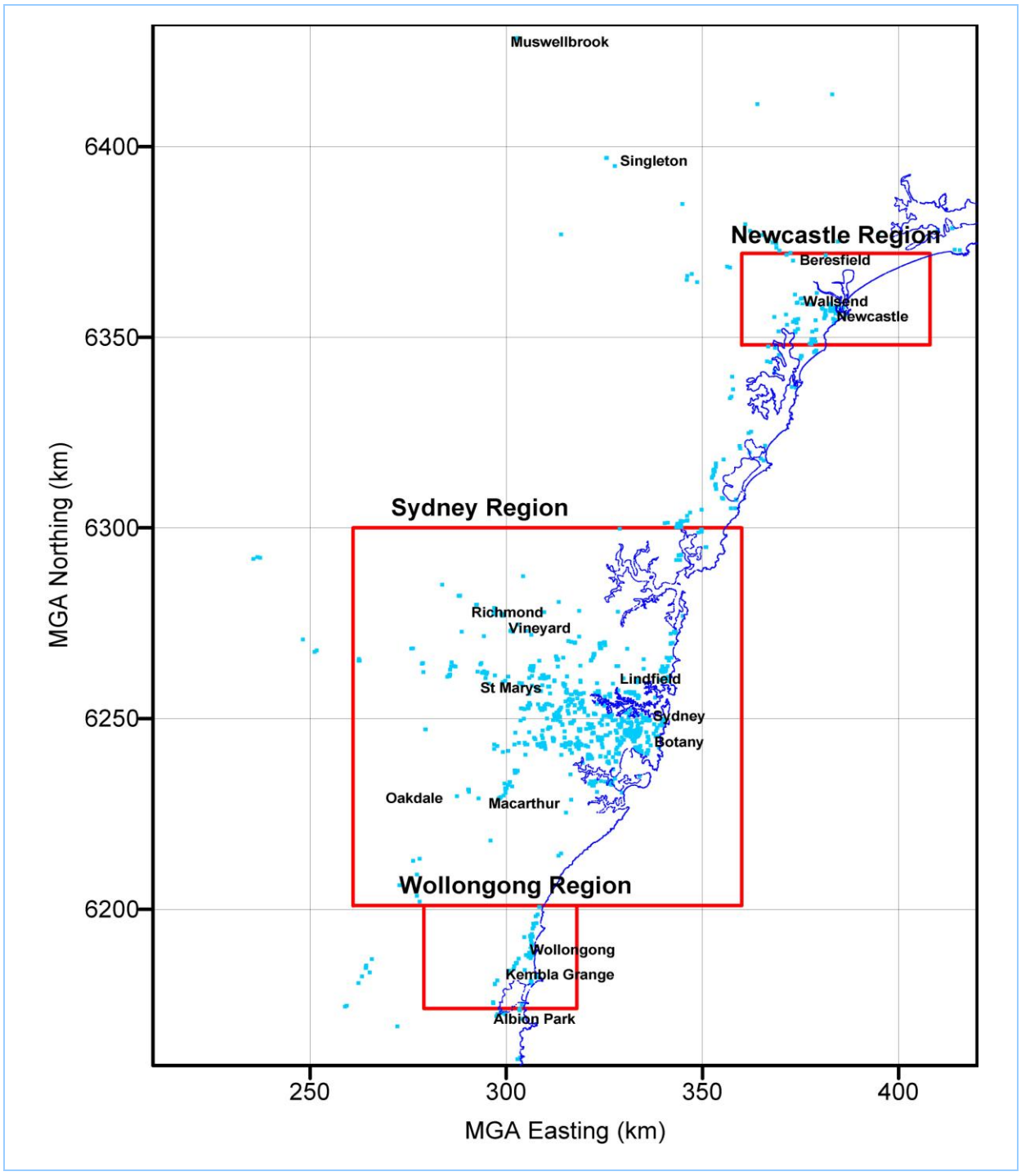

Figure 3-6: Smash repairers within the GMR

3.2.2 *Emission Estimation Methodology*

Emissions from smash repair facilities are estimated assuming that all the VOC contained within automotive coatings are released to atmosphere. VOC content data from Australian automotive coatings were obtained from suppliers and manufacturers as detailed in ENVIRON (2009) and RARE (2009). VOC content data for Australian automotive coatings are provided in Table 3-25.

Table 3-25: VOC content data for Australian automotive coatings

Technology	Coating type	VOC Content (kg/L)
1K	Primers	0.732[a]
1K	Lacquers - Clear	0.738[a]
1K	Lacquers - Colour	0.759[a]
1K	Synthetic air dry enamels	0.631[a]
1K	Thinners	0.855[a]
2K	Primers - Urethane	0.587[a]
2K	Primers - Other	0.697[a]
2K	Basecoats	0.771[a]
2K	Topcoats - Clear	0.587[a]
2K	Topcoats - Colour	0.571[a]
2K	Hardeners - Isocyanates	0.489[b]
2K	Hardeners - Other	0.721[b]
2K	Thinners	0.735[b]
Other	Other (e.g. Cleaners, Enamel)	0.713[b]

[a] Source: Table 31, ENVIRON (2009)
[b] Source: Table A.2, RARE (2009)

3.2.3 *Activity Data*

Quarterly automotive refinishing sales statistics were obtained for the nation from the Australian Paint Manufactures Federation (APMF, 2009) for the year 2008. This data set provided a breakdown of usage by coating type for the nation. However, this data set excluded usage of coatings from original equipment manufacturers (OEM). OEM usage only occurs in South Australia and Victoria. APMF also supplied quarterly sales data for 2008 for the automotive refinishing industry by state separated into two coating categories "primers and undercoats" and "finishing coats" (APMF, 2009). This data set included usage by OEM and excluded usage statistics for thinners and adhesives. Therefore, activity data for the state was estimated using the following procedure:

- The total amount of coating used by OEM was removed from the data set supplied in APMF (2009) by ensuring that the total amount of coating usage correlated between the two data sets.
- The total amount of "primers and undercoats" and "finishing coats" was estimated for NSW based on data supplied by APMF (APMF, 2009).
- The total amount of thinners and adhesives used by each state was assumed to be proportional to the total amount of "primers and undercoats" and "finishing coats" used by each state excluding usage by OEM.
- The total amount of each coating type used was estimated based on the state derived data and the proportion of each coating type used by the automotive industry as supplied in APMF (2009).

- The total amount of automotive surface coatings used in the GMR was estimated using the difference in population in the GMR versus the population in NSW.

The estimated total amount of each coating type used during 2008 in the GMR is provided in Table 3-26.

Table 3-26: Annual consumption of automotive surface coatings by the smash repair industry in NSW and in the GMR

Technology	Coating type	VOC Content (kg VOC/L)	NSW Usage (L/year)	GMR Usage (L/year)
1K	Primers	0.732	11,006	7,871
1K	Lacquers – Clear	0.738	6,775	4,845
1K	Lacquers – Colour	0.759	29,411	21,034
1K	Synthetic air dry enamels	0.631	42,818	30,622
1K	Thinners	0.855	121,383	86,810
2K	Primers – Urethane	0.587	29,797	21,310
2K	Primers – Other	0.697	6,499	4,648
2K	Basecoats	0.771	53,340	38,147
2K	Topcoats – Clear	0.587	84,466	60,407
2K	Topcoats – Colour	0.571	115,358	82,501
2K	Hardeners – Isocyanates	0.489	75,469	53,973
2K	Hardeners – Other	0.721	4,703	3,364
2K	Thinners	0.735	124,223	88,841
Other	Other (e.g. Cleaners, Enamel)	0.713	102,480	73,291
		TOTAL	**807,728**	**577,663**

The annual consumption of automotive surface coatings is also presented in Table 3-27 in categories in concordance with those presented in the *NPI EET Manual for Aggregated Emissions from Motor Vehicle Refinishing* (EA, 1999).

Table 3-27: Annual consumption of automotive surface coatings by the smash repair industry in the GMR

NPI Surface Coating Category	Weighted average VOC content (kg VOC/L)	GMR Usage (L/year)
Primer	0.636	33,829
Lacquer	0.755	25,879
Enamels	0.631	30,622
Thinners	0.770	248,941
Paint (solvent based)	0.618	181,055
Adhesive	0.503	57,337
	TOTAL	**577,663**

Surface coating usage has been spatially allocated to each business in proportion to the population in each local government area (LGA) compared with the total population in the GMR. The total surface coating usage in each LGA has been divided by the total number of smash repairers in each LGA to estimate the amount of surface coating usage for each business.

3.2.4 *Temporal Variation of Emissions*

Emissions from surface coatings and solvents are generally emitted during the application and drying phase of the process. The typical operating hours of smash repairers were estimated from a number of smash repairing businesses provided in the Auto Repairs Directory of Sydney (Sydney Auto Repairers Directory, 2005) during the completion of the 2003 GMR emissions inventory (DECC, 2007). The temporal variation of emissions based on operating hours have been assumed to be constant on weekdays from 7.30 am to 5.30 pm and only Saturdays from 7.30 am to 1 pm. No monthly variations in emissions are assumed to occur during the year.

3.2.5 *Emission Estimates*

Estimated emissions from smash repairing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-28.

Table 3-28: Estimated emissions from smash repairing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	16,400	1,110	807	2,600	20,900
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	74,700	5,050	3,670	11,800	95,300
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	308,000	20,800	15,100	48,800	393,000
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.2.6 *Emission Projection Methodology*

Projection factors for smash repairing have been derived based on final energy consumption projections for commercial and services in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-29 and illustrated in Figure 3-7.

Table 3-29: Projection factors for commercial and services related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0239	2023	1.3455
2010	1.0474	2024	1.3695
2011	1.0708	2025	1.3935
2012	1.0931	2026	1.4175
2013	1.1154	2027	1.4419
2014	1.1377	2028	1.4667
2015	1.1599	2029	1.4919
2016	1.1822	2030	1.5133
2017	1.2047	2031	1.5336
2018	1.2275	2032	1.5569
2019	1.2505	2033	1.5801
2020	1.2740	2034	1.6034
2021	1.2976	2035	1.6267
2022	1.3214	2036	1.6500

Source: ABARE (2006)

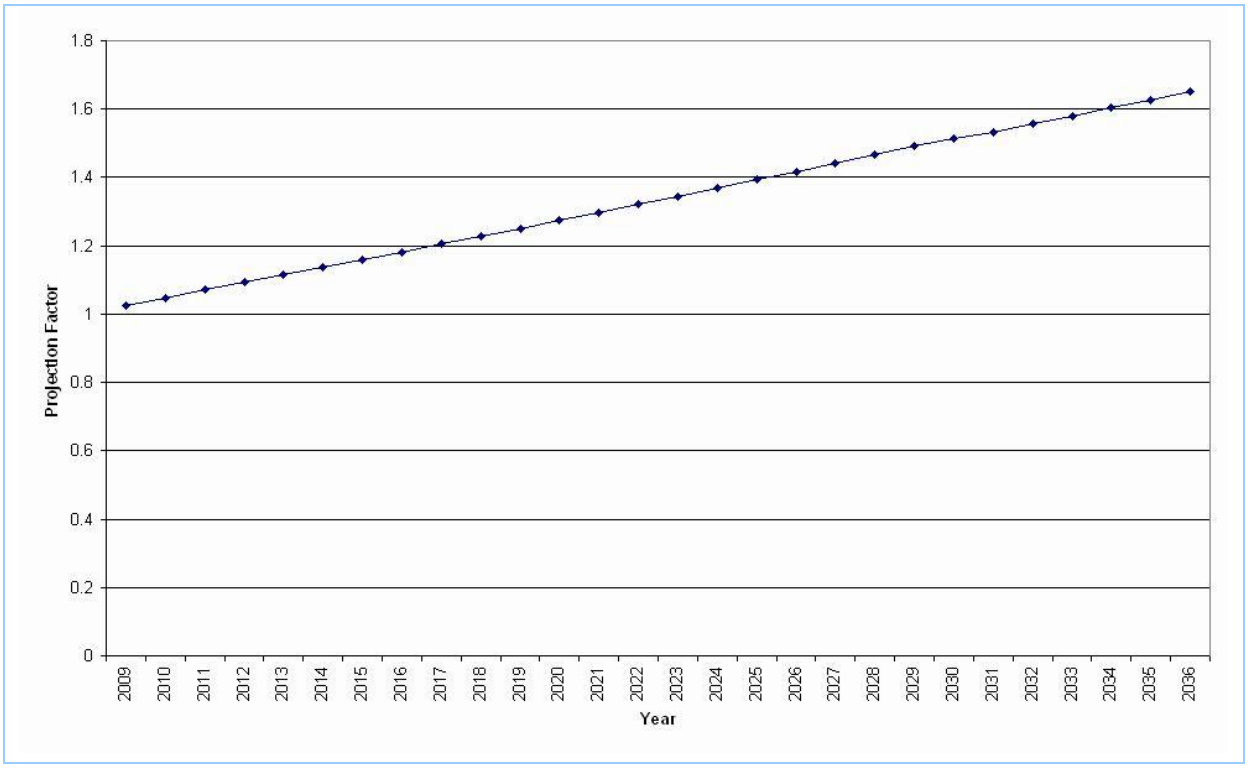

Figure 3-7: Projection factors for commercial and services related sources

3.3 Laundries and Dry Cleaners

3.3.1 Emission Sources and Associated Releases to Air

Laundry and dry cleaning businesses were identified for the 2003 air emissions inventory and were identified using the following sources (DECC, 2007):

- NSW WorkCover database for hazardous materials; and
- NSW telephone directory.

A total of 561 businesses were identified to be within the GMR.

The emission sources and associated releases to air for dry cleaning are outlined in Table 3-30.

Table 3-30: Dry cleaning – emission sources

Emission Source	Emissions to Air
Dry cleaning	VOC

The solvent itself is the primary emission from dry cleaning operations. Solvent is given off by washer, drier, solvent still, cooker, still residue, and filtercake storage areas, as well as by leaky pipes, flanges, and pumps. Two general types of solvents are used in the industry: petroleum solvents and synthetic solvents. In NSW, the principal solvent used is tetrachloroethylene. A small amount of petroleum solvents, such as white spirit, is also used.

The locations of laundries and dry cleaning businesses are shown in Figure 3-8.

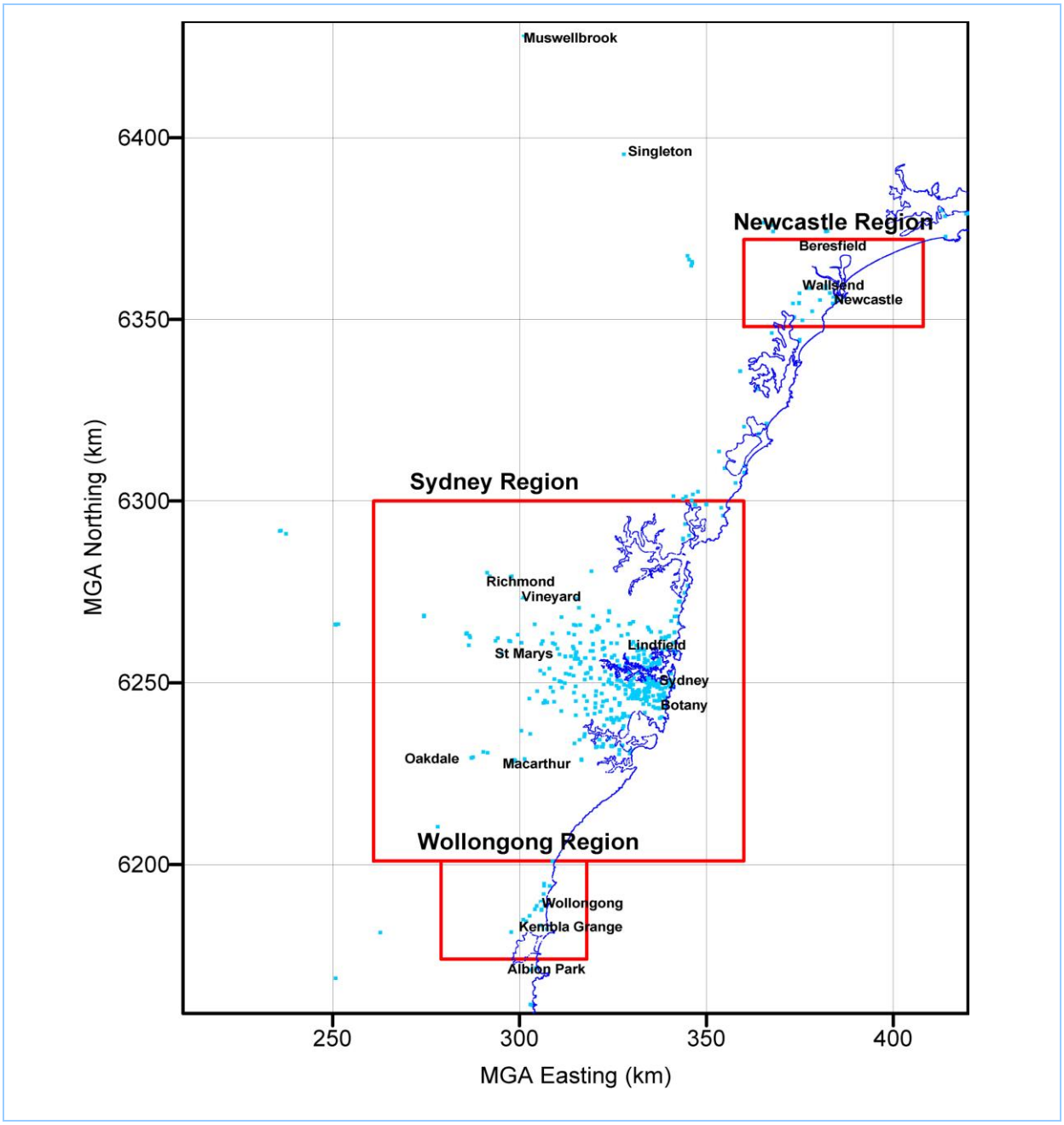

Figure 3-8: Dry cleaners within the GMR

3.3.2 *Emission Estimation Methodology*

Emissions from dry cleaning businesses have been estimated using techniques outlined in the *NPI EET Manual for Aggregated Emissions from Dry Cleaning* (EA, 1999d).

3.3.3 *Activity Data*

Tetrachloroethylene has not been produced in Australia in significant quantities since 1991. Therefore, all tetrachloroethylene used in dry cleaners is imported into Australia. Statistics on tetrachloroethylene imports into the country was available from the Australian Bureau of Statistics

(ABS, 2009d). Data was obtained on annual imports of tetrachloroethylene for the calendar years, 1988 to 2008 (ABS, 2009d). However, data was only available on a State level from 1988 to 2002. From 2003 onwards import data was only available for the country as a whole (ABS, 2009d). In the 2008 calendar year 1,454,759 kg of tetrachloroethylene was imported into the country.

In order to estimate the usage of tetrachloroethylene in NSW, the state disaggregated import data was analysed to determine the percentage of national imports for each State. The data indicates that from 1994 to 2001 the proportion of national imports to each State or Territory was relatively consistent at 52% (annual standard deviation of 4%). Therefore, the average percentage over this period was used to estimate the amount of tetrachloroethylene used in NSW during the 2008 calendar year. It was estimated that in the 2008 calendar year, 758,549 kg of tetrachloroethylene was imported for use in NSW (i.e. 52% of national imports).

It was reported under the National Industrial Chemicals Notification & Assessment Scheme (NICNAS) that in 2001 dry cleaning accounts for 79% of all tetrachloroethylene usage (DHA, 2001). Therefore, it is estimated that 597,283 kg of tetrachloroethylene was used in dry cleaners in NSW during 2008. It is further assumed usage of dry cleaners is directly proportional to the difference in population. Therefore, it is estimated that 448 tonne of tetrachloroethylene was used in dry cleaners in the NSW GMR in the 2008 calendar year.

Summary activity data is presented in Table 3-31.

Table 3-31: Summary activity data for tetrachloroethylene usage in dry cleaners

Parameter	Value	Unit
Total national import of tetrachloroethylene in 2008	1,454,759	kg/year
Average percentage of national import used in NSW	52%	
Estimated usage of tetrachloroethylene in NSW in 2008	758,549	kg/year
Overall use of tetrachloroethylene in dry cleaning operations	79%	
Estimated usage of tetrachloroethylene in NSW in dry cleaners 2008	597,283	kg/year
Percentage of NSW population that lives in GMR	75.05%	
Estimated usage of tetrachloroethylene in NSW GMR in dry cleaners	448.26	t/year

No data were available for white spirit usage in dry cleaners for the 2008 calendar year. Therefore, the ratio between white spirit usage and tetrachloroethylene usage used in the 2003 air emissions inventory was used to estimate the amount of white spirit usage in 2008. In the 2003 emissions inventory, it was estimated that the usage of white spirit in dry cleaners was 13.4 tonne and the usage of tetrachloroethylene in dry cleaners was 263 tonne. For the 2008 air emissions inventory it is assumed this ratio is consistent. Therefore, it is estimated that the usage of white spirit in dry cleaners for the 2008 calendar year is 22.8 tonne.

Solvent usage has been spatially allocated to each business in proportion to the population in each local government area (LGA) compared with the total population in the GMR. The total solvent usage in each LGA has been divided by the number of laundries and dry cleaners in each LGA to estimate the amount of solvent usage for each business.

3.3.4 Temporal Variation of Emissions

VOC emissions from solvents to air are generally emitted during the washing and drying operations of the dry cleaning business. The typical operating hours of dry cleaning businesses have been determined from respondent businesses. The temporal variation of emissions based on operating hours have been assumed to be constant on weekdays from 8 am to 6 pm and only Saturday from 8 am to 1 pm. No monthly variations in emissions are assumed to occur during the year.

3.3.5 Emission Estimates

Estimated emissions from laundries and dry cleaning businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-32.

Table 3-32: Estimated emissions from laundries and dry cleaners

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	23.4	0	0	0	23.4
CARBON MONOXIDE	3870	0	0	0	3,870
FORMALDEHYDE	46.9	0	0	0	46.9
ISOMERS OF XYLENE	751	37.6	29.8	105	924
LEAD & COMPOUNDS	0.0234	0	0	0	0.0234
OXIDES OF NITROGEN	4680	0	0	0	4,680
PARTICULATE MATTER ≤ 10 µm	356	0	0	0	356
PARTICULATE MATTER ≤ 2.5 µm	356	0	0	0	356
PERCHLOROETHYLENE	352,000	21,400	16,900	59,600	450,000
POLYCYCLIC AROMATIC HYDROCARBONS	0.0322	0	0	0	0.0322
SULFUR DIOXIDE	24.5	0	0	0	24.5
TOLUENE	110	4.92	3.9	13.8	133
TOTAL SUSPENDED PARTICULATE	356	0	0	0	356
TOTAL VOLATILE ORGANIC COMPOUNDS	372,000	22,300	17,700	62,400	474,000
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.3.6 Emission Projection Methodology

Projection factors for laundries and dry cleaners have been derived based on population projections for the GMR published by TDC (TDC, 2009).

Derived projection factors are provided in Table 3-33 and illustrated in Figure 3-9.

Table 3-33: Projection factors for population related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0094	2023	1.1333
2010	1.0187	2024	1.1417
2011	1.0281	2025	1.1500
2012	1.0371	2026	1.1584

Year	Projection Factor	Year	Projection Factor
2013	1.0460	2027	1.1662
2014	1.0550	2028	1.1739
2015	1.0640	2029	1.1817
2016	1.0729	2030	1.1895
2017	1.0817	2031	1.1973
2018	1.0904	2032	1.2045
2019	1.0991	2033	1.2118
2020	1.1079	2034	1.2191
2021	1.1166	2035	1.2264
2022	1.1250	2036	1.2336

Source: TDC (2009)

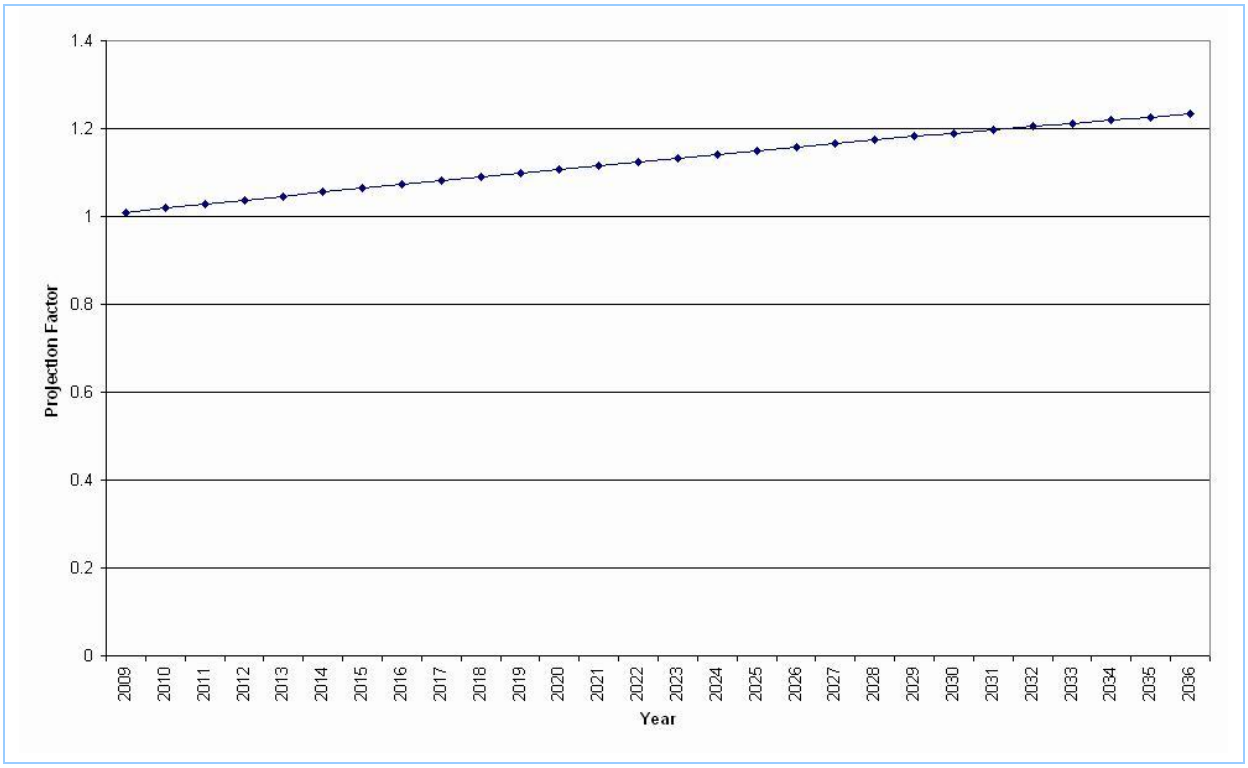

Figure 3-9: Projection factors for population related sources

3.4 Poultry Farming

3.4.1 Emission Sources and Associated Releases to Air

Poultry farming businesses for meat chicken (broiler), laying hens and turkey farms were supplied for the 2003 air emissions inventory by the NSW Department of Primary Industries (DPI) and Australian Egg Corporation Limited (AECL) (DPI, 2005; AECL, 2005). These businesses have been included in the emissions inventory.

The emission sources considered from poultry farming and associated releases to air are outlined in Table 3-34.

Table 3-34: Poultry farming - emission sources

Emission Source	Emissions to Air
Poultry shed	PM, ammonia

The locations of poultry farming businesses are shown in Figure 3-8.

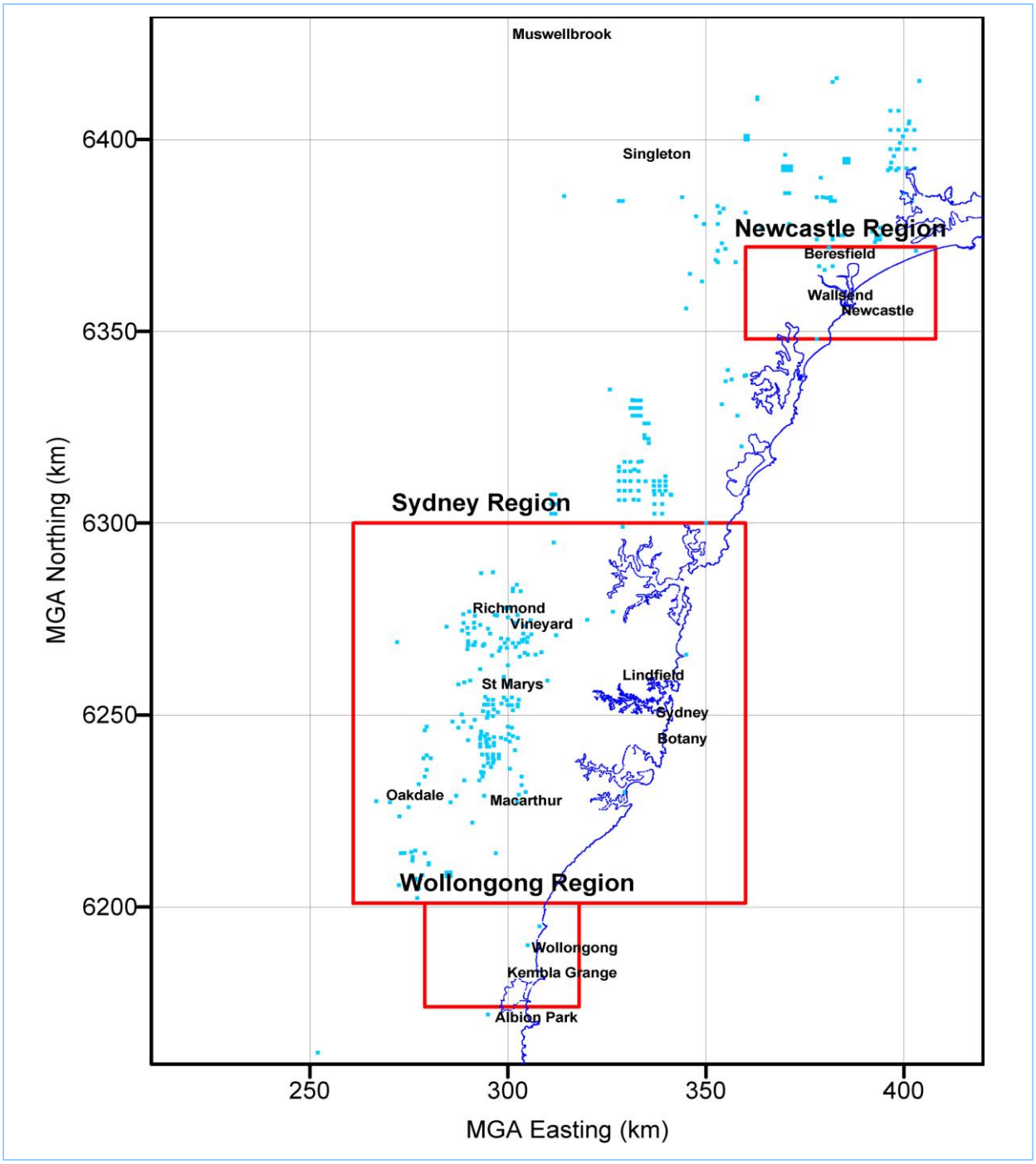

Figure 3-10: Poultry farming businesses within the GMR

3.4.2 *Emission Estimation Methodology*

Emissions of particulate matter from poultry farming (meat chicken) facilities were estimated using measurement data and ventilation data for tunnel ventilated sheds from the *"Silverweir" Broiler Farm Development Approval Application* located in Tamworth, NSW (Mirrabooka, 2002).

Particulate matter measurements were conducted over an eight week chicken rearing cycle from a tunnel ventilated shed fitted with a cup drinker system and during week five of the rearing cycle (when ventilation rates and total bird mass is at a maximum) from a tunnel ventilated shed fitted with a nipple drinker system.

Particulate measurement data is presented in Table 3-35 for the cup drinker shed and in Table 3-36 for the nipple drinker shed.

Table 3-35: Particulate monitoring results – 'cup' drinker shed, May – July 2002

Week	No of Birds	No of Fans	Gas Flow (per fan) (m^3/min)	Total Shed Gas Flow (m^3/min)	TSP Concentration (mg/Nm^3)	Shed TSP Emission Rate (g/min)	PM_{10} Concentration (mg/Nm^3)	Shed PM_{10} Emission Rate (g/min)
1	27,033	1	649	649	5	3.2	1.6	1.0
2	26,749	1	640	640	6	3.8	1.9	1.2
3	26,687	1	656	656	9.6	6.3	3	2.0
4	26,623	1	747	747	14	10.5	5.1	3.8
5	26,558	1	757	757	16	12.1	6.3	4.8
5	26,558	2	737	1,474	11	16.2	5.6	8.3
5	26,558	4	757	3,028	7.3	22.1	2.1	6.4
5	26,558	6	757	4,542	5.1	23.2	1.6	7.3
6	8,620	1	716	716	5.6	4.0	1.7	1.2
7	8,617	1	680	680	8.4	5.7	2.6	1.8
8	7,201	1	692	692	6.9	4.8	2.1	1.5

[a] Source: Table 8, "Silverweir" Broiler Farm Development Approval Application - Air Quality Assessment (Mirrabooka, 2002)

Table 3-36: Particulate monitoring results – 'nipple' drinker shed, August 2002

Week	No of Birds	No of Fans	Gas Flow (per fan) (m^3/min)	Total Shed Gas Flow (m^3/min)	TSP Concentration (mg/Nm^3)	Shed TSP Emission Rate (g/min)	PM_{10} Concentration (mg/Nm^3)	Shed PM_{10} Emission Rate (g/min)
5	30,986	1	639	639	13	8.3	5.2	3.3
5	30,986	2	761	1,522	8.6	13.1	3.5	5.3
5	30,986	4	831	3,324	6.4	21.3	2.5	8.3
5	30,986	5	828	4,140	5	20.7	1.7	7.0
5	30,986	6	801	4,806	4.7	22.6	1.6	7.7

[a] Source: Table 9, "Silverweir" Broiler Farm Development Approval Application - Air Quality Assessment (Mirrabooka, 2002)

The measurements show that TSP emissions from nipple drinker sheds are generally less than from cup drinker sheds. However there is less noticeable difference in emissions of PM_{10} between the different types of sheds. It is also noted that the number of samples collected and included in this analysis is small. Therefore, drawing conclusions between the differences in emission rates for each shed type is highly uncertain. The measurements also show that the concentration of TSP within the shed varies considerably during a meat chicken grow-out cycle. The measured TSP concentration

within the tunnel ventilated shed during the meat chicken grow out cycle are displayed in Figure 3-11. Maximum particulate concentrations occur between weeks four and six and are reduced in weeks seven and eight due to the initial harvesting that generally occurs between weeks five and six. Thinning of bird numbers at this stage supplies the market for smaller size birds and provides additional space for growing larger birds.

The measured variation in particulate concentration inside the shed is provided in Figure 3-11 over the chicken rearing cycle. It was conservatively assumed that the particulate concentration during week six is maintained at the maximum measured particulate concentration (as measured during week five).

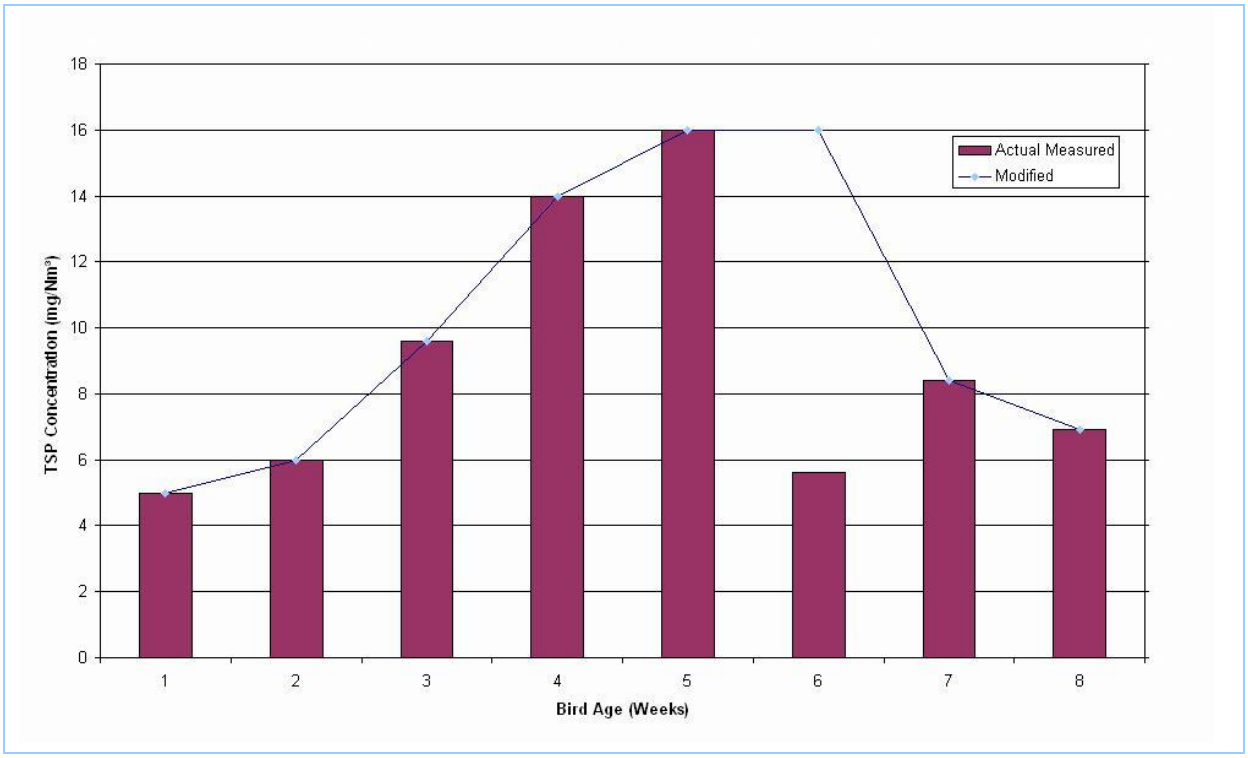

Figure 3-11: Measured TSP concentrations within shed during the chicken grow out cycle

Particulate emissions from the sheds were also analysed to determine the particulate size distribution released from each shed (as provided in Table 3-37).

Table 3-37: Measured particulate size distribution

Particulate Size	'Cup' Drinker Shed	'Nipple' Drinker Shed	Average
$PM_{2.5}$	ND	ND	*10%*
PM_5	17%	22%	20%
PM_{10}	42%	46%	44%
PM_{22}	74%	77%	75%
TSP	100%	100%	100%

[a] Source: Mirrabooka (2002)

No data were available for $PM_{2.5}$ so the fraction of particulates in the $PM_{2.5}$ size range was estimated assuming that the $PM_{2.5}$ fraction was half the PM_5 fraction. The derived particulate size distribution for particulates released from meat chicken farm sheds is shown in Figure 3-12.

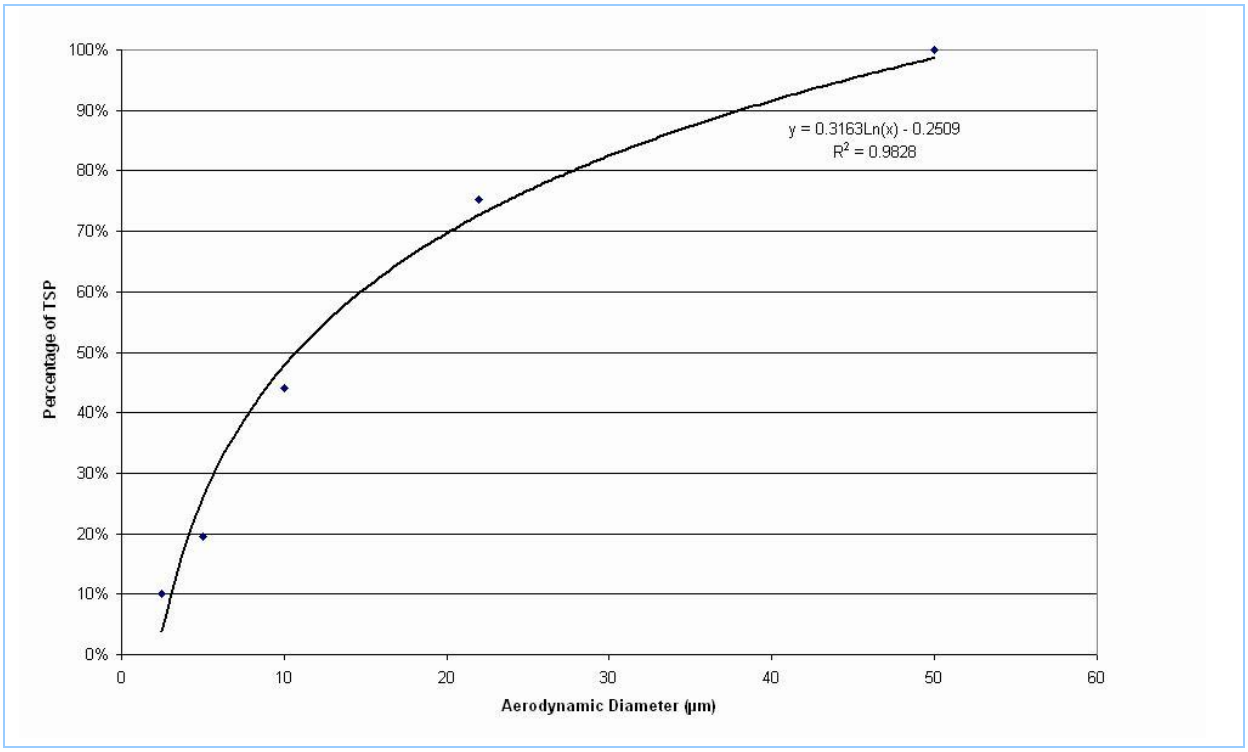

Figure 3-12: Derived particulate size distribution from meat chicken sheds

Ventilation rates also vary according to bird age and ambient temperature. Data sourced from the *"Silverweir" Broiler Farm Development Approval Application* located in Tamworth, NSW (Mirrabooka, 2002) show that typical design tunnel ventilation rates vary according to bird age and ambient temperature as shown in Figure 3-13.

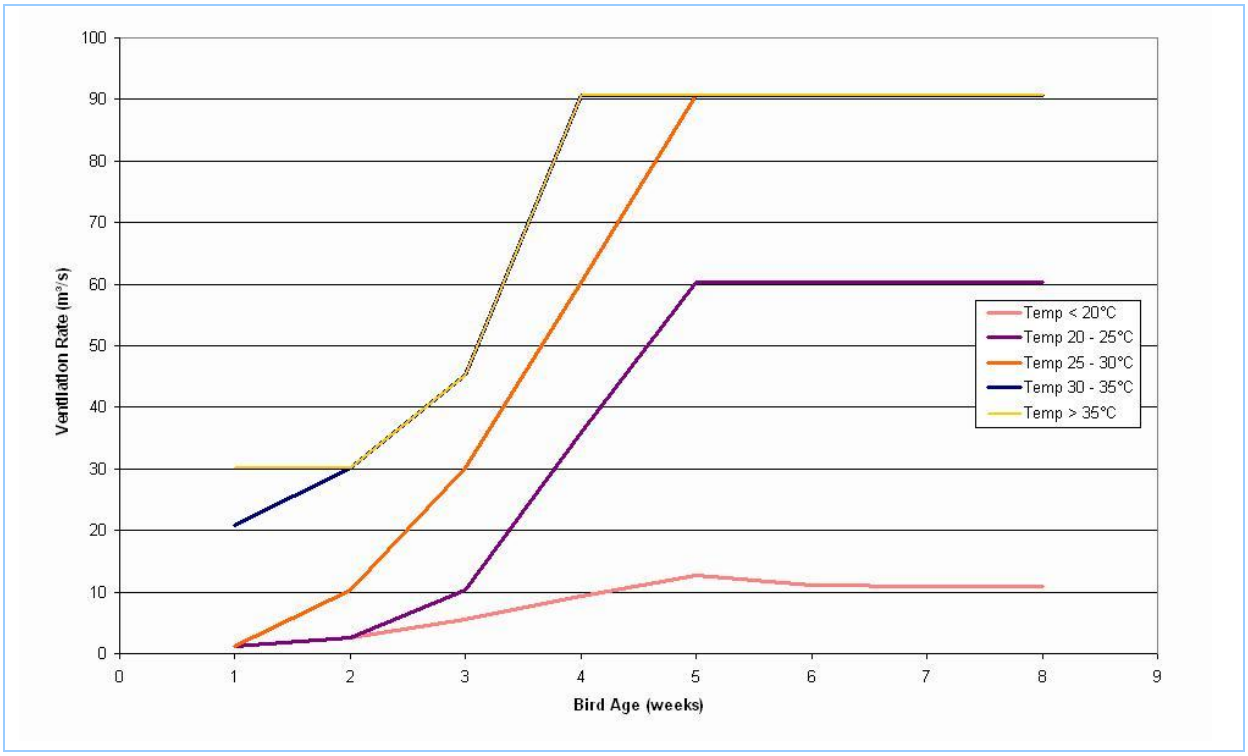

Figure 3-13: Variation in ventilation rates according to bird age and temperature

The average ambient temperature for each hour of the day in the year 2008 was derived using TAPM for locations where facilities are located in the NSW GMR. These data were used to estimate the hourly average ventilation rates for meat chicken farms in the NSW GMR. The hourly average ventilation rates were then combined with the particulate concentration data over the chicken grow out cycle to arrive at hourly estimated emission rates for 2008 from a single shed. The emission testing was conducted on a shed with a stocking capacity of 27.000 birds (Mirrabooka, 2002). Therefore, annual average emission factors for particulate matter (TSP, PM_{10} and $PM_{2.5}$) were derived based on 6 grow out phases occurring per year with a shed size of 27,000 birds. The derived emission factors for particulate matter are presented in Table 3-38.

Table 3-38: Derived particulate matter emission factors

Substance	Derived Emission Factor (kg/bird produced)
TOTAL SUSPENDED PARTICULATE	0.039
PARTICULATE MATTER ≤ 10 µm	0.017
PARTICULATE MATTER ≤ 2.5 µm	0.0039

Emissions of ammonia from each source have been estimated using techniques provided in the *NPI EET Manual for Intensive Livestock – Poultry Raising v1.0* (EA, 2002a).

3.4.3 Activity Data

The number of meat chickens in the GMR was estimated based on data provided by DPI and AECL for meat chicken farms for the 2003 air emissions inventory and data obtained from the ABS for the number of meat chickens in New South Wales for the years 2003 and 2008. The number of meat chickens in the GMR was estimated using the ratio between the number of meat chicken farms in the

GMR compared to NSW and the total number of meat chickens in NSW in 2008 provided in ABS data. It was assumed that there were no changes in facility details between the 2003 and 2008 air emissions inventory. The total estimated number of meat chickens produced in NSW and the GMR are provided in Table 3-39.

Table 3-39: Total estimated number of meat chickens in NSW and the GMR

Period	Area	Number of chickens (birds/year)
2003	GMR	18,300,000 [a]
2003	NSW	27,282,500 [b]
2008	NSW	26,606,372 [c]
2008	GMR	17,900,000

a Data provided by DPI (pers. comm. G Bolla, 14/03/2005 (DPI))
b ABS (2004), 7120 Agricultural Commodities
c ABS (2009) 72150DO018_200812 Livestock Products, Australia, Dec 2008; ABS (2008a) Section 18, ABS Publication 7215.0 Livestock Products (December Quarter 2007) (filename: 72150_dec 2007.pdf)

The total number of egg layer chickens in the GMR in 2008 was estimated based on data provided by the ABS for the number of egg layers in NSW and for specific National Resource Management Regions (NRM) within the GMR. Data published by ABS for the 2007/2008 financial year for NRMs within the GMR are provided in Table 3-40.

Table 3-40: Estimated number of egg layer chickens in the GMR

NRM Region	Estimated Percentage of Region in GMR	Total Number of Egg Chickens in NRM region[a]	Total Number of Egg Chickens in GMR (per annum)
Hawkesbury-Nepean	95%	2,459,910	2,336,915
Sydney-Metro	100%	206,367	206,367
Southern Rivers	1%	35,053	351
Central West	5%	180,000	9,000
Hunter-Central Rivers	40%	473,117	189,247
Lachlan	0%	446,153	-
		TOTAL (2007/2008)	**2,741,879**
		TOTAL (2008)	**2,969,500** [b]

a ABS (2009c) 71210DO009_200708 Agricultural Commodities, Australia, 2007-08, Table 1 Livestock, NRM Region–New South Wales–Year ended 30 June 2008
b Projected for the calendar year based on published growth rates between 2006/2007 and 2007/2008 (ABS, 2009)

No activity data were available for the number of turkeys in the GMR for the 2008 calendar year. Therefore, it was assumed that the change in the number of turkeys between the 2008 inventory period and the 2003 air emissions inventory was proportional to the change in the number of meat chickens between 2003 and 2008. The estimated total turkey production rate for the 2008 inventory is presented in Table 3-41.

Table 3-41: Estimated total turkey in the GMR for 2003 and 2008

Period	Area	Number of birds (birds/year)
2003	GMR	2,580,300
2008	GMR	2,516,300

The ratio between the total poultry production rates between the 2003 and 2008 inventory periods was used to scale activity rates at each poultry farm in NSW. A summary of the data used to estimate emissions is presented in Table 3-42.

Table 3-42: Total number of birds and poultry farms [a]

Poultry Farm Type	Number of Farms Identified [a]	Number of Birds
Broiler	272	17,900,000
Turkey	52	2,516,300
Laying hens	50	2,969,500

[a] Data provided by DPI (2005)

3.4.4 Temporal Variation of Emissions

Temporal factors were derived using TAPM meteorological data averaged over all locations were poultry facilities are located in the GMR to derive temperature and bird age dependent ventilation rates which affect the rate of emission from sheds. The derived monthly and hourly temporal factors are shown in Figure 3-14 and Figure 3-15. There are no estimated variations in emissions between days of the week. Temporal factors are also provided in Table 3-43 and Table 3-44.

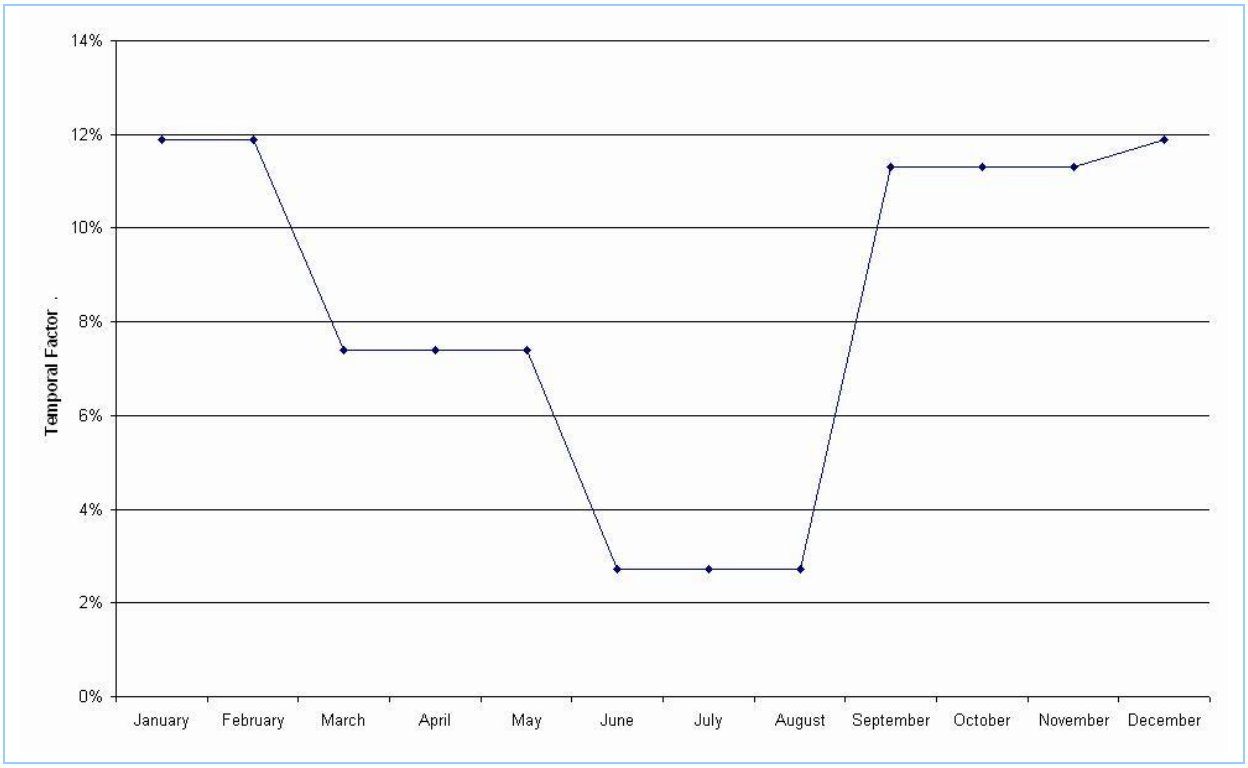

Figure 3-14: Monthly temporal emissions profile – poultry farming

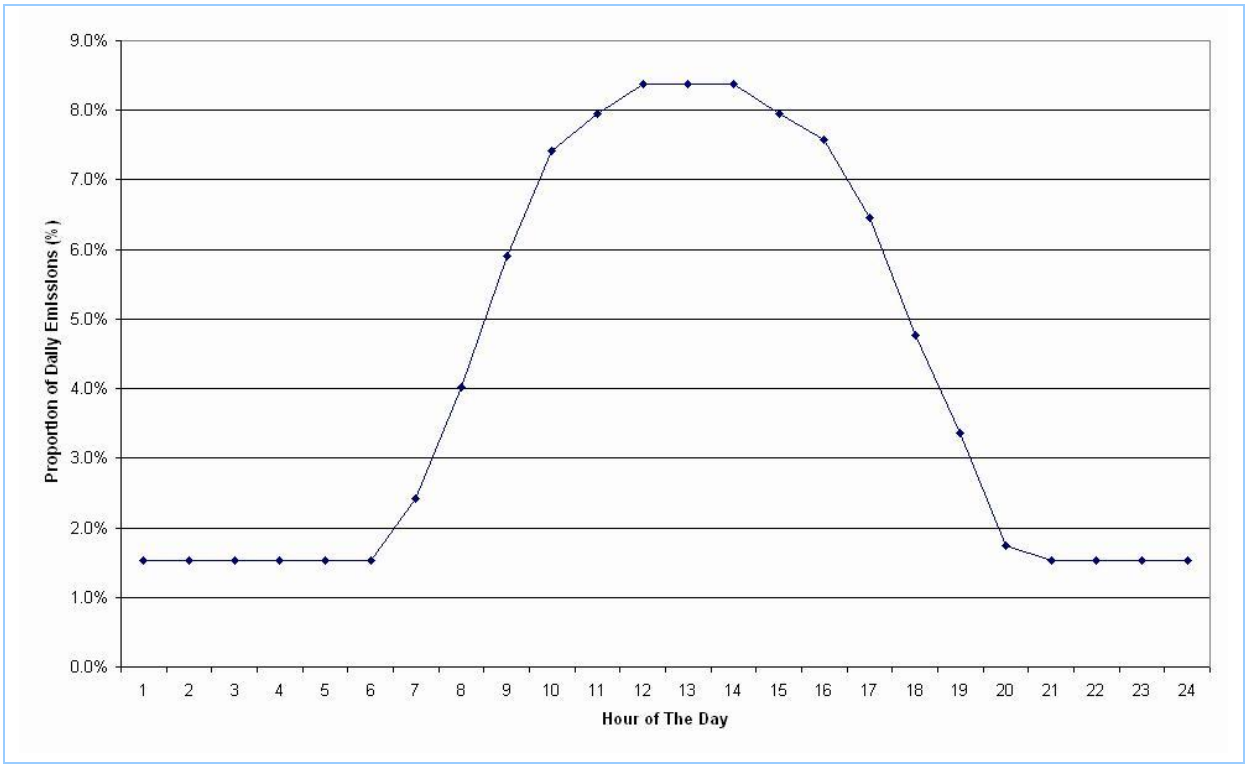

Figure 3-15: Hourly temporal emissions profile – poultry farming

Table 3-43: Monthly temporal factors for emissions from poultry farming

Month	Temporal Factor
January	11.9
February	11.9
March	7.4
April	7.4
May	7.4
June	2.7
July	2.7
August	2.7
September	11.3
October	11.3
November	11.3
December	11.9

Table 3-44: Hourly temporal factors for emissions from poultry farming

Hour	Weekday Temporal Factor	Weekend Temporal Factor
1	1.53	1.53
2	1.53	1.53
3	1.53	1.53
4	1.53	1.53
5	1.53	1.53
6	1.53	1.53
7	2.42	2.42
8	4.02	4.02
9	5.90	5.90

Hour	Weekday Temporal Factor	Weekend Temporal Factor
10	7.41	7.41
11	7.95	7.95
12	8.38	8.38
13	8.38	8.38
14	8.38	8.38
15	7.94	7.94
16	7.57	7.57
17	6.46	6.46
18	4.77	4.77
19	3.37	3.37
20	1.75	1.75
21	1.53	1.53
22	1.53	1.53
23	1.53	1.53
24	1.53	1.53

3.4.5 *Emission Estimates*

Estimated emissions from poultry farming (eggs) within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-45.

Table 3-45: Estimated emissions from poultry farming (eggs)

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	45,400	0	0	5,120	50,500
PARTICULATE MATTER ≤ 2.5 µm	10,400	0	0	1,170	11,600
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	0	0
TOTAL SUSPENDED PARTICULATE	104,000	0	0	11,700	116,000
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	0	0
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

Estimated emissions from poultry farming (meat) (includes emissions from turkey farms and meat chicken farms) within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-46.

Table 3-46: Estimated emissions from poultry farming (meat)

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	6.88	0	0	0	6.88
CARBON MONOXIDE	1,160	0	0	0	1,160
FORMALDEHYDE	13.8	0	0	0	13.8
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.00688	0	0	0	0.00688
OXIDES OF NITROGEN	1,380	0	0	0	1,380
PARTICULATE MATTER ≤ 10 µm	64,100	2,350	593	64,900	132,000
PARTICULATE MATTER ≤ 2.5 µm	14,800	539	136	14,900	30,300
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00946	0	0	0	0.00946
SULFUR DIOXIDE	7.19	0	0	0	7.19
TOLUENE	3.44	0	0	0	3.44
TOTAL SUSPENDED PARTICULATE	147,000	5,390	1,360	149,000	303,000
TOTAL VOLATILE ORGANIC COMPOUNDS	75.7	0	0	0	75.7
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.4.6 Emission Projection Methodology

Projection factors for poultry farming have been derived based on final energy consumption projections for agriculture in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-47 and illustrated in Figure 3-16.

Table 3-47: Projection factors for agriculture related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0123	2023	1.1445
2010	1.0237	2024	1.1533
2011	1.0344	2025	1.1617
2012	1.0444	2026	1.1701
2013	1.0542	2027	1.1785
2014	1.0637	2028	1.1868
2015	1.0729	2029	1.1953
2016	1.0820	2030	1.2055
2017	1.0910	2031	1.2160
2018	1.1000	2032	1.2251
2019	1.1089	2033	1.2342
2020	1.1179	2034	1.2432
2021	1.1269	2035	1.2523
2022	1.1357	2036	1.2613

Source: ABARE (2006)

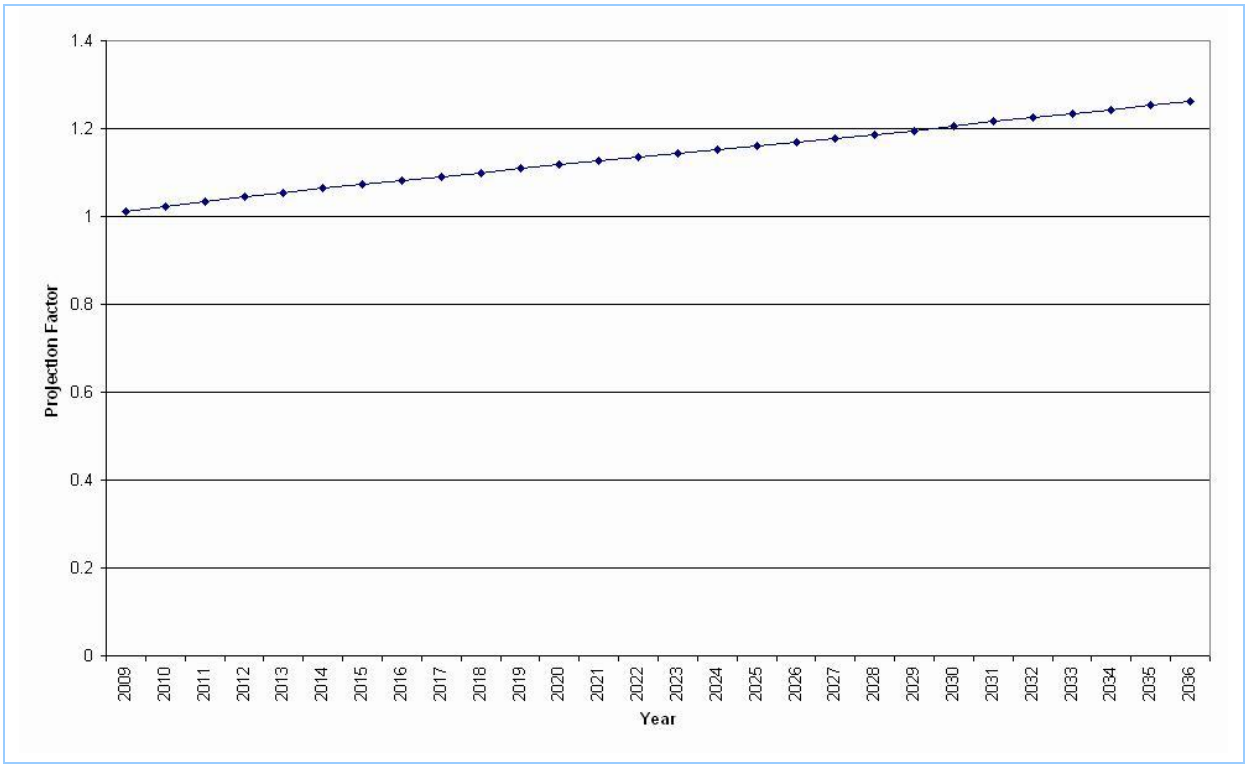

Figure 3-16: Projection factors for agriculture related sources

3.5 Hospitals

3.5.1 Emission Sources and Associated Releases to Air

Hospitals in the GMR have been identified using data supplied by NSW Health (NSW Health, 2009a; 2009b). A total of 129 hospitals have been identified to be within the GMR.

The emission sources and associated releases to air from hospitals are outlined in Table 3-48.

Table 3-48: Hospitals – emission sources

Emission Source	Emissions to Air
Boiler (LPG)	Combustion products
Boiler (natural gas)	Combustion products
Internal combustion engine (diesel)	Combustion products
Surface coating (degreaser)	VOC
Surface coating (solvent based paint)	VOC
Surface coating (water based paint)	VOC

The locations of hospitals within the GMR are shown in Figure 3-17.

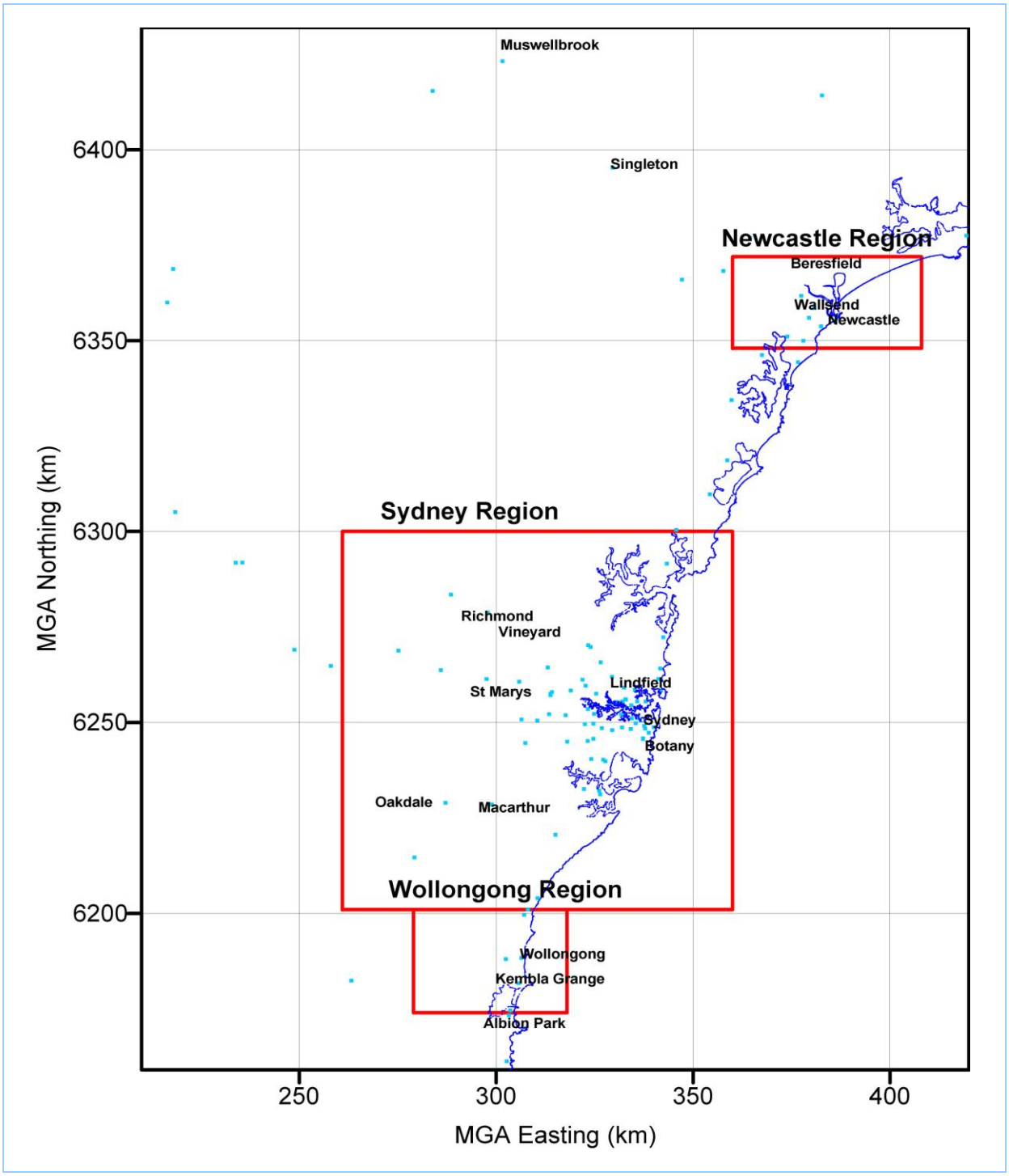

Figure 3-17: Hospitals within the GMR

3.5.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from hospitals are provided in Table 3-49.

Table 3-49: Emission and speciation factors for all substances from hospitals

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (diesel)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996a)
	Surface coating (degreaser)	Mass balance
	Surface coating (solvent based paint)	VOCs from Surface Coatings Final Report (ENVIRON, 2009)
	Surface coating (water based paint)	
$PM_{2.5}$, PM_{10} & TSP	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (diesel)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996a)
Speciated organics (including methane)	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Internal combustion engine (diesel)	SPECIATEv4.2 (Profile ID=0008) (USEPA, 2008c)
	Surface coating (degreaser)	SPECIATEv4.2 (Profile ID=1195) (USEPA, 2008c)
	Surface coating (solvent based paint)	SPECIATEv4.2 (Profile ID=1003) (USEPA, 2008c)
	Surface coating (water based paint)	SPECIATEv3.2 (Profile ID=1013) (USEPA, 2008c)
Speciated particulate matter	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (diesel)	CEIDARS PM profile 114 for speciated metals (CARB, 2007)
Ammonia	Boiler (LPG)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
	Boiler (natural gas)	
	Internal combustion engine (diesel)	
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (diesel)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996)
PCDD/PCDF	Boiler (LPG)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
	Boiler (natural gas)	
Greenhouse gases (CO_2 and N_2O)	Boiler (LPG)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)
	Boiler (natural gas)	
	Internal combustion engine (diesel)	

3.5.3 Activity Data

All hospitals were sent a questionnaire during the 2003 air emissions inventory to collect activity data. Responses were received from 43 hospitals (i.e. a response rate of 30%). It was assumed that data provided for the 2003 air emissions inventory is valid for the 2008 air emissions inventory. Data provided in returned commercial survey questionnaires have been used to estimate site-specific emissions from the 43 hospitals. Analysis of the returned commercial survey questionnaires shows that the number of hospitals with natural gas combustion, diesel combustion and LPG combustion is 22, 3 and 1 respectively. Some hospitals have no fuel usage and hence no air emissions.

Activity data for the 85 hospitals that did not respond to the commercial survey questionnaire have been estimated based on data provided in the returned commercial survey questionnaires.

It has been assumed that all non-respondent hospitals combust natural gas. Analysis of combustion data provided by non-respondent facilities shows that as the number of beds at a hospital increases the rate of natural gas combustion increases. The data showing the relationship between the number of beds at a hospital and the rate of natural gas combustion is shown in Figure 3-18.

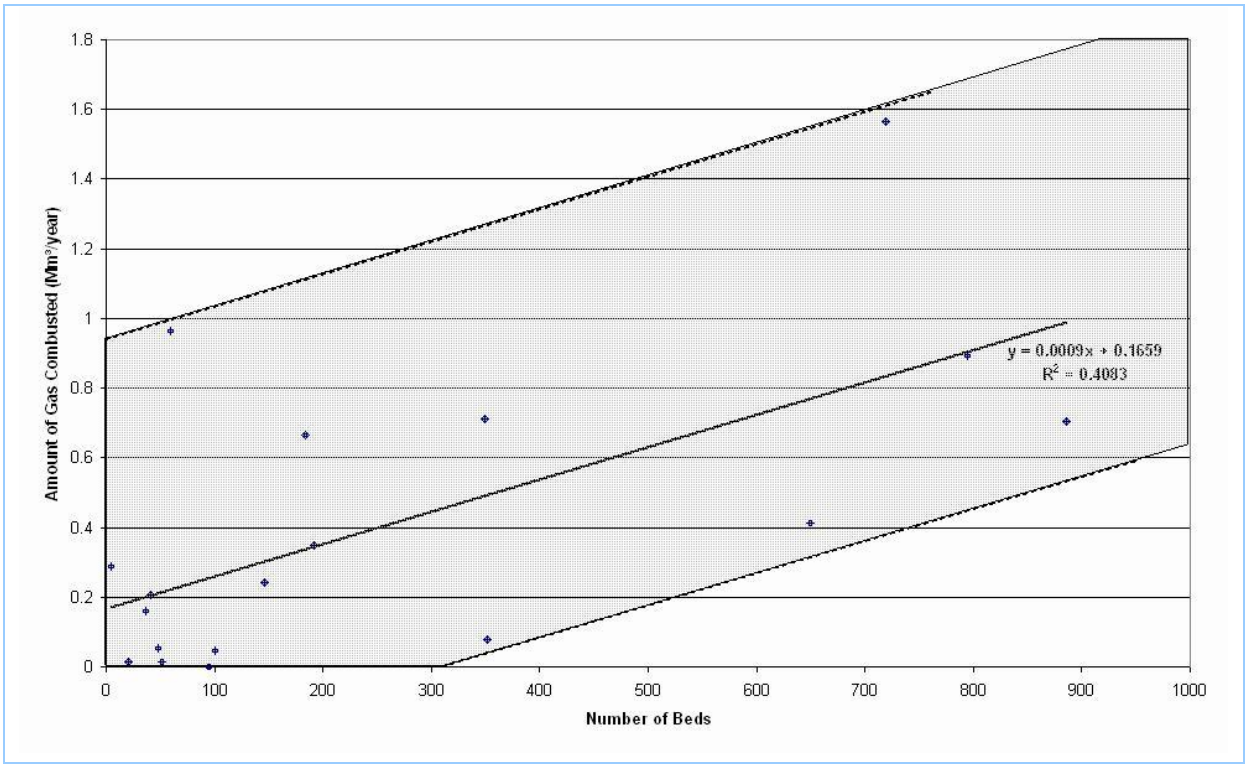

Figure 3-18: Amount of gas combusted versus number of beds at NSW hospitals

In order to estimate the rate of natural gas combustion at non-respondent hospitals, it has been assumed that the best estimation of gas combustion can be achieved through a linear relationship between gas combustion and the number of beds at a hospital. As can be seen from Figure 3-18, there is significant variance at individual hospitals from this relationship. A least squares regression provides a best fit linear relationship of (Equation 16):

$$A_i = 0.0009 \times n_i + 0.1659 \qquad \textbf{Equation 16}$$

where:

A	=	Estimated rate of natural gas combustion at non-respondent hospital i	(Mm^3/year)
n	=	Number of beds at non respondent hospital i	(beds/hospital)

Using this approach, the total natural gas consumption at hospitals in the GMR is estimated to be 41 Mm^3 per year.

As there is significant variance in the derived relationship, analysis has been performed on the data to determine the significance of the variance in terms of its potential contribution to overall uncertainty in estimated emissions. A box and whisker plot, showing the variance in the estimated gas consumption per bed from each respondent hospital, is shown in Figure 3-19.

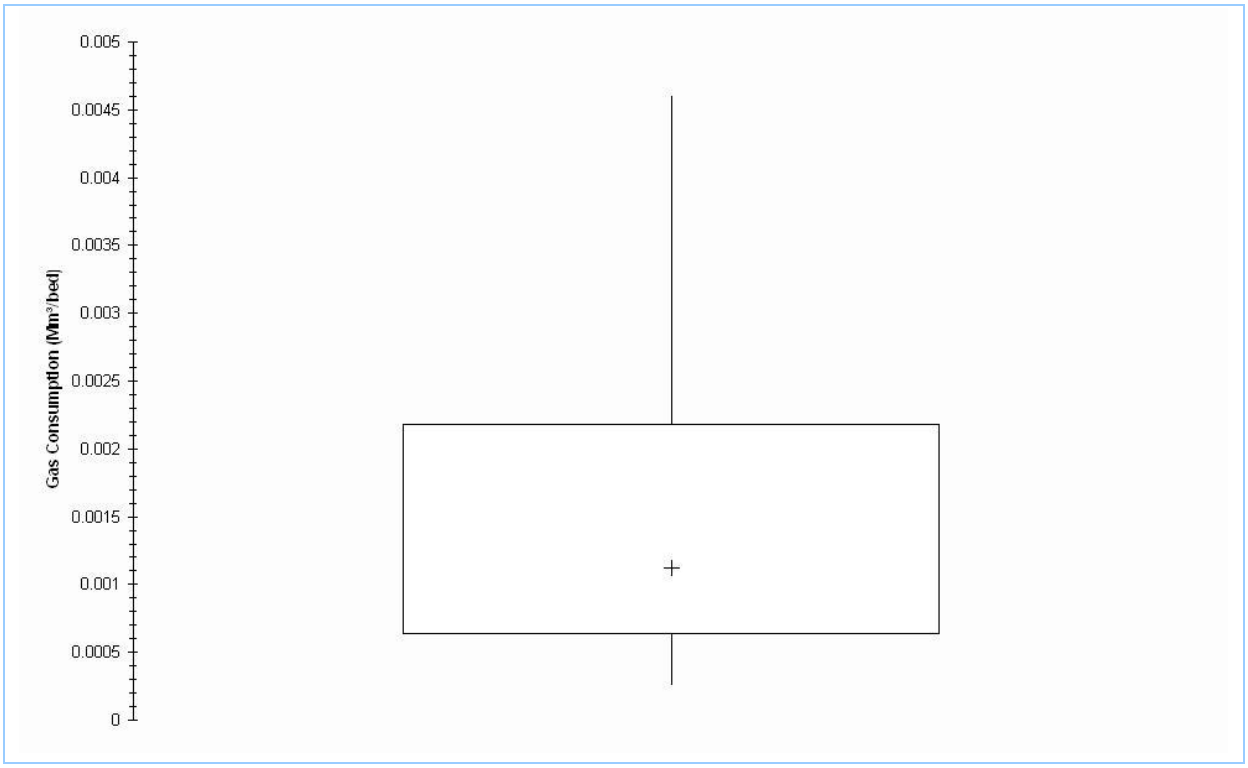

Figure 3-19: Variance in derived natural gas consumption per bed at hospitals in NSW GMR

Applying the maximum, derived natural gas consumption per bed to non-respondent hospitals generates a natural gas consumption rate of 76 Mm^3 per year (~2.9 TJ). This is an additional, 34 Mm^3 of natural gas combustion per year. The difference between the activity estimate and the maximum estimated natural gas consumption represents 1% of the total estimated gas consumption in the GMR. Since the uncertainty in the activity estimate is insignificant in terms of regional emission estimates, further refinement was judged to be unnecessary.

It has been assumed that emissions are released from stacks from non-respondent hospitals with the following stack parameters:

- Stack height = 15 m
- Stack diameter = 0.2 m

- Exit velocity = 10 m/s
- Exit temperature = 423 K

These have been assumed based on typical values supplied in returned commercial survey questionnaires.

3.5.4 Temporal Variation of Emissions

Temporal variation of emissions is assumed to remain constant throughout the day and year.

3.5.5 Emission Estimates

Estimated emissions from hospitals within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-50.

Table 3-50: Estimated emissions from hospitals

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	1.3	8.39	0	1.68	11.4
ACETALDEHYDE	0	0	0	0	0
BENZENE	227	35.4	12.5	59.6	334
CARBON MONOXIDE	38,000	4,660	2,100	9,510	54,200
FORMALDEHYDE	450	51.8	25	115	642
ISOMERS OF XYLENE	3.51	0	0	0	3.51
LEAD & COMPOUNDS	0.336	0.21	0.0125	0.0937	0.652
OXIDES OF NITROGEN	45,600	6,630	2,500	11,800	66,500
PARTICULATE MATTER ≤ 10 µm	3,440	496	190	880	5,000
PARTICULATE MATTER ≤ 2.5 µm	3,440	495	190	880	5,000
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.343	0.0908	0.0172	0.0892	0.54
SULFUR DIOXIDE	256	122	13	77.6	469
TOLUENE	130	13	6.24	28.8	178
TOTAL SUSPENDED PARTICULATE	3,440	498	190	881	5,010
TOTAL VOLATILE ORGANIC COMPOUNDS	2,620	391	137	644	3,790
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.5.6 Emission Projection Methodology

Projection factors for hospitals have been derived based on population projections for the GMR published by TDC (TDC, 2009).

Derived projection factors are provided in Table 3-33 and illustrated in Figure 3-9.

3.6 Wine Manufacturing

3.6.1 Emission Sources and Associated Releases to Air

Wine manufacturers were identified using the Wine Industry Directory sourced from Winetitles (Winetitles, 2009). A total of 105 wine manufacturers were identified to be within the GMR.

The emission sources and associated releases to air from wine manufacturing are outlined in Table 3-51.

Table 3-51: Wine manufacturing – emission sources

Emission Source	Emissions to Air
Boiler (LPG)	Combustion products
Fuel storage (diesel)	VOC
Fuel storage (petrol)	VOC
Wastewater treatment	Ammonia, VOC
Wine fermentation (red wine)	H_2S, VOC
Wine fermentation (white wine)	H_2S, VOC
Wine manufacturing (bottling (red wine))	VOC
Wine manufacturing (bottling (white wine))	VOC
Wine manufacturing (pomace pressing (red wine))	VOC
Wine manufacturing (pomace screening (red wine))	VOC
Wine maturation (red wine, barrel)	VOC
Wine maturation (white wine, barrel)	VOC

The locations of wine manufacturers within the GMR are shown in Figure 3-20.

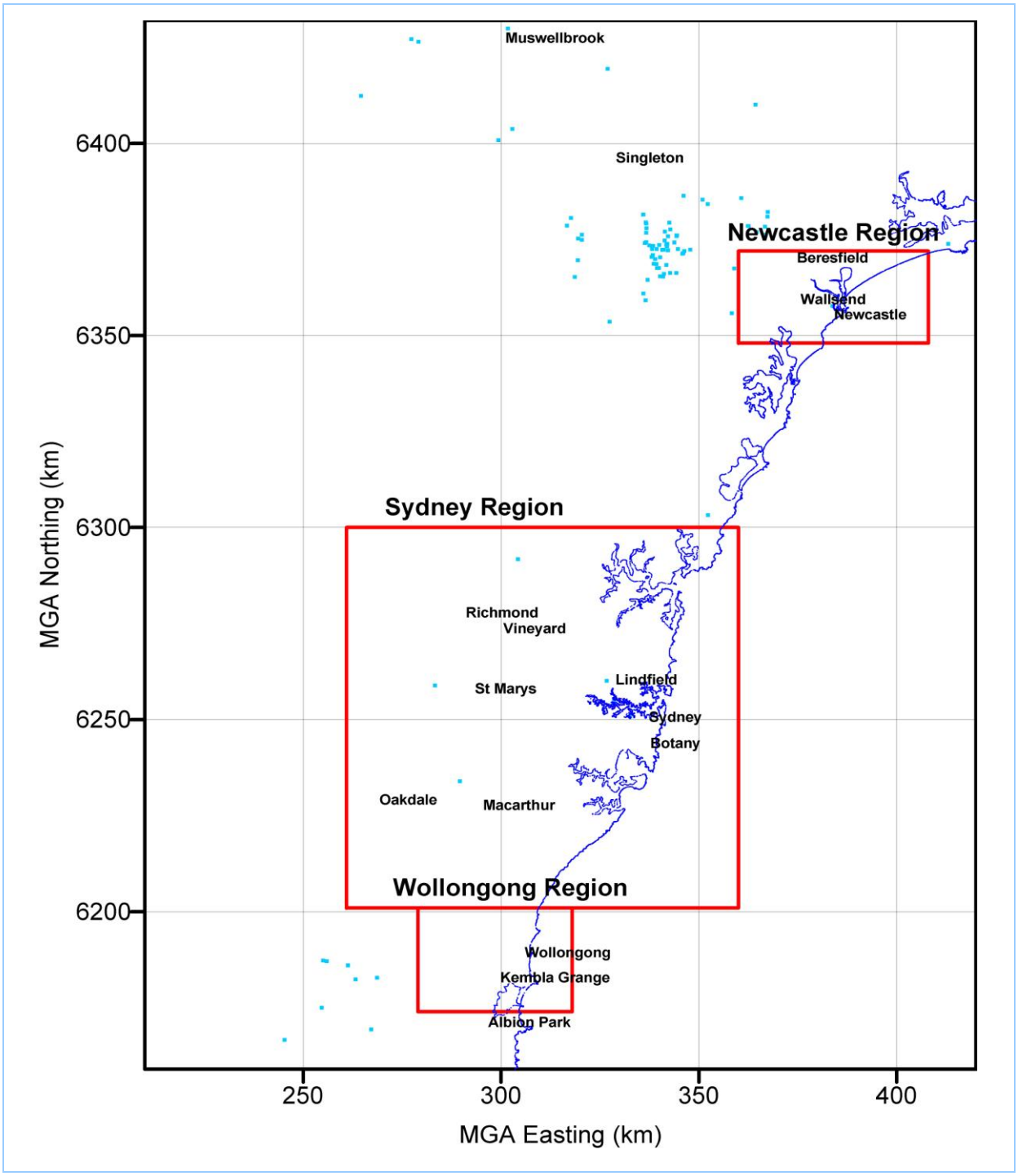

Figure 3-20: Wine manufacturers within the GMR

3.6.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from wine manufacturing are provided in Table 3-52.

Table 3-52: Emission and speciation factors for all substances from hospitals

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Wastewater treatment	NGGIC Workbook for Waste (NGGIC, 1996)
	Wine fermentation (white wine)	AP42 Chapter 9.12.2 Wines and Brandy (USEPA, 1995b)
	Wine fermentation (red wine)	
	Wine manufacturing (bottling (red wine))	
	Wine manufacturing (bottling (white wine))	
	Wine manufacturing (pomace pressing (red wine))	
	Wine manufacturing (pomace screening (red wine))	
	Wine maturation (red wine, barrel)	NPI EET Manual for Wine and Spirit Manufacturing v2.0 (DEWHA, 2010)
	Wine maturation (white wine, barrel)	
$PM_{2.5}$, PM_{10} & TSP	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
Speciated organics (including methane)	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Wastewater treatment	CEIDARS Organic Gas Speciation Profiles (Profile ID=1402) (assuming that unidentified portion is methane) (CARB, 2005)
	Wine fermentation (white wine)	SPECIATEv4.2 (Profile ID=1188) (USEPA, 2008c)
	Wine fermentation (red wine)	
	Wine manufacturing (bottling (red wine))	
	Wine manufacturing (bottling (white wine))	
	Wine manufacturing (pomace pressing (red wine))	
	Wine manufacturing (pomace screening (red wine))	
	Wine maturation (red wine, barrel)	
	Wine maturation (white wine, barrel)	
Speciated particulate matter	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998a) (assuming the same emissions per joule combusted as natural gas)
Ammonia	Boiler (LPG)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
PCDD/PCDF	Boiler (LPG)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	Boiler (LPG)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)

3.6.3 Activity Data

State wine production was sourced from the ABS and found to be 422,354 kL for the 2008 calendar year (ABS, 2009b).

Wine facilities were identified from the Wine Industry Directory (Winetitles, 2009). The Wine Industry Directory also had other data for each facility such as fermentation capacity, tonnage ranges and case production ranges for each winery. An initial estimate on facility production volumes was made using the following hierarchical approach.

1) If a winery completed a questionnaire for the 2003 air emissions inventory, it was assumed that production for the 2008 calendar year was the same as in 2003;

2) For facilities that did not fill out a questionnaire, it was assumed the fermentation capacity was the same as the annual production capacity for the winery;

3) Where fermentation capacity was not available, production capacities were assumed to be the same as other wineries with similar tonnage ranges and case production ranges as the winery with no production data available.

Using this approach the estimated total wine production in NSW was 364,988 kL. The estimated production rate at each facility were then adjusted so that the total wine production in the GMR was equal to the total wine production sourced from the ABS of 422,354 kL (i.e. estimated production rates were increased by 16% at each facility).

Where site specific data were not available to estimate the rate of red versus white wine production rates, the average grape type production in the GMR sourced from ABARE was used to estimate site specific red and white wine production rates. ABARE reports that 56% of grape production in the GMR is for white wine and 44% of grape production is for red wine (ABARE, 2009a).

Summary activity statistics collected for wine production in the GMR is presented in Table 3-53.

Table 3-53: Summary activity statistics collected for wine production in the GMR

Parameter	Value
Amount of wine produced in NSW in 2008	422,354 kL/year [a]
Amount of wine produced in NSW in 2008	422,354 kL/year [b]
Total red/rose wine production in NSW in 2008	216,338 kL/year [a]
Total white wine production in NSW in 2008	206,016 kL/year [a]
Amount of wine produced in GMR	54,901 kL/year [b]
Percentage of total state wine produced in GMR	13.0% [b]
Amount of grapes produced in NSW in 2008	385,169 t/year [c]
Amount of grapes produced in GMR in 2008	56,948 t/year [c]

[a] ABS (2009b)
[b] Derived from Winetitles (2009)
[c] ABARE (2009a)

3.6.4 Temporal Variation of Emissions

Temporal variation of emissions has been estimated based on data provided in returned commercial survey questionnaires. It has been assumed that emissions remain constant throughout the operating hours of the business from 6 am to 3 pm each day, for 7 days a week. Monthly temporal factors are provided in Table 3-54 and Figure 3-21.

Table 3-54: Monthly temporal variation of emissions for wine manufacturing

Month	Proportion [a]
January	0.50
February	1.66
March	1.67
April	1.67
May	0.75
June	0.75
July	0.50
August	0.50
September	0.50
October	0.50
November	0.50
December	0.50

a Temporal variation of emissions provided by Tamburlain Wines

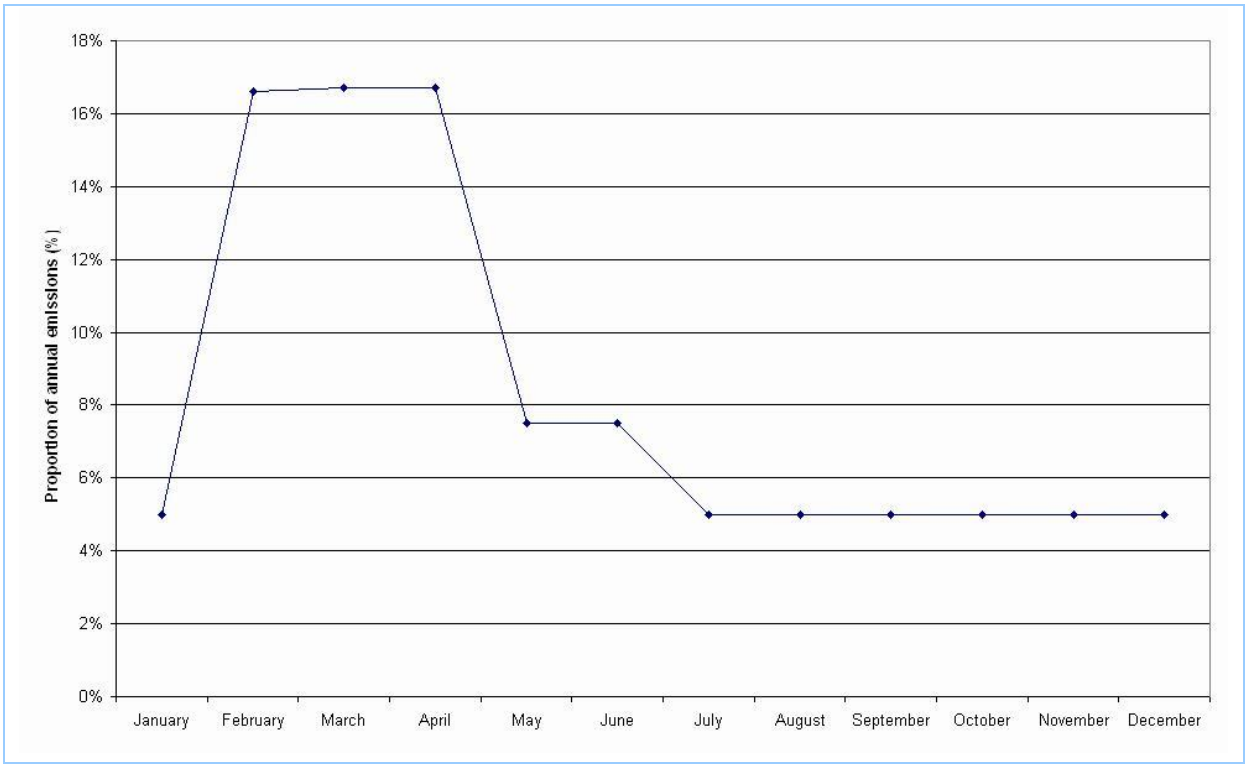

Figure 3-21: Monthly temporal factors for wine manufacturing sources

3.6.5 Emission Estimates

Estimated emissions from wine manufacturing within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-55.

Table 3-55: Estimated emissions from wine manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.0541	0	0	0.174	0.229
CARBON MONOXIDE	0.241	0	0	0	0.241
FORMALDEHYDE	0.247	0.0407	0	5.33	5.62
ISOMERS OF XYLENE	1.39	0.244	0	32.3	33.9
LEAD & COMPOUNDS	0.00000535	0	0	0	0.00000535
OXIDES OF NITROGEN	1.75	0	0	0	1.75
PARTICULATE MATTER ≤ 10 µm	0.0542	0	0	0	0.0542
PARTICULATE MATTER ≤ 2.5 µm	0.0537	0	0	0	0.0537
PERCHLOROETHYLENE	1.58	0.285	0	37.3	39.2
POLYCYCLIC AROMATIC HYDROCARBONS	0.00000747	0	0	0	0.00000747
SULFUR DIOXIDE	0.00000903	0	0	0	0.00000903
TOLUENE	1.02	0.163	0	21.8	23
TOTAL SUSPENDED PARTICULATE	0.0555	0	0	0	0.0555
TOTAL VOLATILE ORGANIC COMPOUNDS	3,180	34	0	20,900	24,100
TRICHLOROETHYLENE	0.226	0.0407	0	5.33	5.6

[a] Totals may not appear additive due to rounding

3.6.6 Emission Projection Methodology

Projection factors for wine manufacturing have been derived based on population projections for the GMR published by TDC (TDC, 2009).

Derived projection factors are provided in Table 3-33 and illustrated in Figure 3-9.

3.7 Construction Material Mining

3.7.1 Emission Sources and Associated Releases to Air

The category construction material mining includes ANZSIC classes 'Gravel and Sand Quarrying' and 'Construction Material Mining n.e.c.'. Construction material mines were identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of 60 commercial construction material mines have been identified from these sources to be within the GMR. The emission sources and associated releases to air for construction material mining are outlined in Table 3-56.

Table 3-56: Construction material mining – emission sources

Emission Source	Emissions to Air
Blasting	PM
Drilling	PM
Fuel storage (diesel)	VOC
Loaders (overburden)	PM
Primary crushing (M < 4%)	PM
Screening	PM
Secondary crushing (M < 4%)	PM
Tertiary crushing (M < 4%)	PM
Trucks (dumping overburden)	PM
Wheel generated dust (unpaved roads)	PM
Wind erosion	PM

The locations of commercial construction material mining businesses are shown in Figure 3-22.

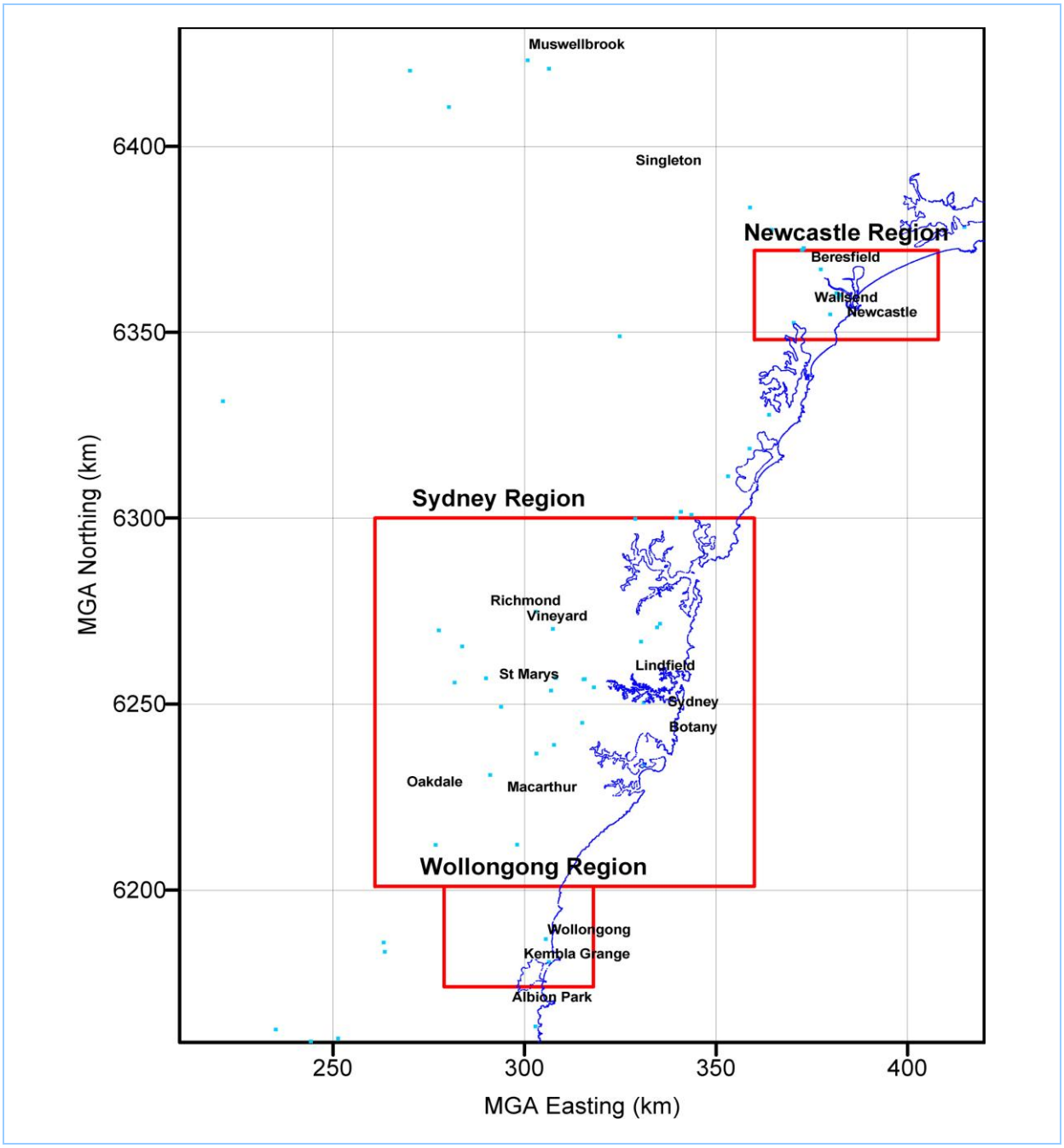

Figure 3-22: Commercial construction material mines within the GMR

3.7.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from construction material mining are provided in Table 3-57.

Table 3-57: Emission and speciation factors for all substances from construction material mining

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
$PM_{2.5}$, PM_{10} & TSP	Blasting	NPI EET Manual for Mining v2.3 (EA, 2003b)
	Drilling	
	Loaders (overburden)	
	Primary crushing (M < 4%)	
	Screening	
	Secondary crushing (M < 4%)	
	Tertiary crushing (M < 4%)	
	Trucks (dumping overburden)	
	Wheel generated dust (unpaved roads)	AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006c)
	Wind erosion	NPI EET Manual for Mining v2.3 (EA, 2003b)
Speciated organics (including methane)	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001a)
Speciated particulate matter	Blasting	Appendix B, NPI EET Manual for Mining v2.3 (EA, 2003b)
	Drilling	
	Loaders (overburden)	
	Primary crushing (M < 4%)	CEIDARS Particulate Matter (PM) Speciation Profiles - Rock crushing (CARB, 2007)
	Screening	CEIDARS Particulate Matter (PM) Speciation Profiles - Rock screening (CARB, 2007)
	Secondary crushing (M < 4%)	CEIDARS Particulate Matter (PM) Speciation Profiles - Rock crushing (CARB, 2007)
	Tertiary crushing (M < 4%)	
	Trucks (dumping overburden)	Appendix B, NPI EET Manual for Mining v2.3 (EA, 2003b)
	Wheel generated dust (unpaved roads)	California Emissions Inventory and Reporting System - Unpaved Road Dust, 1997 (CARB, 2007)
	Wind erosion	Appendix B, NPI EET Manual for Mining v2.3 (EA, 2003b)
Ammonia	NA	NA
Sulfuric or hydrochloric acid	NA	NA
PAH	NA	NA
PCDD/PCDF	NA	NA
Greenhouse gases (CO_2 and N_2O)	NA	NA

3.7.3 Activity Data

The methodology to estimate emissions from commercial construction material mining facilities has not changed from the 2003 air emissions inventory. The only change to this sector is the inclusion of wheel generated dust in the commercial emissions module and the removal of facilities that are known to have ceased operation.

All 60 identified construction material mining businesses were sent commercial surveys for the 2003 air emissions inventory. The number of respondent businesses is provided in Table 3-58.

Table 3-58: Number of construction material mining businesses in the GMR and the number of respondent businesses

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Response Rate (%)
Gravel and sand quarrying	58	2	3
Construction material mining	2	1	50
Total	**60**	**3**	**5.0**

Site specific data supplied in the returned commercial survey questionnaires from respondent businesses have been used for emissions estimation when provided. Further, air emissions reported to the NPI have also been included from non-respondent commercial construction material mining businesses.

Activity data for non-respondent commercial construction material mining businesses have been estimated based on data extracted from the following references:

- *New South Wales Industrial Minerals Database*, NSW Department of Mineral Resources (DMR, 2003);
- *Supply and Demand for Construction Sand in the Sydney Planning Region*, NSW Department of Mineral Resources (DMR, 2001a);
- *Structural Clay/Shale Resources of the Sydney Region*, NSW Department of Mineral Resources (DMR, 2001b); and
- *Supply and Demand for Coarse Aggregate in the Sydney Planning Region*, NSW Department of Mineral Resources (DMR, 2000).

These references were queried to retrieve business and annual production data for all material extraction sites located within the GMR. The business list was cross-checked with licensed premises and all licensed (i.e. industrial) businesses have been removed. Further, businesses that are known to have ceased production have been removed.

If no data were available from the DMR references, it has been assumed that each business has the air emission sources detailed in Table 3-59 . Furthermore, if no production data were available from the DMR references it has been assumed that the annual production at each business is equal to the median value of all identified non-licensed material extraction sites. The median production quantity from all non-licensed sites has been determined from the *New South Wales Industrial Minerals Database* (DMR, 2003) to be 17,500 tonne per year. The activity data assumed in order to estimate emissions from each emission source are provided in Table 3-59.

Table 3-59: Emission sources and activity data used for non–respondent businesses

Emission Source	Inputs for Emission Estimation
Drilling	260 holes/year
Blasting [a,b,c]	431 m² /blast
Stockpile loading	17,500 tonne/year
Stockpile unloading	17,500 tonne/year
Primary crushing	17,500 tonne/year
Secondary crushing	17,500 tonne/year
Tertiary crushing	17,500 tonne/year
Screening	17,500 tonne/year
Material loaded onto trucks	17,500 tonne/year
Fuel storage (diesel)	1.8 kg VOC/year
Wheel generated dust (unpaved roads)	See Appendix B
Wind erosion (exposed area) [d,e]	30,000 m²
Wind erosion (stockpiles) [d,e]	7,725 m²

a Moisture content of material was estimated to be 2% (EA, 2003b)
b Average depth of blast was assumed to be 20 m
c Number of blasts per year was assumed to be 10
d Silt content was assumed to be 15%

3.7.4 *Temporal Variation of Emissions*

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions for respondent businesses. Temporal variations in emission sources from construction material mining businesses have been assumed to remain constant throughout the operating hours of the businesses. Monthly variations have been assumed to vary directly in proportion to production variations provided in returned commercial survey questionnaires. Temporal variation of emission sources from non-respondent businesses have been estimated based on the response provided for a typical 'small to medium' sized quarry which indicates that the typical operating hours are from 6 am to 4 pm on weekdays.

3.7.5 *Emission Estimates*

Estimated emissions from construction material mining n.e.c. within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-60.

Table 3-60: Estimated emissions from construction material mining n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	5.25	0	0	0	5.25
BENZENE	52	0	0	0	52
CARBON MONOXIDE	4,540	0	0	0	4,540
FORMALDEHYDE	55.6	0	0	0	55.6
ISOMERS OF XYLENE	125	0	0	33.5	158
LEAD & COMPOUNDS	3.89	0	0	0.00185	3.89
OXIDES OF NITROGEN	5,540	0	0	0	5,540
PARTICULATE MATTER ≤ 10 µm	9,510	0	0	7.86	9,520

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
PARTICULATE MATTER ≤ 2.5 µm	1,910	0	0	5.69	1,920
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0382	0	0	0	0.0382
SULFUR DIOXIDE	29,600	0	0	0	29,600
TOLUENE	138,000	0	0	71.9	138,000
TOTAL SUSPENDED PARTICULATE	30,800	0	0	19.9	30,800
TOTAL VOLATILE ORGANIC COMPOUNDS	510,000	6,340	0	4,060	520,000
TRICHLOROETHYLENE	3,500	0	0	0	3,500

[a] Totals may not appear additive due to rounding

Estimated emissions from gravel or sand quarrying within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-61.

Table 3-61: Estimated emissions from gravel or sand quarrying

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	4.31	0.812	0.325	4.02	9.46
LEAD & COMPOUNDS	40.9	2.44	1.17	29.5	74
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	647,000	85,500	35,100	621,000	1,391,000
PARTICULATE MATTER ≤ 2.5 µm	145,000	18,400	7,620	136,000	306,000
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	1.32	0.249	0.0998	1.23	2.91
TOTAL SUSPENDED PARTICULATE	2,594,000	245,000	106,000	2,140,000	5,084,000
TOTAL VOLATILE ORGANIC COMPOUNDS	47.7	9	3.6	44.5	105
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.7.6 Emission Projection Methodology

Projection factors for construction material mining have been derived based on final energy consumption projections for mining in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-62 and illustrated in Figure 3-23.

Table 3-62: Projection factors for mining related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0415	2023	1.6258
2010	1.0819	2024	1.6735
2011	1.1216	2025	1.7215
2012	1.1602	2026	1.7703
2013	1.1990	2027	1.8202
2014	1.2383	2028	1.8716
2015	1.2780	2029	1.9243
2016	1.3181	2030	1.9580
2017	1.3591	2031	1.9869
2018	1.4008	2032	2.0307
2019	1.4437	2033	2.0746
2020	1.4878	2034	2.1184
2021	1.5330	2035	2.1623
2022	1.5789	2036	2.2061

Source: ABARE (2006)

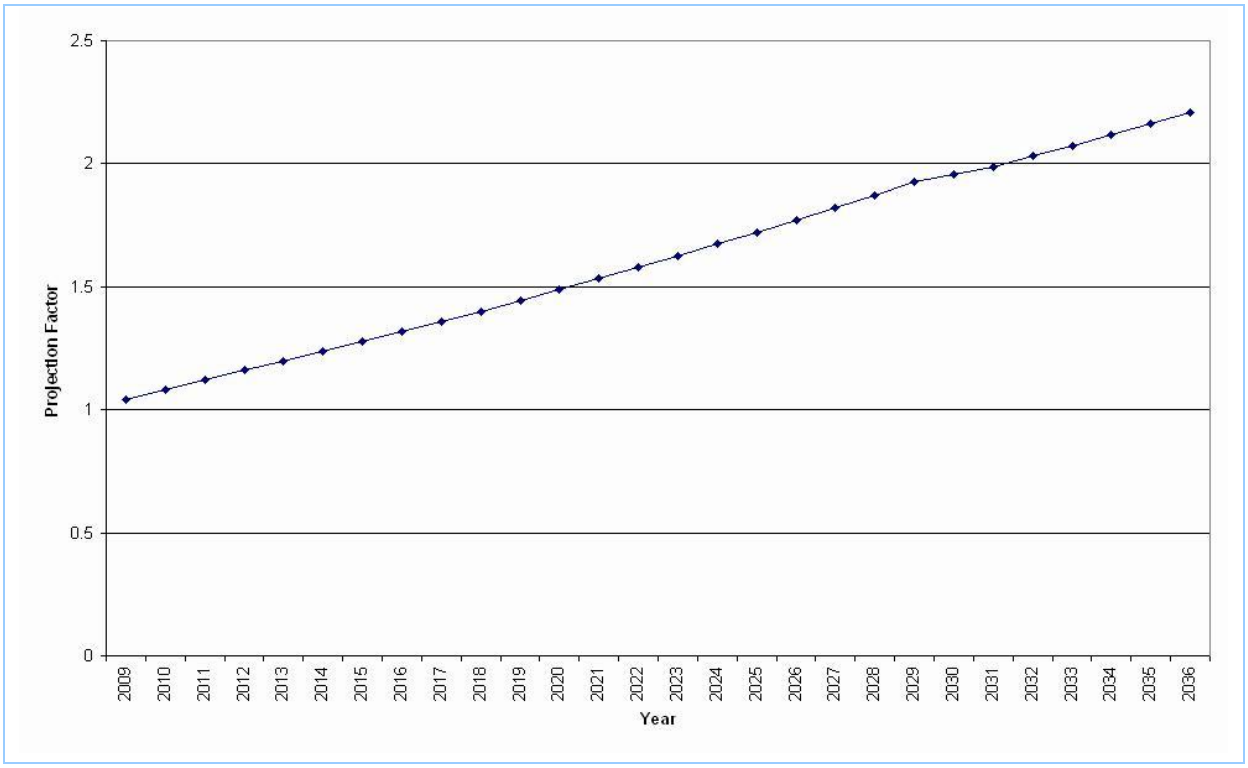

Figure 3-23: Projection factors for mining related sources

3.8 Funeral Directors, Crematoria and Cemeteries

3.8.1 Emission Sources and Associated Releases to Air

Crematories are usually designed with a primary and a secondary combustion chamber. The crematories are usually single ended units which process one coffin at a time. The coffin is placed inside the primary chamber of the crematory at a temperature of about 300-800°C. The primary

chamber is only preheated by the previous cremation. The secondary chamber, however, is preheated by the support fuel to about 850°C (EEA, 2009). Emissions from preheating are not included in this sector but are covered under unaccounted for fuel combustion (see the domestic-commercial air emissions inventory)

The primary chamber has burners that are directed at the coffin and air lances to break up the remains and promote combustion. The combustion gases from the primary chamber are then fed by a series of ducts into the compartmentalised secondary chamber, which is heated with afterburners and supplied with secondary air to complete combustion and reduce the emissions of carbon based particulate matter (PM), VOC, and persistent organic pollutants (POPs). The secondary chamber has a residence time for the gases of one to two seconds (EEA, 2009).

Cremation begins immediately once the coffin is inserted into the first chamber and only one coffin is ever placed inside the chamber at any one time. The average time taken to for an adult cremation is 90 minutes at a temperature between 800°C and 1,000°C (DEWHA, 2011). The main fuels used in NSW crematoria are natural gas and LPG.

Twenty-one crematoria businesses were identified within the NSW GMR through consultation with the Environmental Health Branch of the NSW Government. Commercial survey questionnaires were sent to crematoria businesses for the 2003 emissions inventory to collect activity data and responses were received from nine businesses (representing a response rate of 42.9%) (DECC, 2007).

The emission source and associated release to air from funeral directors and cemeteries is outlined in Table 3-63.

Table 3-63: Funeral directors and cemeteries – emission sources

Emission Source	Emissions to Air
Cremation	Combustion products

The locations of crematoria businesses within the GMR are shown in Figure 3-24.

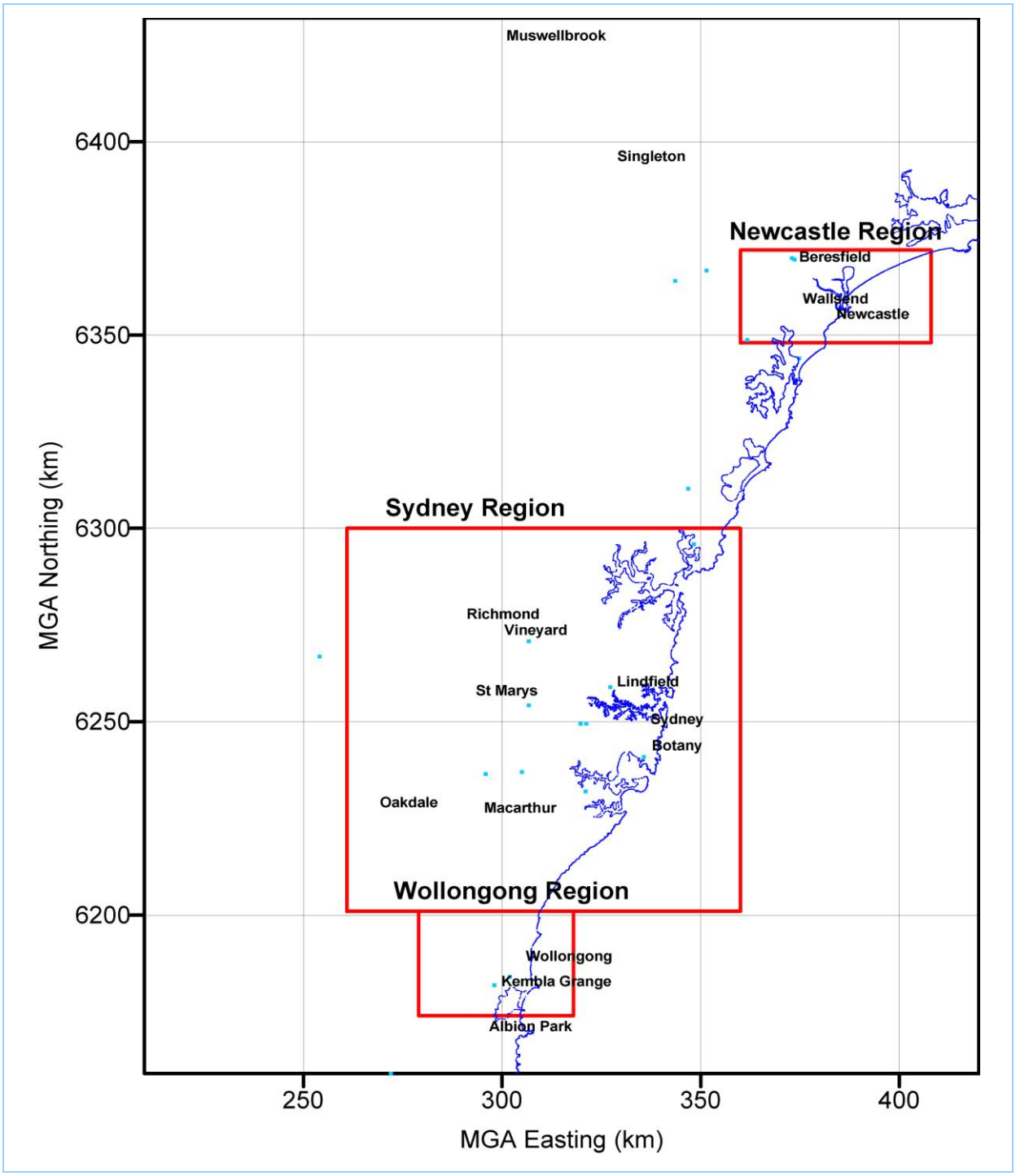

Figure 3-24: Crematoria within the GMR

3.8.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from crematoria are provided in Table 3-64.

Table 3-64: Emission and speciation factors for all substances from crematoria

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Cremation	Tier 1 emission factors for source category 6.C.d Cremation: Cremation of human bodies (EEA, 2009)
$PM_{2.5}$, PM_{10} & TSP	Cremation	Tier 1 emission factors for source category 6.C.d Cremation: Cremation of human bodies (EEA, 2009)
Speciated organics (including methane)	Cremation	Evaluation Test on Two Propane Fired Crematories at Camellia Memorial Lawn Cemetery (CARB, 1990)
Speciated particulate matter	Cremation	Tier 1 emission factors for source category 6.C.d Cremation: Cremation of human bodies (EEA, 2009) and Evaluation Test on Two Propane Fired Crematories at Camellia Memorial Lawn Cemetery (CARB, 1990)
Ammonia	NA	NA
Sulfuric or hydrochloric acid	Cremation	Evaluation Test on Two Propane Fired Crematories at Camellia Memorial Lawn Cemetery (CARB, 1997)
PAH	Cremation	Tier 1 emission factors for source category 6.C.d Cremation: Cremation of human bodies (EEA, 2009)
PCDD/PCDF	Cremation	Tier 1 emission factors for source category 6.C.d Cremation: Cremation of human bodies (EEA, 2009)
Greenhouse gases (CO_2 and N_2O)	Cremation	Cremation or Burial – Carbon Emissions and the Environment (Stevens, H, 2010) and nitrous oxide emission factor estimated by using the same ratio of CO_2:N_2O as LPG combustion from National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)

3.8.3 Activity Data

Data received in returned commercial survey questionnaires performed for the 2003 air emissions inventory were used to estimate emissions from these businesses. The number of cremations performed per year at respondent businesses was scaled according to the difference in population between the years 2003 and 2008.

The number of deaths, burials and cremations performed in NSW in 2008 was obtained from the NSW Registry Births Deaths and Marriages (NSWBDM, 2009). The number of cremations that occurred within the GMR was estimated assuming that the rate of death is proportional to population (i.e. approximately 75% of NSW population are in the GMR). Based on information provided by the NSW Registry of Births Deaths & Marriages, the total number of cremations that occurred in the GMR in 2008 is estimated to be 21,788.

The number of cremations performed by the respondent businesses is estimated to be 16,049 per year based on questionnaire responses. Therefore, it is estimated that 5,739 cremations occur at non-respondent businesses at an average rate of 480 cremations (2 significant figures) per year per business.

The derived activity data for crematoria is provided in Table 3-65.

Table 3-65: Activity data used to estimate emissions from crematoria

Statistic	Value
NSW - number of deaths 2008 [a, b]	48,020
NSW - number of burials 2008 [a, b]	18,066
NSW - number of cremations 2008 [a, b]	29,032
GMR – number of cremations 2008	21,788
Number of cremations from survey respondents	16,049
Remaining cremations from non-respondent crematoria	5,739
Number of non-respondent crematoria	12
Cremations per non-respondent facility [c]	480

[a] NSWBDM (2009)

[b] The difference between the total deaths and the sum of burials & cremations is due to some bodies being prepared for burial overseas/interstate and donated to universities for study.

[c] Expressed to two significant figures

The stack parameters have been estimated based on average stack parameters provided in returned commercial survey questionnaires from respondent businesses. The assumed stack parameters are:

- Stack height = 8 m
- Stack diameter = 0.7 m
- Exit velocity = 15.4 m/s
- Exit temperature = 635 K

3.8.4 Temporal Variation of Emissions

Emissions are assumed to be constant during normal operating hours for crematoria businesses. Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions. Typical operating hours of crematoria have been assumed to be weekdays from 7 am to 5 pm and 9 am to 1 pm on Saturday. No monthly variations in emissions have been assumed to occur during the year.

3.8.5 Emission Estimates

Estimated emissions from crematoria within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-66.

Table 3-66: Estimated emissions from crematoria

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	11.6	2.28	0.704	3.75	18.4
BENZENE	0	0	0	0	0
CARBON MONOXIDE	1,950	381	118	627	3,070
FORMALDEHYDE	41.9	8.19	2.53	13.5	66
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.000257	0.0000503	0.0000155	0.0000827	0.000405
OXIDES OF NITROGEN	4,270	835	258	1,370	6,730
PARTICULATE MATTER ≤ 10 µm	60.5	11.8	3.66	19.5	95.5

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
PARTICULATE MATTER ≤ 2.5 µm	40.3	7.89	2.44	13	63.6
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.000000142	2.78x10^{-08}	8.6x10^{-09}	4.58x10^{-08}	0.000000224
SULFUR DIOXIDE	7,510	1,470	454	2,420	11,900
TOLUENE	0	0	0	0	0
TOTAL SUSPENDED PARTICULATE	202	39.4	12.2	64.9	318
TOTAL VOLATILE ORGANIC COMPOUNDS	180	35.1	10.9	57.8	283
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.8.6 Emission Projection Methodology

Projection factors for funeral directors, crematoria and cemeteries have been derived based on population projections for the GMR published by TDC (TDC, 2009).

Derived projection factors are provided in Table 3-33 and illustrated in Figure 3-9.

3.9 Printing, Publishing and Recorded Media

3.9.1 Emission Sources and Associated Releases to Air

Printing, publishing and recorded media businesses have been identified using the following sources:

- NSW WorkCover database for hazardous materials; and
- NSW telephone directory.

A total of 70 commercial businesses have been identified to be within the GMR.

The emission sources and associated releases to air for printing and graphical arts are outlined in Table 3-67.

Table 3-67: Printing and graphical arts – emission sources

Emission Source	Emissions to Air
Boiler (natural gas)	Combustion products
Dust - direct measure	PM
Fugitive emissions – VOC	VOC
Internal combustion engine (diesel, P<450kW)	Combustion products
Internal combustion engine (natural gas, 2-Stroke lean-burn)	Combustion products
Printing (heat set)	VOC
Printing (non-heat set)	VOC
Surface coating (adhesive)	VOC
Surface coating (paint - solvent based)	VOC
Surface coating (thinner)	VOC
Wastewater treatment	VOC, ammonia

The locations of printing businesses within the GMR are shown in Figure 3-25.

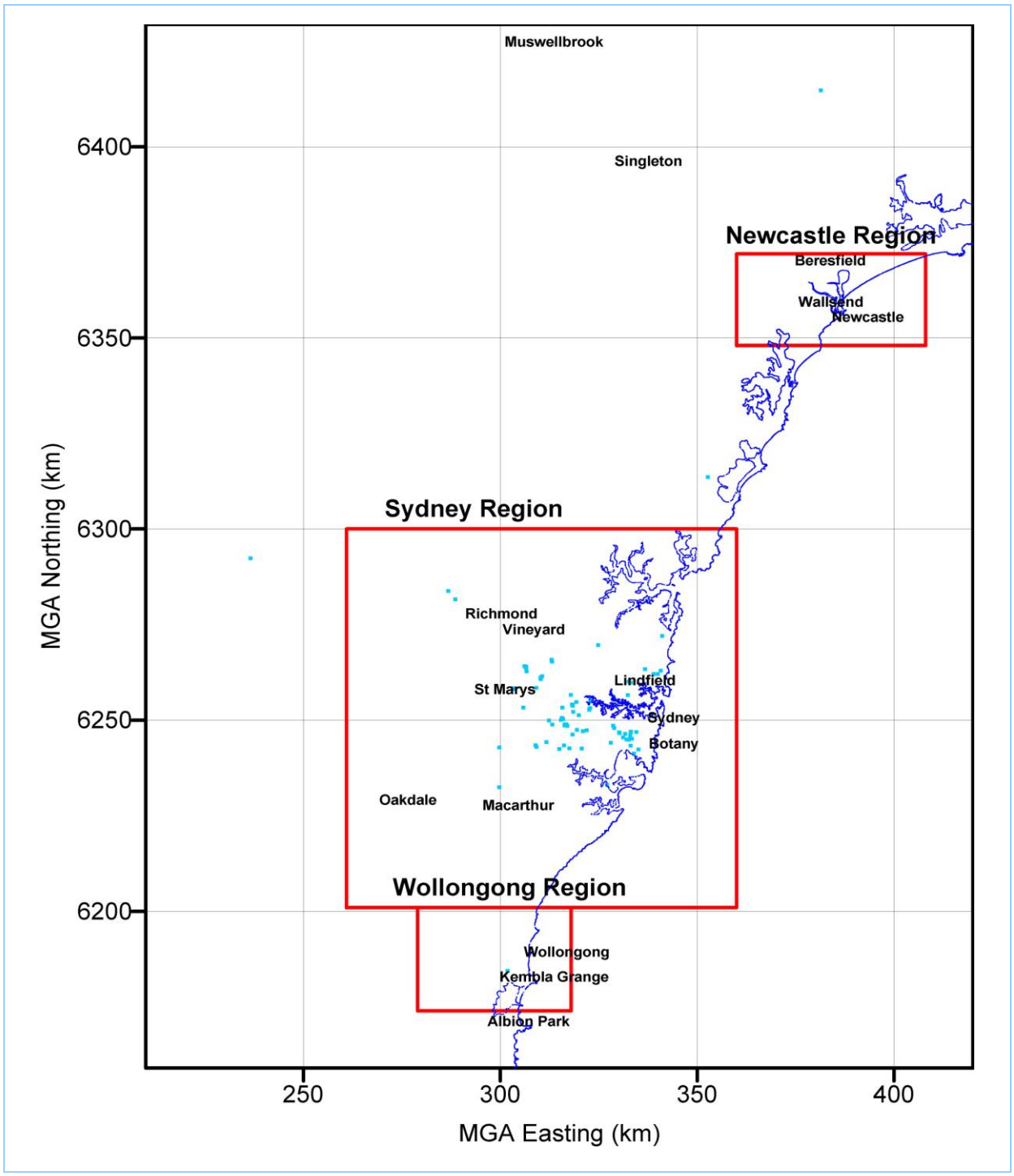

Figure 3-25: Commercial printing businesses within the GMR

3.9.2 *Emission Estimation Methodology*

Data sources for emission and speciation factors used to estimate emissions from printing businesses are provided in Table 3-68.

Table 3-68: Emission and speciation factors for all substances from printing, publishing and recorded media

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Fugitive emissions - VOC	Site specific emission estimates
	Internal combustion engine (diesel, P<450kW)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996a)
	Internal combustion engine (natural gas, 2-stroke lean-burn)	AP42 Chapter 3.2 Natural Gas-fired Reciprocating Engines (USEPA, 2000)
	Printing (heat set)	NPI EET Manual for Aggregated Emissions from Printing and Graphic Arts (EA, 1999b)
	Printing (non-heat set)	
	Surface coating (adhesive)	VOCs from Surface Coatings Final Report (ENVIRON, 2009)
	Surface coating (paint - solvent based)	
	Surface coating (thinner)	
	Wastewater treatment	NGGIC Workbook for Waste (NGGIC, 1996)
$PM_{2.5}$, PM_{10} & TSP	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Dust - direct measure	Site specific emission estimates
	Internal combustion engine (diesel, P<450kW)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996a)
	Internal combustion engine (natural gas, 2-stroke lean-burn)	AP42 Chapter 3.2 Natural Gas-fired Reciprocating Engines (USEPA, 2000)
Speciated organics (including methane)	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Fugitive emissions - VOC	SPECIATEv4.2 (Profile ID=1191) (USEPA, 2008c)
	Internal combustion engine (diesel, P<450kW)	SPECIATEv4.2 (Profile ID=0008) (USEPA, 2008c)
	Internal combustion engine (natural gas, 2-stroke lean-burn)	SPECIATEv4.2 (Profile ID=1001) (USEPA, 2008c)
	Printing (heat set)	SPECIATEv4.2 (Profile ID=1191) (USEPA, 2008c)
	Printing (non-heat set)	
	Surface coating (adhesive)	SPECIATEv4.2 (Profile ID=1020) (USEPA, 2008c)
	Surface coating (paint - solvent based)	SPECIATEv4.2 (Profile ID=1003) (USEPA, 2008c)
	Surface coating (thinner)	SPECIATEv4.2 (Profile ID=1016) (USEPA, 2008c)
	Wastewater treatment	CEIDARS Organic Gas Speciation Profiles (Profile ID=1402) (assuming that unidentified portion is methane) (CARB, 2005)
Speciated particulate matter	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (diesel, P<450kW)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996a)
Ammonia	Boiler (natural gas)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
	Internal combustion engine (diesel, P<450kW)	
	Internal combustion engine	

Substance	Emission Source	Emission Factor Source
	(natural gas, 2-stroke lean-burn)	
	Wastewater treatment	
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (diesel, P<450kW)	AP42 Chapter 3.3 Gasoline and Diesel Industrial Engines (USEPA, 1996a)
	Internal combustion engine (natural gas, 2-stroke lean-burn)	AP42 Chapter 3.2 Natural Gas-fired Reciprocating Engines (USEPA, 2000)
PCDD/PCDF	Boiler (natural gas)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	Boiler (natural gas)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)
	Internal combustion engine (diesel, P<450kW)	
	Internal combustion engine (natural gas, 2-stroke lean-burn)	

3.9.3 *Activity Data*

Data received in returned commercial survey questionnaires performed for the 2003 air emissions inventory were used to estimate emissions from these businesses. Emissions reported to the NPI for the 2007/2008 period have also been included in the emissions inventory.

Emissions from non-respondent businesses have been included in the inventory using the following methodology:

- VOC emissions from the printing and graphical arts sector have been estimated using the emission factor presented in the *NPI EET Manual for Aggregated Emissions from Printing and Graphic Arts* (EA, 1999b) of 169 kg VOC per employee per year;
- A total of 21,885 full time persons are employed in NSW in the printing, publishing and recorded media sector for 2006/2007 (ABS, 2008b);
- It is assumed that 85% of employees in NSW are employed within the GMR. This proportion is slightly higher than the population ratio of 75% as it is assumed that a slighter higher proportion of printing occurs in urban centres than indicated by the population ratio. Therefore, it is estimated that 18,602 persons are employed in the GMR by the printing, publishing and recorded media industries;
- Using the employee based emission factor of 169 kg VOC per employee per year provides an estimated VOC emission of 3,143,780 kg per year for the entire printing industry. However, emissions from printing already included in the industrial emissions inventory account for 1,828,606 kg VOC per year from the printing and recorded media sector. Therefore, emissions from commercial businesses involved in printing, publishing and recorded media have been estimated to be 1,315,175 kg VOC per year;

- Emissions from respondent commercial printing businesses account for 956,357 kg per year. Therefore, emissions from non-respondent printing businesses have been estimated to account for 358,817 kg VOC per year; and
- Emissions have been spatially allocated to each business in proportion to the population in each local government area (LGA) compared with the total population in the GMR. The total emissions in each LGA have been divided by the total number of printing businesses in each LGA to estimate the site specific emissions.

Other assumptions included in the estimation of emissions from the printing industry are outlined as follows:

- All emissions from proofing presses, cleaning, ink storage and ink mixing for non-respondent businesses are assumed to be accounted for in the employee based EET;
- All VOC contained in inks are assumed to escape to the atmosphere and no emission control technologies are used by from non-respondent businesses; and
- Non-heat set inks are assumed to be used by respondent businesses that did not provide the ink type used in the returned commercial survey questionnaire. Non-heat set inks have the highest emission rate, therefore, this technique is a worst case approach to emissions estimation.

3.9.4 Temporal Variation of Emissions

VOC emissions from the use of ink and solvent emitted during the application, clean up and drying phases have been assumed to be constant throughout the operating hours of the business from 6 am to 6 pm from Monday to Saturday.

3.9.5 Emission Estimates

Estimated emissions from printing, publishing and recorded media within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-69.

Table 3-69: Estimated emissions from printing, publishing or recorded media

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0.42	0	0	0	0.42
ACETALDEHYDE	0.455	0	0	0	0.455
BENZENE	85.2	0	0	0.000208	85.2
CARBON MONOXIDE	14,900	0	0	0.0349	14,900
FORMALDEHYDE	42,500	0	0	175	42,700
ISOMERS OF XYLENE	11,200	0	0	0	11,200
LEAD & COMPOUNDS	0.0922	0	0	$2.08x10^{-07}$	0.0922
OXIDES OF NITROGEN	26,000	0	0	0.0416	26,000
PARTICULATE MATTER ≤ 10 µm	1,460	0	0	0.00316	1,460
PARTICULATE MATTER ≤ 2.5 µm	1,460	0	0	0.00316	1,460
PERCHLOROETHYLENE	4,960	0	0	0	4,960
POLYCYCLIC AROMATIC HYDROCARBONS	0.511	0	0	$2.86x10^{-07}$	0.511
SULFUR DIOXIDE	93.3	0	0	0.000217	93.3
TOLUENE	20,200	0	0	0.000104	20,200

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
TOTAL SUSPENDED PARTICULATE	1,460	0	0	0.00316	1,460
TOTAL VOLATILE ORGANIC COMPOUNDS	1,300,000	0	6,190	13,000	1,320,000
TRICHLOROETHYLENE	0.0804	0	0	0	0.0804

[a] Totals may not appear additive due to rounding

3.9.6 Emission Projection Methodology

Projection factors for printing, publishing and recorded media have been derived based on final energy consumption projections for wood, paper and printing in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-70 and illustrated in Figure 3-26.

Table 3-70: Projection factors for wood, paper and printing related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0143	2023	1.1965
2010	1.0282	2024	1.2096
2011	1.0419	2025	1.2225
2012	1.0548	2026	1.2355
2013	1.0676	2027	1.2487
2014	1.0804	2028	1.2620
2015	1.0930	2029	1.2755
2016	1.1056	2030	1.2882
2017	1.1183	2031	1.3006
2018	1.1310	2032	1.3135
2019	1.1440	2033	1.3265
2020	1.1570	2034	1.3395
2021	1.1701	2035	1.3525
2022	1.1833	2036	1.3655

Source: ABARE (2006)

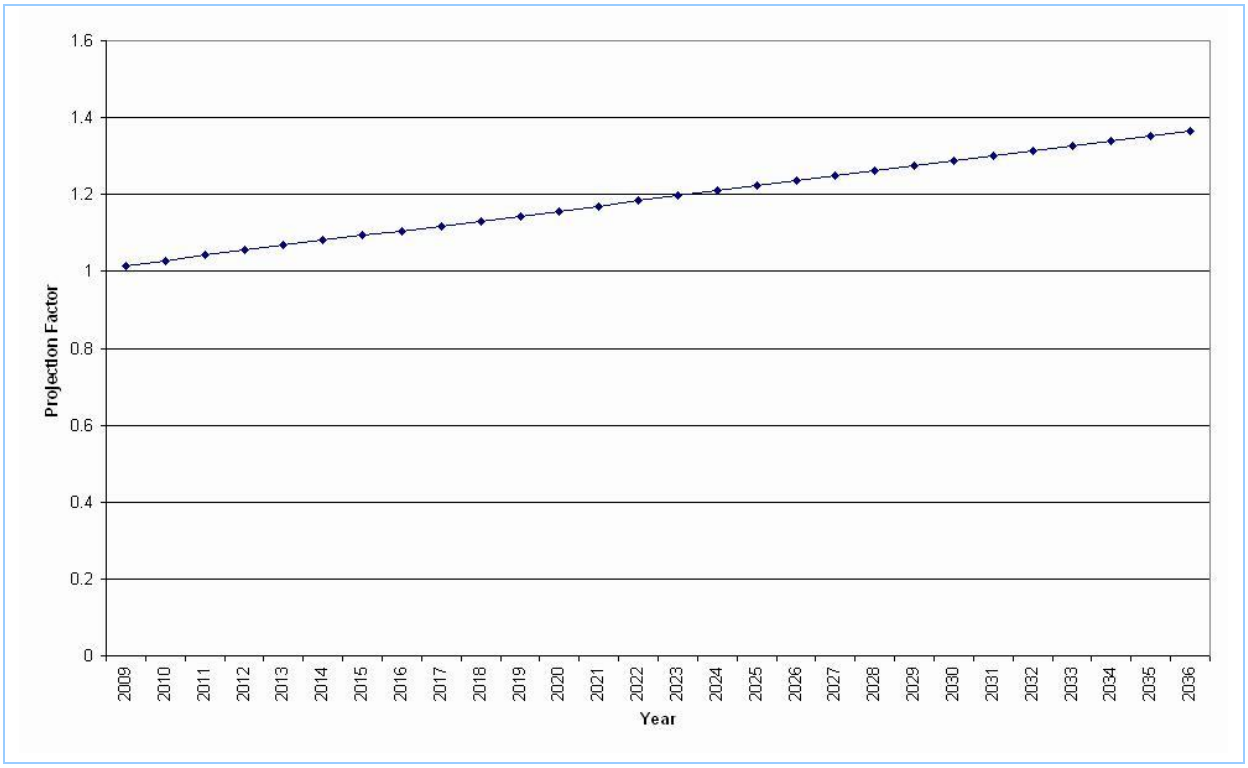

Figure 3-26: Projection factors for wood, paper and printing related sources

3.10 Plastic Product Rigid Fibre Manufacturing

3.10.1 Emission Sources and Associated Releases to Air

Plastic product rigid fibre reinforced manufacturing (fibreglass) businesses have been identified using the following sources:

- NSW WorkCover database for hazardous materials; and
- NSW telephone directory.

A total of 87 commercial businesses have been identified to be within the GMR.

The emission sources and associated releases to air for fibreglass manufacturing are summarised in Table 3-71.

Table 3-71: Plastic product rigid fibre reinforced manufacturing – emission sources

Emission Source	Emissions to Air
Boiler (natural gas)	Combustion products
Fibreglass (gel coat application)	VOC
Fibreglass (manual resin application)	VOC
Fibreglass (mechanical resin application)	VOC
Fugitive emissions - VOC	VOC
Solvent usage (acetone)	VOC
Surface coating (adhesive)	VOC
Surface coating (paint - solvent based)	VOC
Surface coating (primer)	VOC

Emission Source	Emissions to Air
Surface coating (thinner)	VOC
Wheel generated dust (paved roads)	PM
Wheel generated dust (unpaved roads)	PM

The locations of fibreglass manufacturing businesses are shown in Figure 3-27.

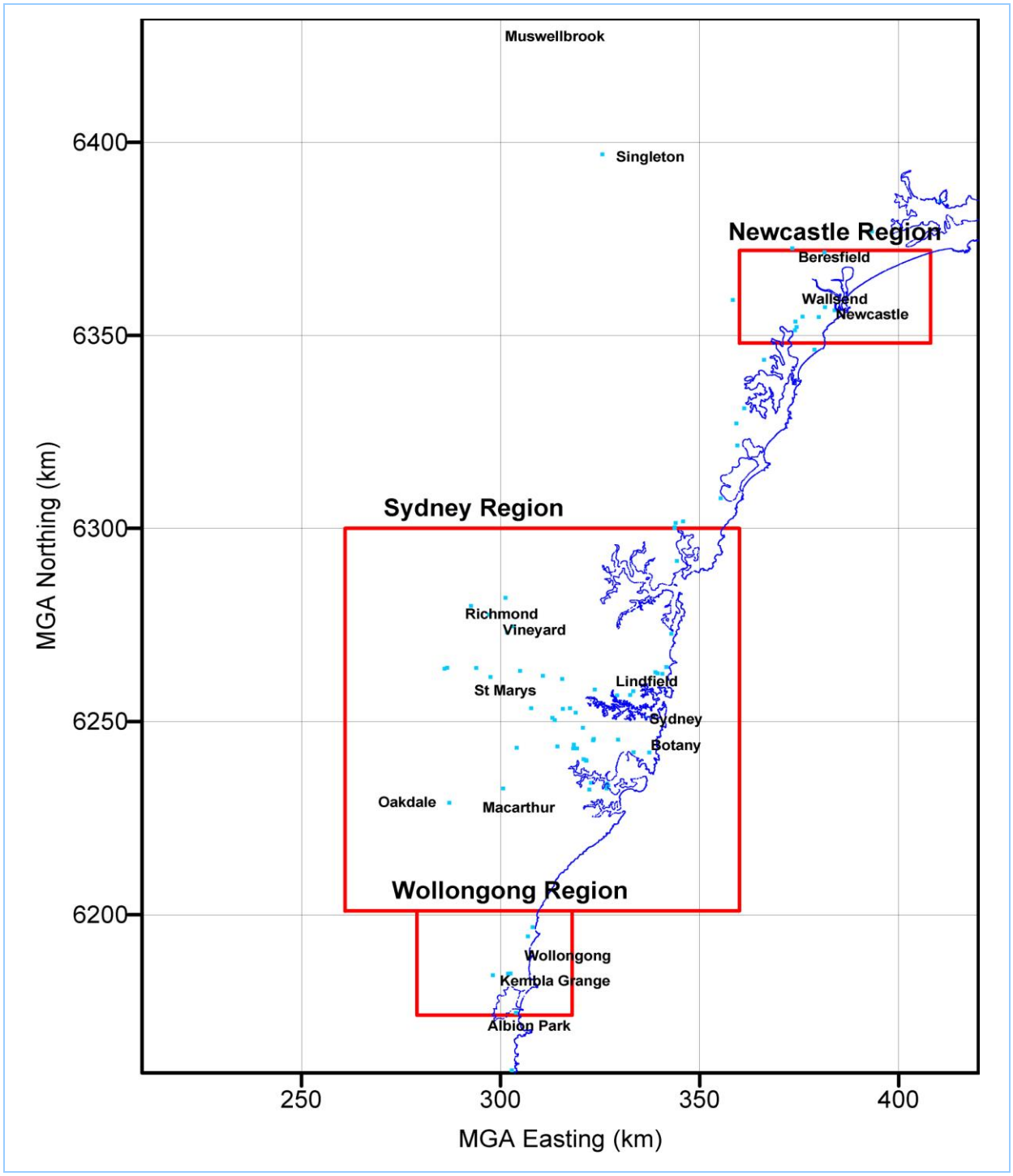

Figure 3-27: Fibreglass manufacturers within the GMR

3.10.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from plastic product rigid fibre manufacturing businesses are provided in Table 3-68.

Table 3-72: Emission and speciation factors for all substances from plastic product rigid fibre manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Fibreglass (gel coat application)	NPI EET Manual for Fibreglass Product Manufacturing (EA, 1999e)
	Fibreglass (manual resin application)	
	Fibreglass (mechanical resin application)	
	Fugitive emissions - VOC	Site specific emission estimates
	Solvent usage (acetone)	Mass balance
	Surface coating (adhesive)	VOCs from Surface Coatings Final Report (ENVIRON, 2009)
	Surface coating (paint - solvent based)	
	Surface coating (primer)	
	Surface coating (thinner)	
$PM_{2.5}$, PM_{10} & TSP	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
	Wheel generated dust (unpaved roads)	AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006c)
Speciated organics (including methane)	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Fibreglass (gel coat application)	CEIDARS Organic Gas Speciation Profiles (Profile ID=9014) Rubber/Misc. Plastics Production (CARB, 2005)
	Fibreglass (manual resin application)	
	Fibreglass (mechanical resin application)	
	Fugitive emissions - VOC	
	Solvent usage (acetone)	Mass balance (100% acetone)
	Surface coating (adhesive)	SPECIATEv4.2 (Profile ID=1020) (USEPA, 2008c)
	Surface coating (paint - solvent based)	SPECIATEv4.2 (Profile ID=1003) (USEPA, 2008c)
	Surface coating (primer)	SPECIATEv4.2 (Profile ID=1019) (USEPA, 2008c)
	Surface coating (thinner)	SPECIATEv4.2 (Profile ID=1016) (USEPA, 2008c)
Speciated particulate matter	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
	Wheel generated dust (unpaved roads)	California Emissions Inventory and Reporting System - Unpaved Road Dust, 1997 (CARB, 2007)
Ammonia	Boiler (natural gas)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)

Substance	Emission Source	Emission Factor Source
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
PCDD/PCDF	Boiler (natural gas)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	Boiler (natural gas)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)

3.10.3 Activity Data

The methodology to estimate emissions from commercial construction material mining facilities has not changed from the 2003 air emissions inventory. Emissions reported to the NPI for the 2007/2008 period have also been included in the emissions inventory. Also, emissions from wheel generated dust have been included in the commercial emissions module based on information provided in returned questionnaires.

For the 2003 air emissions inventory survey questionnaires were sent to all fibreglass businesses to collect activity data and responses were received from 8 businesses (i.e. representing a response rate of 9%). Data provided in returned commercial survey questionnaires was quite similar indicating that the emission sources and estimation data for fibreglass manufacturing businesses that did not respond to the commercial survey questionnaire would likely be similar to the businesses that provided a response. Therefore, emissions from non-respondent businesses were estimated based on data provided by a medium size fibreglass manufacturing business identified within the returned commercial survey questionnaires.

The estimated activity data for facilities that did not respond to the inventory questionnaire or report to the NPI is provided in Table 3-73.

Table 3-73: Assumed activity data for non-respondent fibreglass manufacturing businesses

Emission Source	Input data for Emissions Estimation
Solvent usage (acetone)	220 L/year
Fibreglass manual resin application (non-vapour suppressed)	440 kg/year
Fibreglass gel coat application	120 kg/year
Surface coating (adhesive)	10 L/year

3.10.4 Temporal Variation of Emissions

VOC emissions from the use of ink and solvent emitted during the application, clean up and drying phases have been assumed to be constant throughout the operating hours of the business from 6 am to 6 pm from Monday to Saturday.

3.10.5 Emission Estimates

Estimated emissions from plastic product rigid fibre manufacturing within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-74.

Table 3-74: Estimated emissions from plastic product rigid fibre manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	1,330	202	63.7	319	1,920
ACETALDEHYDE	0	0	0	0	0
BENZENE	242	35.3	11.1	55.9	344
CARBON MONOXIDE	1,400	0	0	0	1,400
FORMALDEHYDE	16.6	0	0	0	16.6
ISOMERS OF XYLENE	80.9	0	93.8	0	175
LEAD & COMPOUNDS	0.0205	0	0	0.0264	0.0469
OXIDES OF NITROGEN	1,660	0	0	0	1,660
PARTICULATE MATTER ≤ 10 µm	153	0	0	40.9	194
PARTICULATE MATTER ≤ 2.5 µm	129	0	0	9.9	139
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0114	0	0	0	0.0114
SULFUR DIOXIDE	8.69	0	0	0	8.69
TOLUENE	515	3.12	34	4.78	557
TOTAL SUSPENDED PARTICULATE	220	0	0	213	433
TOTAL VOLATILE ORGANIC COMPOUNDS	20,400	5,310	13,400	4,350	43,400
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.10.6 Emission Projection Methodology

Projection factors for plastic product rigid fibre manufacturing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

Table 3-75: Projection factors for other (manufacturing) industry related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0054	2023	1.0921
2010	1.0111	2024	1.0981
2011	1.0177	2025	1.1038
2012	1.0242	2026	1.1096
2013	1.0306	2027	1.1153
2014	1.0370	2028	1.1212
2015	1.0433	2029	1.1270
2016	1.0495	2030	1.1336
2017	1.0556	2031	1.1403
2018	1.0617	2032	1.1464
2019	1.0679	2033	1.1525
2020	1.0740	2034	1.1586
2021	1.0801	2035	1.1647
2022	1.0861	2036	1.1707

Source: ABARE (2006)

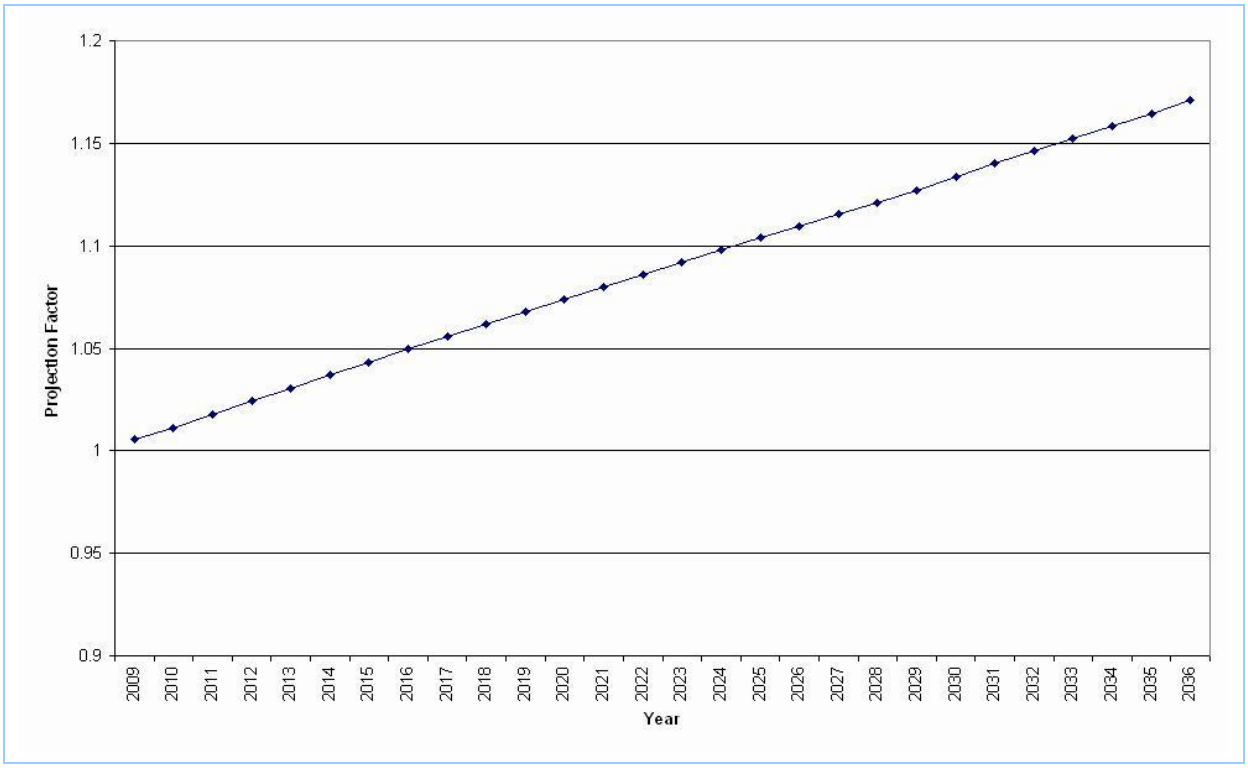

Figure 3-28: Projection factors for other (manufacturing) industry related sources

3.11 Concrete Product Manufacturing

3.11.1 Emission Sources and Associated Releases to Air

Concrete product manufacturing businesses have been identified using the following sources:

- NSW WorkCover database for hazardous materials; and
- NSW telephone directory.

A total of 58 commercial businesses have been identified to be within the GMR.

The emission sources and associated releases to air for concrete manufacturing businesses are outlined in Table 3-76.

Table 3-76: Concrete batching – emission sources

Emission Source	Emissions to Air
Aggregate transfer to conveyor	PM
Aggregate transfer to ground	PM
Cement unloading	PM
Conveyor transfer of aggregate to elevated storage	PM
Conveyor transfer of sand to elevated storage	PM
Flyash transfer (cement supplement)	PM
Fuel storage (diesel)	VOC
Mixer loading (central mix)	PM
Sand transfer to conveyor	PM
Sand transfer to ground	PM
Wheel generated dust (paved roads)	PM

The locations of commercial concrete product manufacturing businesses are shown in Figure 3-29.

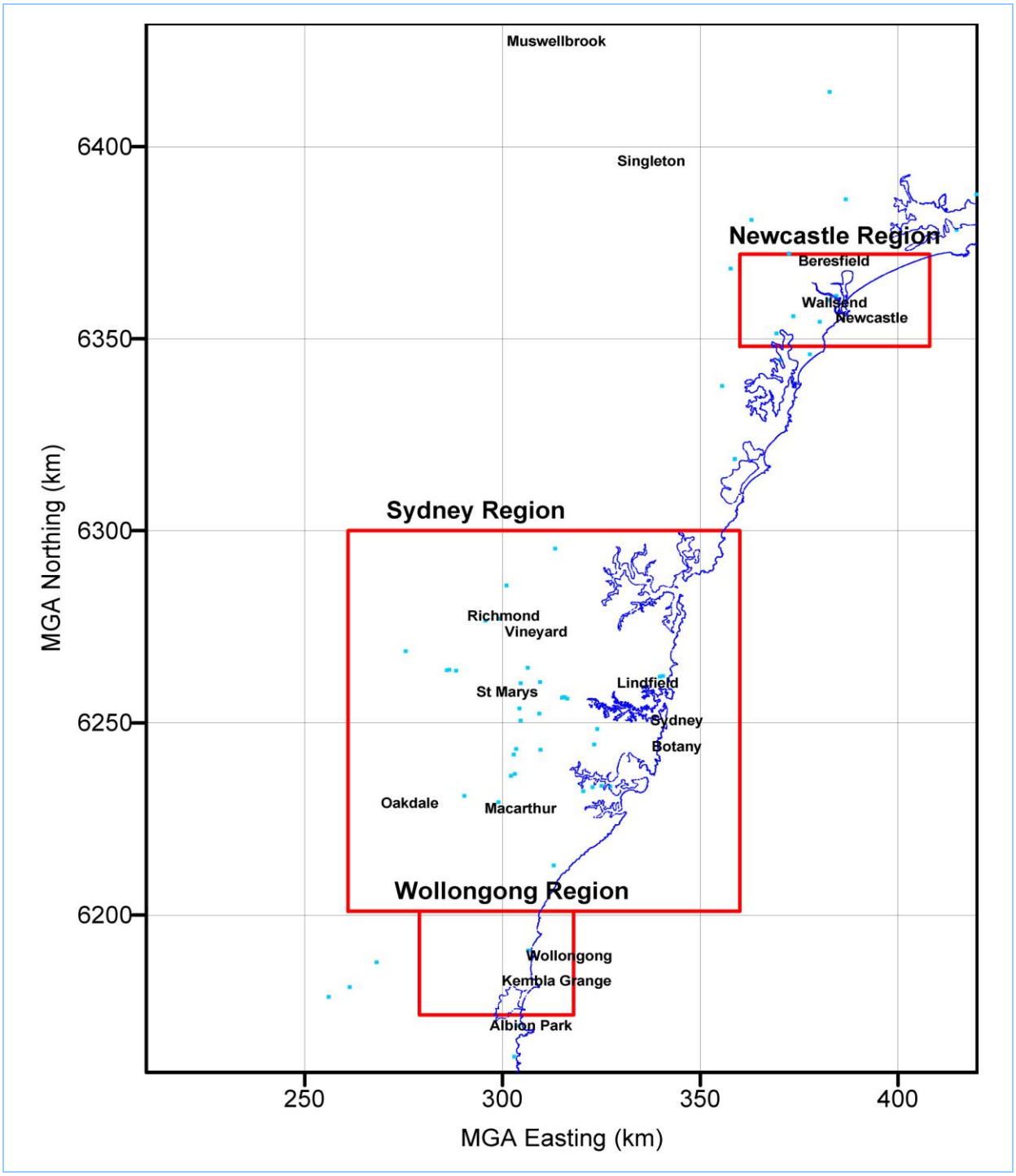

Figure 3-29: Commercial concrete product manufacturing businesses within the GMR

3.11.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from concrete product manufacturing businesses are provided in Table 3-77.

Table 3-77: Emission and speciation factors for all substances from concrete product manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
$PM_{2.5}$, PM_{10} & TSP	Aggregate transfer to conveyor	AP-42, Chapter 11.12 Concrete Batching (USEPA, 2006b)
	Aggregate transfer to ground	
	Cement unloading	
	Conveyor transfer of aggregate to elevated storage	
	Conveyor transfer of sand to elevated storage	
	Flyash transfer (cement supplement)	
	Mixer loading (central mix)	
	Sand transfer to conveyor	
	Sand transfer to ground	
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
Speciated organics (including methane)	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001a)
Speciated particulate matter	Cement unloading	AP-42, Chapter 11.12 Concrete Batching (USEPA, 2006b)
	Mixer loading (central mix)	
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
Ammonia	NA	NA
Sulfuric or hydrochloric acid	NA	NA
PAH	NA	NA
PCDD/PCDF	NA	NA
Greenhouse gases (CO_2 and N_2O)	NA	NA

3.11.3 Activity Data

The total concrete produced in the NSW GMR, obtained from ABS is 5,134,100 m^3 for 2008 (ABS, 2009). This was derived as the sum of the amounts produced by major regions in the GMR as presented in Table 3-78.

Table 3-78: Amount of concrete produced in the GMR by major regions

Region in the GMR	Amount of Concrete Produced (m^3/year)	Amount of Concrete Produced[a] (tonne/year)
Sydney	3,753	9,006,720
Gosford/Wyong	211	506,880
Hunter	699	1,677,360
Illawarra	471	1,130,640
Total	5,134	12,321,600

a Density of concrete was assumed to be 2.4 tonne/m^3

Industrial survey questionnaire responses indicate that 11,833,654 tonne of concrete are produced in the NSW GMR by industrial businesses. Therefore, the estimated concrete production rate from commercial facilities is 487,946 tonne per year which equates to 4% of all concrete produced in the GMR.

One concrete product manufacturing business that was included in the 2003 industrial air emissions inventory has been de-scheduled. Therefore, the facility is included in the 2008 commercial air emissions inventory. Production data collected for this business in the 2003 inventory survey indicates that this business produces approximately 168,000 tonne of concrete per year. Therefore, the remaining concrete production not accounted for by the remaining 57 commercial concrete product manufacturing facilities is 319,946 tonne per year. Therefore, it was estimated that each business produced 5,613 tonne of concrete in 2008 (equivalent to 2,339 m^3 of concrete).

The amount of other raw materials used, required for emission estimation calculations, have been estimated based on proportions of raw materials used that have been provided in completed industrial survey questionnaires. The proportions of raw materials used to estimate activity data are provided in Table 3-79.

Table 3-79: Proportions of raw materials for non-respondent businesses

Material Type	Proportion Usage Factor (tonne raw material/m^3 concrete produced)	Estimated Commercial Business Usage (tonne/year)
Cement	0.24	561
Fly ash	0.75	1,754
Aggregate	1	2,339
Sand	0.78	1,824

It was further assumed that the businesses are equipped with standard emissions controls. The emission sources and control methods and efficiencies assumed for concrete product manufacturing are presented in Table 3-80.

Table 3-80: Emission sources and estimation data used for non–respondent concrete product manufacturing businesses

Emission Source	Control Technologies Utilised	Particulate Control Efficiency
Cement unloading to elevated storage	Baghouse	98%
Conveyor transfer to elevated storage (aggregate)	Wind breaks equipped on conveyors	30%
Conveyor transfer to elevated storage (sand)	Wind breaks equipped on conveyor	30%
Fly ash transfer to elevated storage	Baghouse	98%

Emission Source	Control Technologies Utilised	Particulate Control Efficiency
Mixer loading (central mix)	Enclosed bins	90%
Transfer from bins to conveyor (aggregate)	Enclosed bins	90%
Transfer from bins to conveyor (sand)	Enclosed bins	90%
Transfer to weigh bins (aggregate)	Enclosed bins	90%
Transfer to weigh bins (sand)	Enclosed bins	90%
Truck delivery to ground storage (aggregate)	No control	0%
Truck delivery to ground storage (sand)	No control	0%
Wind erosion (stockpiles)[a,b,c]	Stockpiles enclosed on three sides	75%

a Silt content was assumed to be 10%
b Number of rainfall days was assumed to be 138 days provided by the Bureau of Meteorology for Sydney
c Frequency of wind speed that exceeds 5.4 m/s was approximately 30%

It should be noted that estimated emissions from concrete slurry manufacturing takes account of all emissions emitted from concrete pipe and box culvert manufacturing.

3.11.4 Temporal Variation of Emissions

Since most commercial concrete batching businesses are small concrete batching plants, it was assumed that they operate only on weekdays for 9 hours a day. Emissions have been assumed to be constant between 9 am to 6 pm with monthly variation of emissions provided in Table 3-81 and Figure 3–30.

Table 3-81: Monthly temporal variation of emission for concrete product manufacturing

Monthly	Proportion
January	5.0
February	8.8
March	8.8
April	8.8
May	8.8
June	8.8
July	8.8
August	8.8
September	8.8
October	8.8
November	8.8
December	7.0

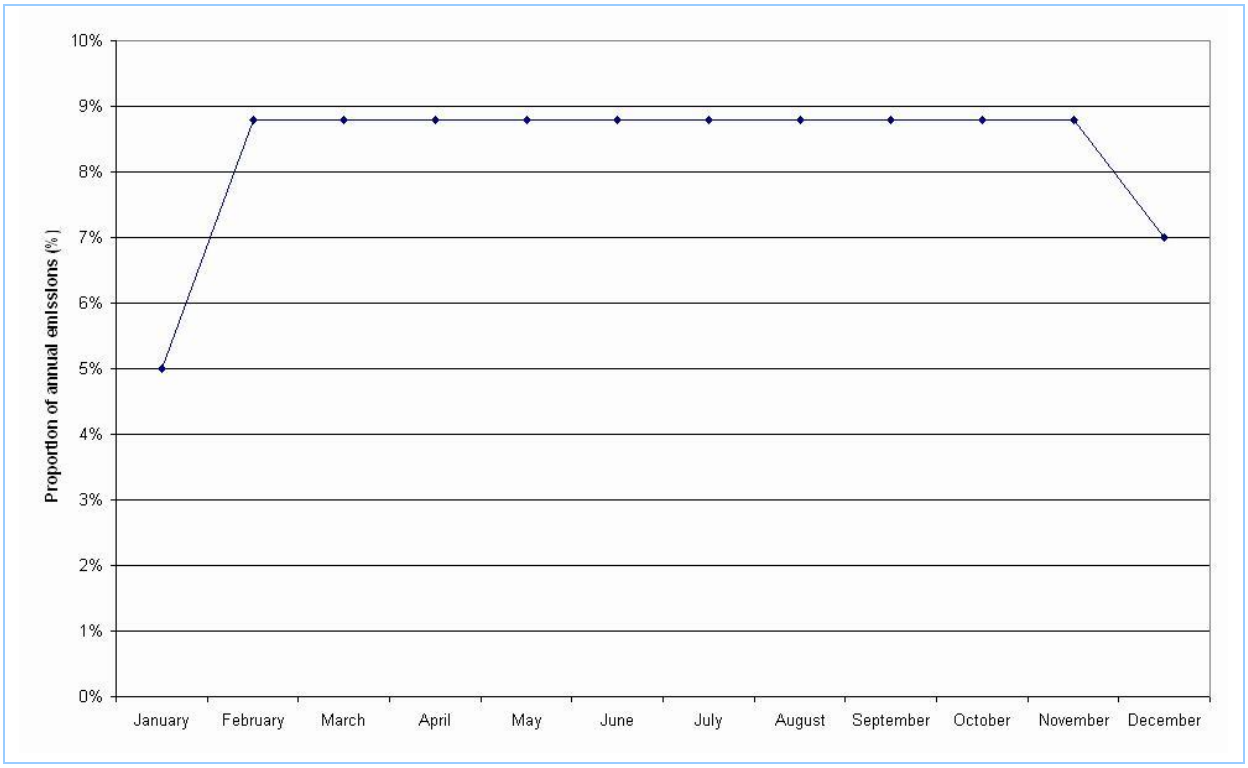

Figure 3-30: Monthly temporal variation for concrete product manufacturing

3.11.5 Emission Estimates

Estimated emissions from concrete product manufacturing within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-82.

Table 3-82: Estimated emissions from concrete product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0.00528	0	0	0	0.00528
LEAD & COMPOUNDS	0.609	0.112	0.00937	0.159	0.89
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	4,520	1,030	84	1,430	7,060
PARTICULATE MATTER ≤ 2.5 µm	716	161	13.4	228	1,120
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0.00162	0	0	0	0.00162
TOTAL SUSPENDED PARTICULATE	13,200	2,810	236	4,010	20,200
TOTAL VOLATILE ORGANIC COMPOUNDS	0.0585	0	0	0	0.0585
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.11.6 Emission Projection Methodology

Projection factors for concrete product manufacturing have been derived based on final energy consumption projections for non-metallic minerals in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-83 and illustrated in Figure 3-31.

Table 3-83: Projection factors for non-metallic minerals related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0108	2023	1.1119
2010	1.0210	2024	1.1193
2011	1.0282	2025	1.1265
2012	1.0337	2026	1.1335
2013	1.0400	2027	1.1407
2014	1.0464	2028	1.1479
2015	1.0527	2029	1.1552
2016	1.0595	2030	1.1622
2017	1.0670	2031	1.1691
2018	1.0745	2032	1.1762
2019	1.0819	2033	1.1834
2020	1.0895	2034	1.1906
2021	1.0970	2035	1.1978
2022	1.1045	2036	1.2050

Source: ABARE (2006)

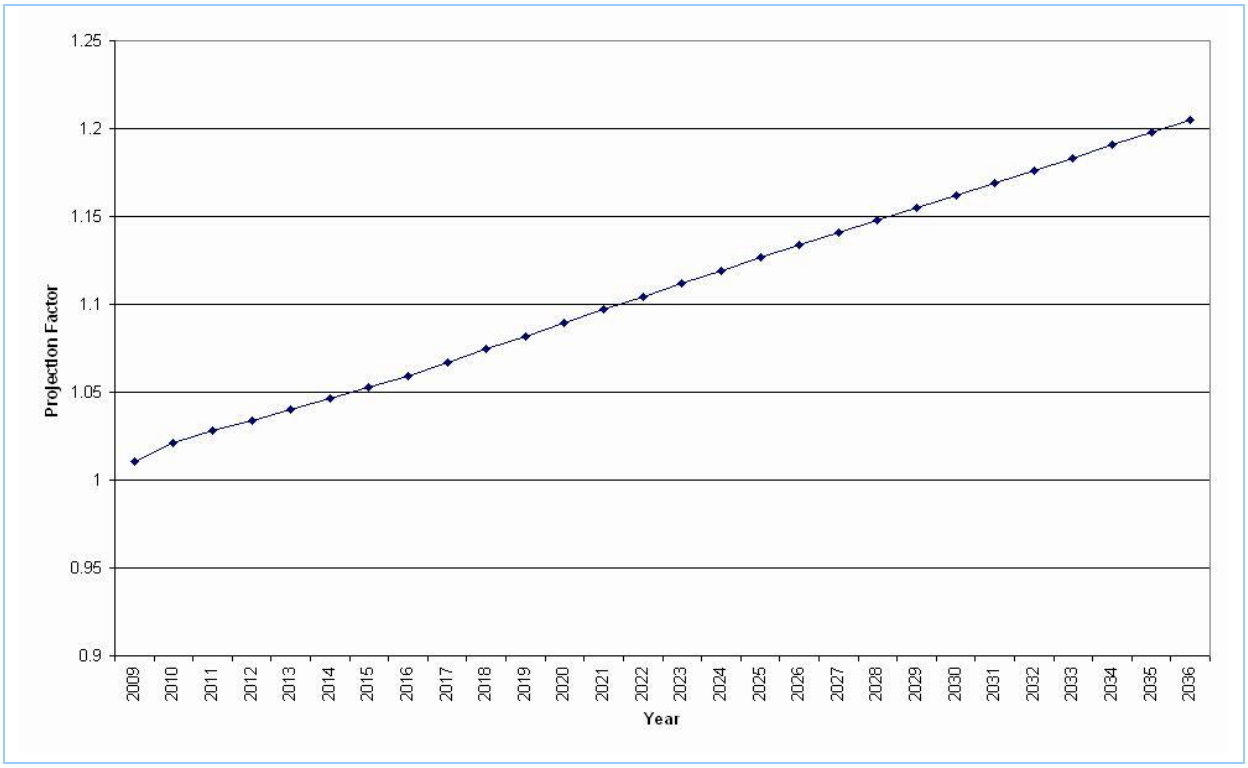

Figure 3-31: Projection factors for non-metallic minerals related sources

3.12 Basic Iron and Steel Manufacturing

3.12.1 Emission Sources and Associated Releases to Air

Basic iron and steel manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of eleven commercial basic iron and steel manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-84.

Table 3-84: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
BISALLOY STEELS PTY LTD	3571	LOT 14 RESOLUTION DR	UNANDERRA	2526
FLAME-CUT P/L	3572	68 ELIZABETH ST	WETHERILL PARK	2164
SERVICE POWDER COATING P/L	3575	30 HARLEY CR	CONDELL PARK	2200
QUALITY CASTINGS P/L	3576	42 VIOLET ST	REVESBY	2212
ONESTEEL OIL & GAS KEMBLA GRANGE	3580	WEST DAPTO ROAD	KEMBLA GRANGE	2530
ONESTEEL REINFORCING VILLAWOOD	3581	33 SHADDOCK AVENUE	VILLAWOOD	2163
JOHN HEINE & SON PTY LTD	7016	273 EDGAR STREET	BANKSTOWN	2200

The emission sources and associated releases to air from basic iron and steel manufacturing are outlined in Table 3-85.

Table 3-85: Basic iron and steel manufacturing – emission sources

Emission Source	Emissions to Air
Boiler (natural gas)	Combustion products
Casting (hot metal transfer)	PM
Direct entry - PM measurement	PM
Fuel storage (diesel)	VOC
Iron making (blast furnace)	PM
Iron production (furnace, electric induction furnace)	PM, PCDD/F
Iron production (pouring and cooling)	PM
Iron production (sand handling)	PM
Iron production (scrap and charge handling)	PM
Metal cutting (mild steel, 8 mm)	NO_x, magnesium oxide fume
Steel production (furnace, electric induction)	PM, PCDD/F
Steel production (sand handling)	PM
Surface coating (enamel)	VOC
Surface coating (lacquer)	VOC
Surface coating (paint - solvent based)	VOC
Surface coating (thinner)	VOC
Welding	PM
Wheel generated dust (paved roads)	PM

The locations of commercial basic iron and steel manufacturing businesses are shown in Figure 3-32.

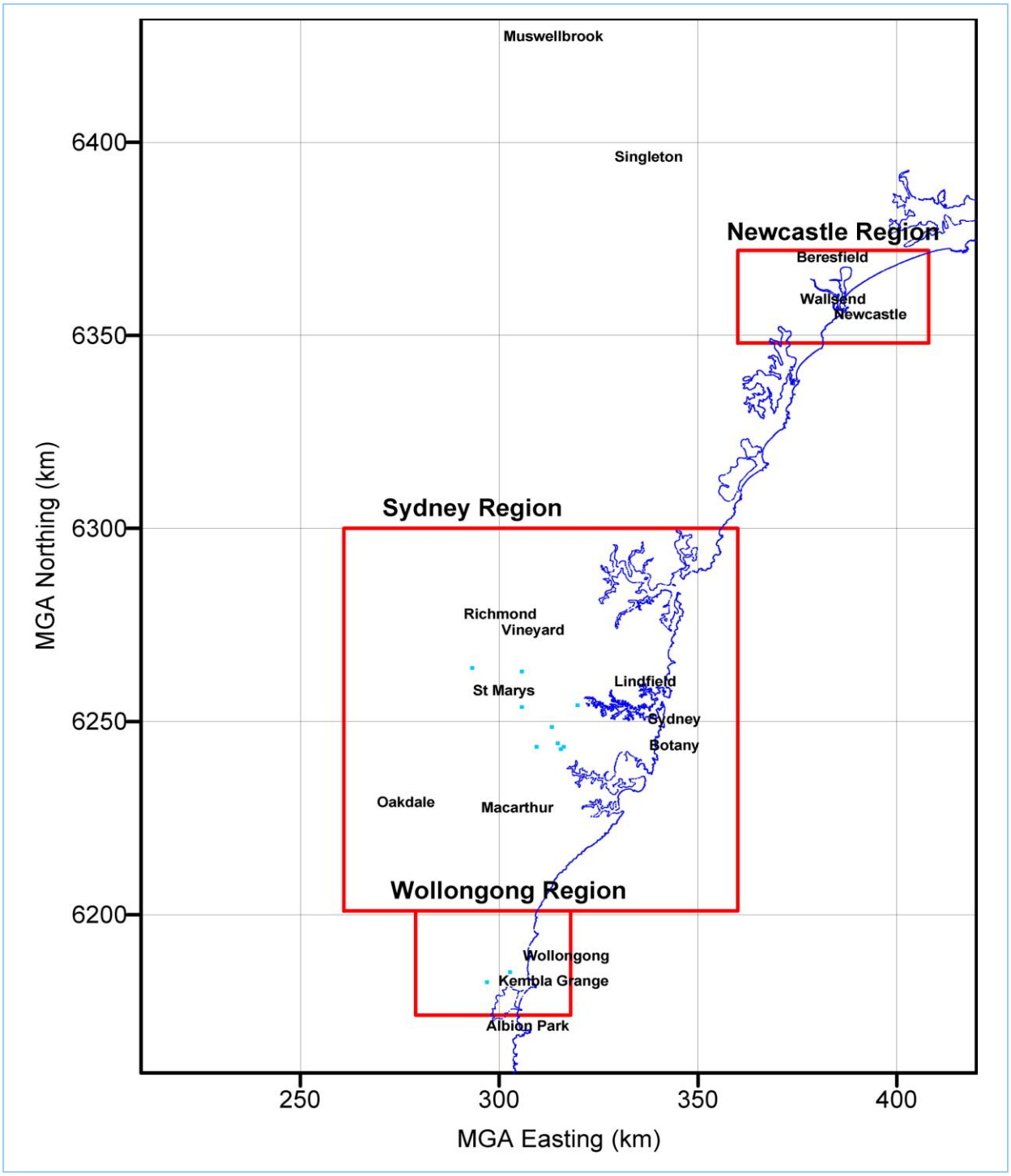

Figure 3-32: Basic iron and steel manufacturers within the GMR

3.12.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from basic iron and steel manufacturing businesses are provided in Table 3-86.

Table 3-86: Emission and speciation factors for all substances from basic iron and steel manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
	Metal cutting (mild steel, 8 mm)	NPI EET Manual for Structural and Fabricated Metal Product Manufacture (EA, 1999i)
	Surface coating (enamel)	VOCs from Surface Coatings Final Report (ENVIRON, 2009)
	Surface coating (lacquer)	
	Surface coating (paint - solvent based)	
	Surface coating (thinner)	
$PM_{2.5}$, PM_{10} & TSP	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Casting (hot metal transfer)	NPI EET Manual for Iron and Steel Production (EA, 1999g) & CEIDARS Profile 90010 EPA AVG Grey Iron Foundries (CARB, 2005)
	Direct entry - PM measurement	Site specific emission estimate
	Iron making (blast furnace)	NPI EET Manual for Iron and Steel Production (EA, 1999g) & CEIDARS Profile 90010 EPA AVG Grey Iron Foundries (CARB, 2005)
	Iron production (furnace, electric induction furnace)	AP42 Chapter 12.10 Gray Iron Foundries (USEPA, 2003)
	Iron production (pouring and cooling)	
	Iron production (sand handling)	
	Iron production (scrap and charge handling)	
	Steel production (furnace, electric induction)	AP42 Chapter 12.13 Steel Foundries (USEPA, 1995d)
	Steel production (sand Handling)	
	Welding	NPI EET Manual for Fugitive Emissions (assuming manual metal arc welding and electrode type 14Mn-4Cr) (EA, 1999f)
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
Speciated organics (including methane)	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001a)
	Surface coating (enamel)	SPECIATEv4.2 (Profile ID=1018) (USEPA, 2008c)
	Surface coating (lacquer)	SPECIATEv4.2 (Profile ID=1017) (USEPA, 2008c)
	Surface coating (paint - solvent based)	SPECIATEv4.2 (Profile ID=1003) (USEPA, 2008c)
	Surface coating (thinner)	SPECIATEv4.2 (Profile ID=1016) (USEPA, 2008c)
Speciated particulate matter	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Direct entry - PM measurement	Site specific emission estimate
	Iron production (furnace, electric induction furnace)	AP42 Chapter 12.10 Gray Iron Foundries (USEPA, 2003b)

Substance	Emission Source	Emission Factor Source
	Welding	NPI EET Manual for Fugitive Emissions (assuming manual metal arc welding and electrode type 14Mn-4Cr) (EA, 1999f)
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
Ammonia	Boiler (natural gas)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
PCDD/PCDF	Boiler (natural gas)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
	Iron production (furnace, electric induction furnace)	
	Steel production (furnace, electric induction)	
Greenhouse gases (CO_2 and N_2O)	Boiler (natural gas)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)

3.12.3 *Activity Data*

Site specific data supplied in the returned commercial survey questionnaires for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. One non-respondent business that reported emissions to the NPI but did not respond to the commercial survey has also been included in the emissions inventory.

The number of respondent and non-respondent businesses in the GMR is provided in Table 3-87.

Table 3-87: Number of basic iron and steel manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Basic Iron and Steel Manufacturing	11	6	1

3.12.4 *Temporal Variation of Emissions*

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions. Monthly variations have been accounted for if data have been provided. It has been assumed that emissions remain constant throughout the operating hours of the business. Businesses with emissions estimated using reported NPI emissions have been assumed to operate 24 hours a day.

3.12.5 *Emission Estimates*

Estimated emissions from basic iron and steel manufacturing within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-88.

Table 3-88: Estimated emissions from basic iron and steel manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	5.07	0	27.2	0	32.3
CARBON MONOXIDE	853	0	4,570	0	5,420
FORMALDEHYDE	10.1	0	54.4	0	64.5
ISOMERS OF XYLENE	414	0	2.89	0	417
LEAD & COMPOUNDS	31.7	0	0.0272	0	31.7
OXIDES OF NITROGEN	3,160	0	5,440	0	8,600
PARTICULATE MATTER ≤ 10 µm	9,450	0	457	0	9,910
PARTICULATE MATTER ≤ 2.5 µm	7,860	0	457	0	8,320
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00698	0	0.0374	0	0.0444
SULFUR DIOXIDE	5.3	0	28.4	0	33.7
TOLUENE	2,050	0	27	0	2,080
TOTAL SUSPENDED PARTICULATE	14,400	0	457	0	14,900
TOTAL VOLATILE ORGANIC COMPOUNDS	12,000	0	334	0	12,300
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.12.6 Emission Projection Methodology

Projection factors for basic iron and steel manufacturing have been derived based on primary energy consumption projections for iron and steel in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-89 and illustrated in Figure 3-33.

Table 3-89: Projection factors for iron and steel (primary energy) related sources

Year	Projection Factor	Year	Projection Factor
2009	0.9968	2023	0.9958
2010	0.9950	2024	0.9959
2011	0.9946	2025	0.9961
2012	0.9944	2026	0.9963
2013	0.9944	2027	0.9965
2014	0.9944	2028	0.9967
2015	0.9944	2029	0.9969
2016	0.9946	2030	0.9967
2017	0.9947	2031	0.9964
2018	0.9949	2032	0.9965
2019	0.9951	2033	0.9966
2020	0.9953	2034	0.9966
2021	0.9954	2035	0.9967
2022	0.9956	2036	0.9968

Source: ABARE (2006)

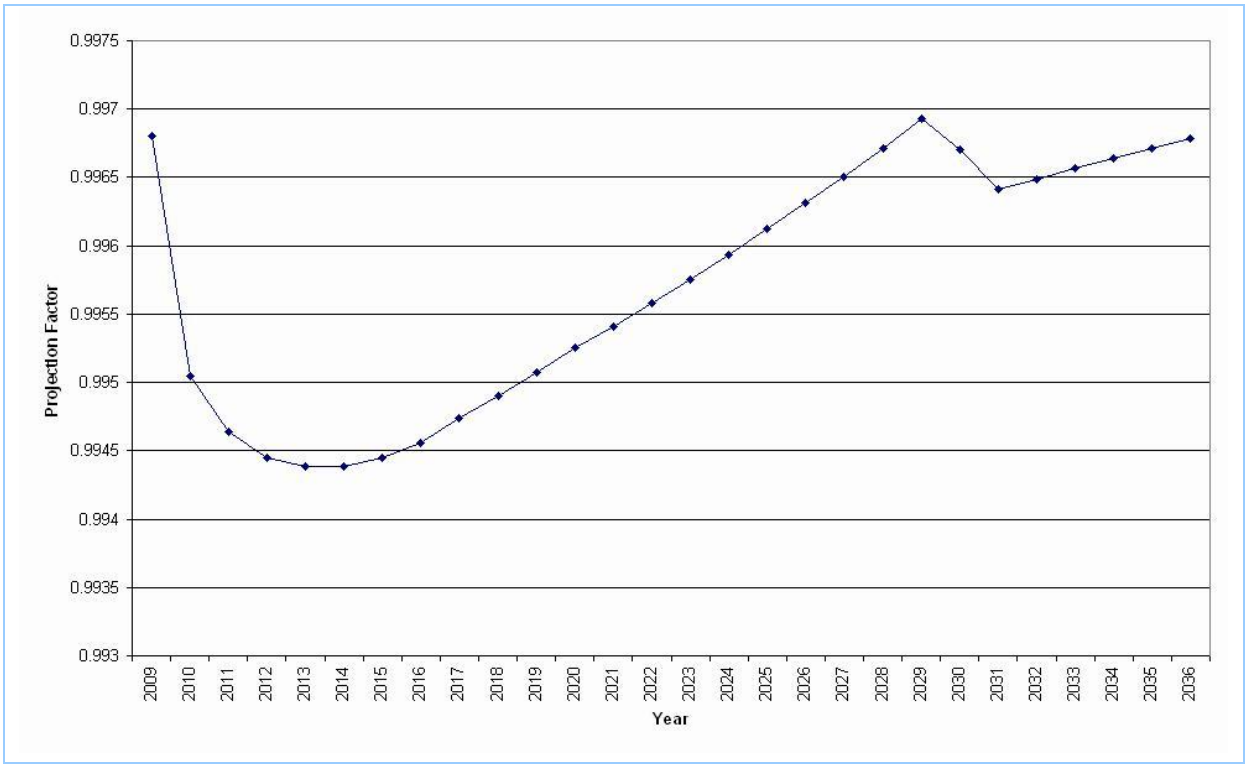

Figure 3-33: Projection factors for iron and steel (primary energy) related sources

3.13 Bread Manufacturing

3.13.1 Emission Sources and Associated Releases to Air

Bread manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of eight commercial bread manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-90.

Table 3-90: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
TIP TOP BAKERIES NEWCASTLE	2720	31 OAKDALE RD	GATESHEAD	2290
FRESH START BAKERIES LIVERPOOL	2722	GATE 2, HOMEPRIDE AVENUE	LIVERPOOL	2170
QUALITY BAKERS AUSTRALIA MOOREBANK PLANT	2723	MOOREBANK AVENUE	MOOREBANK	2170
TIP TOP BAKERIES CHULLORA	7137	9 MUIR ROAD	CHULLORA	2109
TIP TOP BAKERIES FAIRFIELD	7138	311 THE HORSLEY DRIVE	FAIRFIELD	2165

The emission sources and associated releases to air for bread manufacturing are outlined in Table 3-91.

Table 3-91: Bread manufacturing – emission sources

Emission Source	Emissions to Air
Baking (fermentation)	VOC
Boiler (natural gas)	Combustion products
Direct entry - PM measurement	PM
Fuel storage (diesel)	VOC
Fuel storage (petrol)	VOC
Fugitive emissions - VOC	VOC
Wastewater treatment	VOC, ammonia
Wheel generated dust (paved roads)	PM

The locations of commercial bread manufacturing businesses are shown in Figure 3-34.

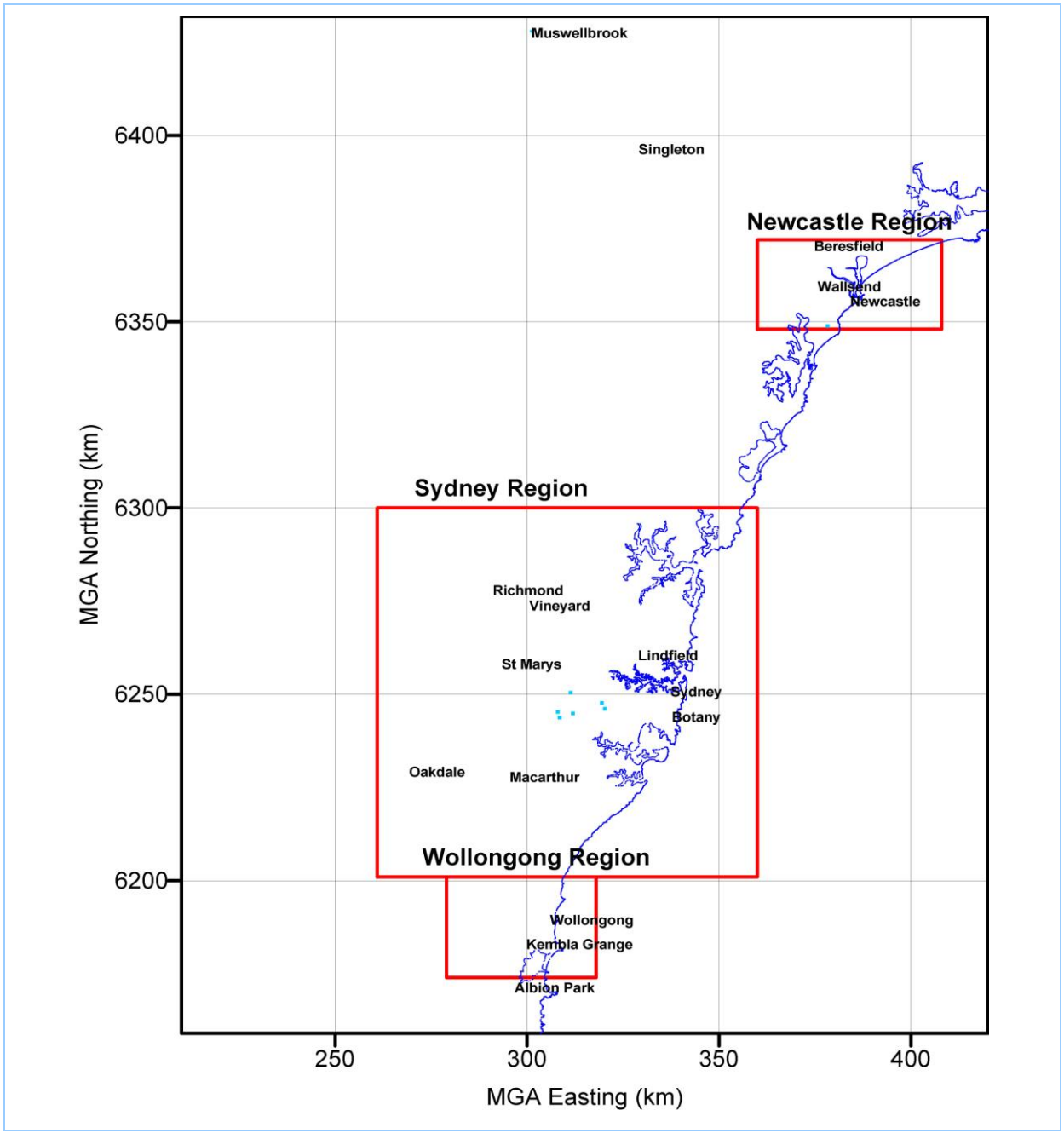

Figure 3-34: Locations of bread manufacturers within the GMR

3.13.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from basic iron and steel manufacturing businesses are provided in Table 3-92.

Table 3-92: Emission and speciation factors for all substances from basic iron and steel manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Baking (fermentation)	NPI EET Manual for Bread Manufacturing v1.1 (EA, 2003a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
	Fuel storage (petrol)	
	Fugitive emissions - VOC	Site specific emission estimate
	Wastewater treatment	NGGIC Workbook for Waste (NGGIC, 1996)
$PM_{2.5}$, PM_{10} & TSP	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Direct entry - PM measurement	Site specific emission estimate
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
Speciated organics (including methane)	Baking (fermentation)	SPECIATEv4.2 (Profile ID=1188) (USEPA, 2008c)
	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001b)
	Fuel storage (petrol)	Average petrol concentration from petrol produced at BP refineries around Australia (BP, 2001a)
	Fugitive emissions - VOC	SPECIATEv4.2 (Profile ID=1188) (USEPA, 2008c)
	Wastewater treatment	CEIDARS Organic Gas Speciation Profiles (Profile ID=1402) (assuming that unidentified portion is methane) (CARB, 2005)
Speciated particulate matter	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
Ammonia	Boiler (natural gas)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
	Wastewater treatment	
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998)
PCDD/PCDF	Boiler (natural gas)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	Boiler (natural gas)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)

3.13.3 Activity Data

Site specific data supplied from one respondent business are available in the returned commercial survey questionnaires for the 2003 air emissions inventory. This data has been used to estimate emissions from this business for the 2008 calendar year. Four non-respondent businesses reported

emissions to the NPI and have also been included in the emissions inventory. The number of bread manufacturing businesses is provided in Table 3-93.

Table 3-93: Number of bread manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Bread Manufacturing	8	1	4

No emission estimates have been performed for non-respondent businesses that do not report to the NPI as there are no relevant sources of estimation data available in the public arena.

3.13.4 Temporal Variation of Emissions

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions for respondent businesses. Process emissions have been assumed to vary in direct proportion to the change in production rates over a typical year which was supplied in the returned commercial survey questionnaire. Businesses with emissions estimated using reported NPI emissions have been assumed to operate 24 hours a day.

3.13.5 Emission Estimates

Estimated emissions from bread manufacturing within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-94.

Table 3-94: Estimated emissions from bread manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR [a]
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	69	10.4	0	0	79.4
CARBON MONOXIDE	11,600	1,680	0	0	13,300
FORMALDEHYDE	138	20	0	0	158
ISOMERS OF XYLENE	0	0.472	0	0	0.472
LEAD & COMPOUNDS	0.069	0.122	0	0	0.191
OXIDES OF NITROGEN	13,800	2,000	0	0	15,800
PARTICULATE MATTER ≤ 10 µm	1,050	477	0	0	1530
PARTICULATE MATTER ≤ 2.5 µm	1,050	346	0	0	1390
PERCHLOROETHYLENE	0	0.0197	0	0	0.0197
POLYCYCLIC AROMATIC HYDROCARBONS	0.0949	0.0138	0	0	0.109
SULFUR DIOXIDE	72.1	10.5	0	0	82.6
TOLUENE	34.5	6.12	0	0	40.6
TOTAL SUSPENDED PARTICULATE	1,050	1,200	0	0	2,250
TOTAL VOLATILE ORGANIC COMPOUNDS	132,000	10,300	0	0	143,000
TRICHLOROETHYLENE	0	0.00282	0	0	0.00282

a Totals may not appear additive due to rounding

3.13.6 Emission Projection Methodology

Projection factors for bread manufacturing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

3.14 Ceramic Product Manufacturing

3.14.1 Emission Sources and Associated Releases to Air

Ceramic product manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of five commercial ceramic product manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-95.

Table 3-95: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
SHINAGAWA THERMAL CERAMICS BERKELEY ROAD	3402	231-235 BERKELEY ROAD	UNANDERRA	2526
SHINAGAWA THERMAL CERAMICS GLASTONBURY AVENUE	3403	23 GLASTONBURY AVENUE	UNANDERRA	2526
CAROMA INDUSTRIES WETHERILL PARK	7132	26-32 WALTER STREET	WETHERILL PARK	2164

The emission sources and associated releases to air for ceramic product manufacturing (excluding glass) processes are outlined in Table 3-96.

Table 3-96: Ceramic product manufacturing (excluding glass) – emission sources

Emission Source	Emissions to Air
Ceramic - Firing-natural gas fired kiln	Combustion products
Direct entry - PM measurement	PM
Direct entry - VOC measurement	VOC

The locations of commercial ceramic product manufacturing businesses are shown in Figure 3-35.

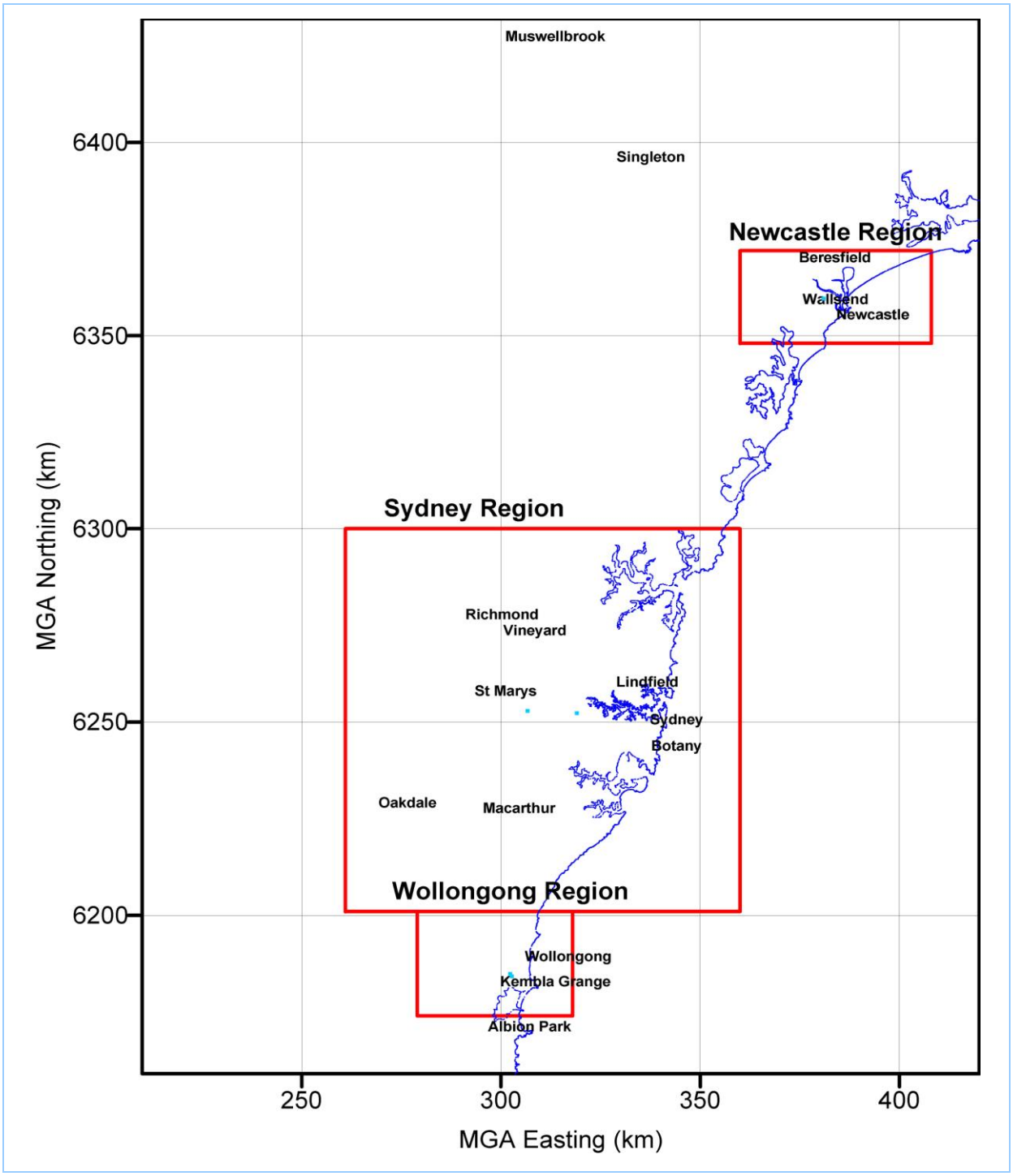

Figure 3-35: Ceramic product manufacturers within the GMR

3.14.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from ceramic product manufacturing businesses are provided in Table 3-97.

Table 3-97: Emission and speciation factors for all substances from ceramic product manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Ceramic - firing-natural gas fired kiln	AP42 Chapter 11.7 Ceramic Product Manufacturing (USEPA, 1996b)
	Direct entry - VOC measurement	Site specific emission estimates
$PM_{2.5}$, PM_{10} & TSP	Ceramic - firing-natural gas fired kiln	AP42 Chapter 11.7 Ceramic Product Manufacturing (USEPA, 1996b)
	Direct entry – PM measurement	Site specific emission estimates
Speciated organics (including methane)	Ceramic - firing-natural gas fired kiln	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Direct entry - VOC measurement	Site specific emission estimates
Speciated particulate matter	Ceramic - firing-natural gas fired kiln	AP42 Chapter 11.7 Ceramic Product Manufacturing (USEPA, 1996b)
	Direct entry – PM measurement	Site specific emission estimates
Ammonia	NA	NA
Sulfuric or hydrochloric acid	NA	NA
PAH	NA	NA
PCDD/PCDF	Ceramic - firing-natural gas fired kiln	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	Ceramic - firing-natural gas fired kiln	Mass balance

3.14.3 Activity Data

Commercial survey questionnaires were sent to four ceramic product manufacturing businesses during the compilation of the 2003 air emissions inventory, however none were returned. Three non-respondent businesses that reported emissions to the NPI have been included in the 2008 commercial air emissions inventory. The number of businesses identified and included in the emissions inventory is provided in Table 3-98.

Table 3-98: Number of ceramic product manufacturing businesses within the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Ceramic Product Manufacturing	5	0	3

No emission estimates have been performed for non-respondent businesses that do not report to the NPI as there are no relevant sources of estimation data available in the public arena.

3.14.4 Temporal Variation of Emissions

Businesses with emissions estimated using reported NPI emissions have been assumed to operate 24 hours a day.

3.14.5 Emission Estimates

Estimated emissions from ceramic product manufacturing within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-99.

Table 3-99: Estimated emissions from ceramic product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	13.9	0	43	0	56.9
CARBON MONOXIDE	15,700	0	12,900	0	28,600
FORMALDEHYDE	27.9	0	86	0	114
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.74	0	0.03	0	0.77
OXIDES OF NITROGEN	2,570	0	3,870	0	6440
PARTICULATE MATTER ≤ 10 µm	23,300	0	7,540	0	30,800
PARTICULATE MATTER ≤ 2.5 µm	21,300	0	1,900	0	23,200
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0.17	0	0.17
SULFUR DIOXIDE	47,500	0	220	0	47,700
TOLUENE	6.96	0	21.5	0	28.5
TOTAL SUSPENDED PARTICULATE	41,600	0	7,960	0	49,600
TOTAL VOLATILE ORGANIC COMPOUNDS	153	0	477	0	630
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

3.14.6 Emission Projection Methodology

Projection factors for ceramic product manufacturing have been derived based on final energy consumption projections for non-metallic minerals in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-83 and illustrated in Figure 3-31.

3.15 Chemical Product Manufacturing

3.15.1 Emission Sources and Associated Releases to Air

Commercial chemical product manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of 72 commercial chemical product manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-100.

Table 3-100: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
RUAKURA PTY LIMITED	3018	UNIT 2/12 BLACKMORE RD	NARELLAN	2567
INTERNATIONAL ANIMAL HEALTH PRODUCTS PTY LTD	3031	18 HEALEY CCT	HUNTINGWOOD	2148
HURST AUSTRALIA PTY LTD	3050	10 BELLONA AVE	REGENTS PARK	2143
LO-CHLOR CHEMICALS	3061	86 MEEKS RD	MARRICKVILLE	2204
A J BLACKWOOD PTY LTD	3066	53-55 RALPH ST	ALEXANDRIA	2015
DEGUSSA CATALYSTS & INITIATORS PTY LIMITED	3075	20-22 MCPHERSON ST	BANKSMEADOW	2019
BOTANY INDUSTRIAL PARK PTY LTD	3076	MCPHERSON ST	BANKSMEADOW	2019
CARSON ADHESIVES P/L	3078	57 MITCHELL RD	BROOKVALE	2100
GLASON GROUP CLEANING PRODUCTS	3081	UNIT 4 16-17 MERINEE RD	GOSFORD WEST	2250
APPLIED PRODUCTS AUSTRALIA	3085	11 GAMMA CL	BERESFIELD	2322
ALUMINATES (NSW) PTY LTD	3091	PO BOX 241	WYONG	2259
MAURI YEAST AUSTRALIA	3093	15 GRAND AVENUE	CAMELLIA	2142
ZENECA PHARMACEUTICALS AUST PTY LTD	3096	CHRISTINA ROAD	VILLAWOOD	2163
TOWN & COUNTRY CHEMICALS PTY LTD	4098	UNIT 5 / 6 CATAMARAN DR	BERKELEY VALE	2261
F.I.P. PTY LIMITED	7009	6 WENBAN PLACE	WETHERILL PARK	2164
PYLON COATINGS PTY LIMITED	7065	6 MARGATE STREET	BOTANY	2019
GREENCORP MAGNETICS PTY LTD	7068	80 PERRY STREET	MATRAVILLE	2036

The emission sources and associated releases to air for commercial chemical product manufacturing are outlined in Table 3-101.

Table 3-101: Emission sources from chemical product manufacturing

Emission Source	Emissions to Air
Acid storage	HCl
Boiler (natural gas)	Combustion products
Direct entry - SO_2 and VOC measurement	SO_2, VOC
Direct entry - PM measurement	PM
Grain milling	PM
Fuel storage (ethanol)	VOC
Fuel storage (petrol)	VOC
Direct entry - VOC measurement	VOC
Wheel generated dust (paved roads)	PM
Wheel generated dust (unpaved roads)	PM

The locations of commercial chemical product manufacturing businesses are shown in Figure 3-36.

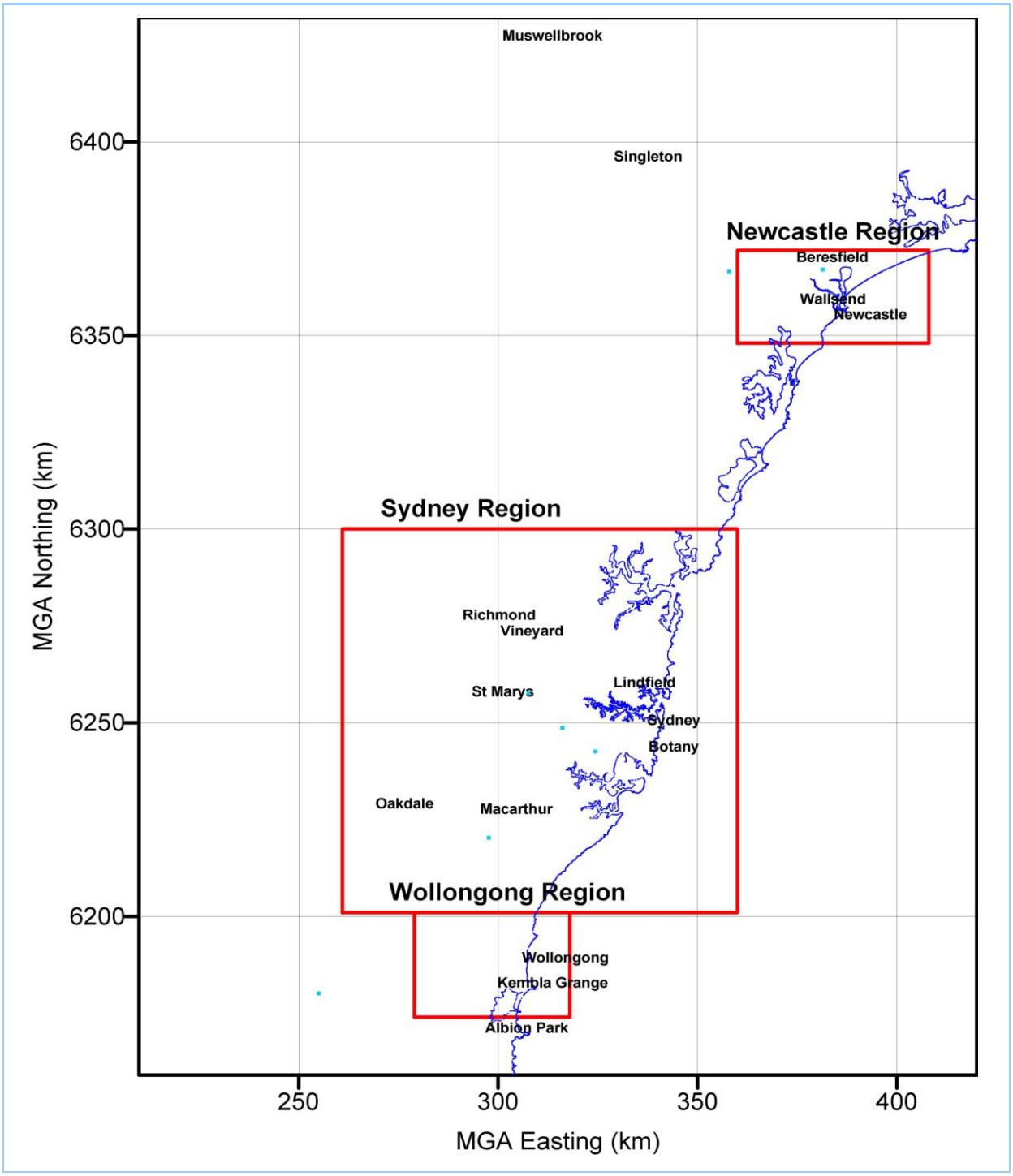

Figure 3-36: Commercial chemical product manufacturers within the GMR

3.15.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from commercial chemical product manufacturing businesses are provided in Table 3-97.

Table 3-102: Emission and speciation factors for all substances from chemical product manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Direct entry - SO_2 and VOC measurement	Site specific emission estimates
	Fuel storage (ethanol)	TANKS 4.09D software (USEPA, 2006d)
	Fuel storage (petrol)	
	Direct entry - VOC measurement	Site specific emission estimates
$PM_{2.5}$, PM_{10} & TSP	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Direct entry - PM measurement	Site specific emission estimates
	Grain milling	AP42 Chapter 9.9.1 Grain Elevators & Processes (USEPA, 2003a)
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
	Wheel generated dust (unpaved roads)	AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006c)
Speciated organics (including methane)	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Direct entry - SO_2 and VOC measurement	Site specific emission estimates
	Fuel storage (ethanol)	Mass balance (100% ethanol)
	Fuel storage (petrol)	Average petrol vapour concentration from petrol produced at BP refineries around Australia (BP, 2001a)
	Direct entry - VOC measurement	Site specific emission estimates
Speciated particulate matter	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
	Wheel generated dust (unpaved roads)	California Emissions Inventory and Reporting System - Unpaved Road Dust, 1997 (CARB, 2007)
Ammonia	Boiler (natural gas)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
Sulfuric or hydrochloric acid	Acid storage	Raoult's law (Raoult, M, 1882a; 1882b, 1887a; 1887b), using chemical properties from Perry and Green (1997)
PAH	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
PCDD/PCDF	Boiler (natural gas)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	Boiler (natural gas)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)

3.15.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaires for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. Two non-respondent businesses that reported emissions to the NPI but did not respond to the commercial survey have also been included in the emissions inventory. No emission estimates have been performed for non-respondent businesses that do not report to the NPI as there are no relevant sources of estimation data available in the public arena.

The number of businesses identified and included in the emissions inventory is provided in Table 3-103.

Table 3-103: Number of chemical product manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Chemical Product Manufacturing n.e.c.	72	15	2

It should be noted that in processing the returned commercial survey questionnaires, seven businesses have been determined to have no emission sources in the operation of the business. Hence, these businesses have been estimated to emit zero air emissions.

3.15.4 Temporal Variation of Emissions

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions. Monthly variations have been accounted for if data have been provided. It was assumed that emissions remain constant throughout the operating hours of the business. Businesses with emissions estimated using reported NPI emissions have been assumed to operate 24 hours a day.

3.15.5 Emission Estimates

Estimated emissions from commercial chemical product manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-104.

Table 3-104: Estimated emissions from commercial chemical product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	5.25	0	0	0	5.25
BENZENE	52	0	0	0	52
CARBON MONOXIDE	4,540	0	0	0	4,540
FORMALDEHYDE	55.6	0	0	0	55.6
ISOMERS OF XYLENE	125	0	0	33.5	158
LEAD & COMPOUNDS	3.89	0	0	0.00185	3.89
OXIDES OF NITROGEN	5,540	0	0	0	5,540
PARTICULATE MATTER ≤ 10 µm	9,510	0	0	7.86	9,520
PARTICULATE MATTER ≤ 2.5 µm	1,910	0	0	5.69	1,920
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0382	0	0	0	0.0382
SULFUR DIOXIDE	29,600	0	0	0	29,600
TOLUENE	138,000	0	0	71.9	138,000
TOTAL SUSPENDED PARTICULATE	30,800	0	0	19.9	30,800
TOTAL VOLATILE ORGANIC COMPOUNDS	510,000	6,340	0	4,060	520,000
TRICHLOROETHYLENE	3,500	0	0	0	3,500

a Totals may not appear additive due to rounding

3.15.6 Emission Projection Methodology

Projection factors for chemical product manufacturing have been derived based on final energy consumption projections for basic chemicals in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-105 and illustrated in Figure 3-37.

Table 3-105: Projection factors for basic chemicals related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0082	2023	1.1320
2010	1.0162	2024	1.1416
2011	1.0245	2025	1.1510
2012	1.0329	2026	1.1604
2013	1.0415	2027	1.1700
2014	1.0501	2028	1.1798
2015	1.0587	2029	1.1898
2016	1.0675	2030	1.1979
2017	1.0764	2031	1.2055
2018	1.0854	2032	1.2146
2019	1.0945	2033	1.2237
2020	1.1038	2034	1.2328
2021	1.1131	2035	1.2419
2022	1.1225	2036	1.2510

Source: ABARE (2006)

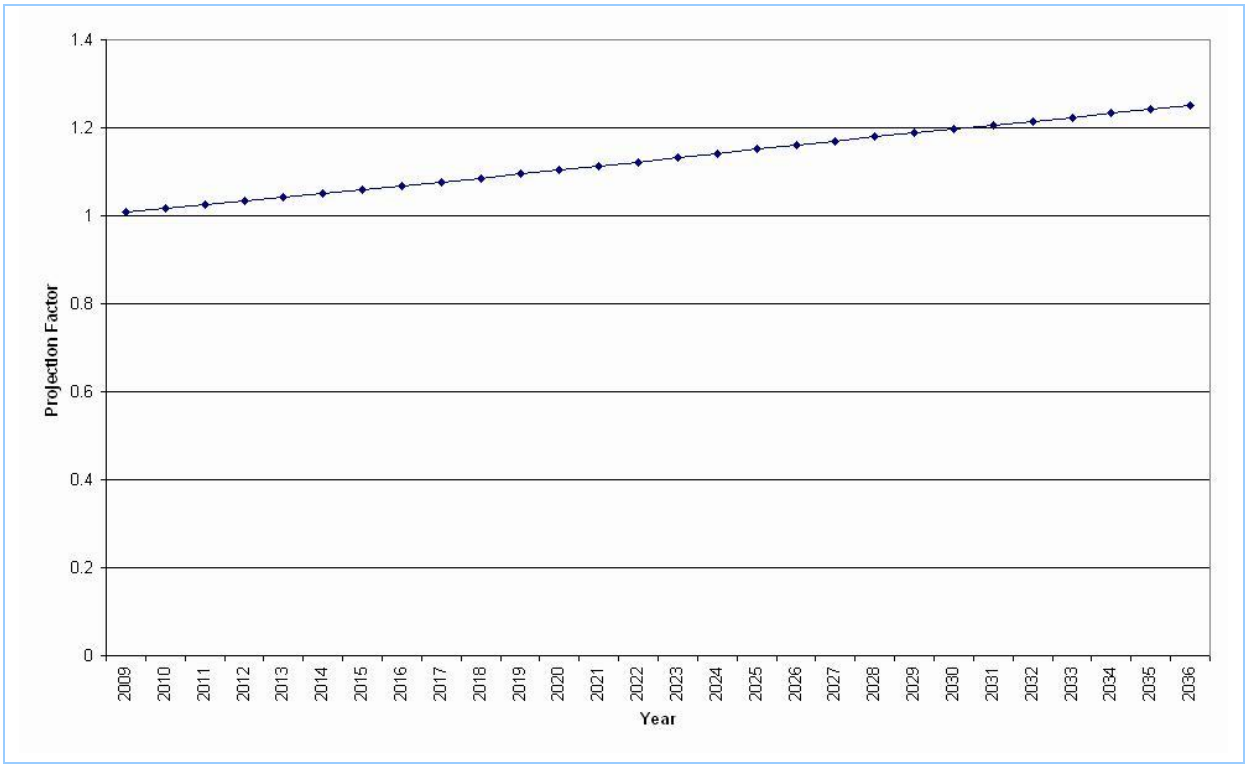

Figure 3-37: Projection factors for basic chemicals related sources

3.16 Food Manufacturing

3.16.1 Emission Sources and Associated Releases to Air

Food manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of 59 commercial food manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-106.

Table 3-106: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
GENERAL MILLS AUSTRALIA PTY LIMITED	2746	16 KELLOGG RD	ROOTY HILL	2766
ARNOTTS SNACK FOODS	2760	15-21 BRITTON ST	SMITHFIELD	2164
GIVAUDAN AUSTRALIA PTY LTD	2771	9 CAROLYN ST	SILVERWATER	2141
FROZEN FOOD PACKERS P/L	2772	59-61 DERBY ST	SILVERWATER	2128
BIG SISTER FOODS PTY LTD	2778	44A WHARF RD	ERMINGTON	2115
SARA LEE COFFEE & TEA (AUSTRALIA) PTY LTD	2782	18 FORRESTER ST	KINGSGROVE	2208
AUSTRALIAN HEALTH & NUTRITION ASSOCIATION LTD	2797	LOT 13 2 SANITARIUM DR	BERKELEY VALE	2261
EFFEM FOODS WYONG	2801	4 CORELLA CLOSE	WYONG	2259
SANITARIUM HEALTH FOOD COMPANY	6981	FREEMANS DR	COORANBONG	2265
CAMELLIA VINEGAR	7120	15 GRAND AVENUE	CAMELLIA	2142
MARS FOOD BERKELEY VALE	7124	4 CORELLA CLOSE	BERKELEY VALE	2261

The emission sources and associated releases to air from food manufacturing outlined in Table 3-107.

Table 3-107: Food manufacturing – emission sources

Emission Source	Emissions to Air
Boiler (coal)	Combustion products
Boiler (diesel)	Combustion products
Boiler (LPG)	Combustion products
Boiler (natural gas)	Combustion products
Fuel storage (diesel)	VOC
Fugitive emissions - VOC	VOC
Snack chip deep fat frying (other chips)	VOC
Wastewater treatment	VOC, ammonia
Wheel generated dust (paved roads)	PM

The locations of commercial food manufacturing n.e.c. businesses are shown in Figure 3-38.

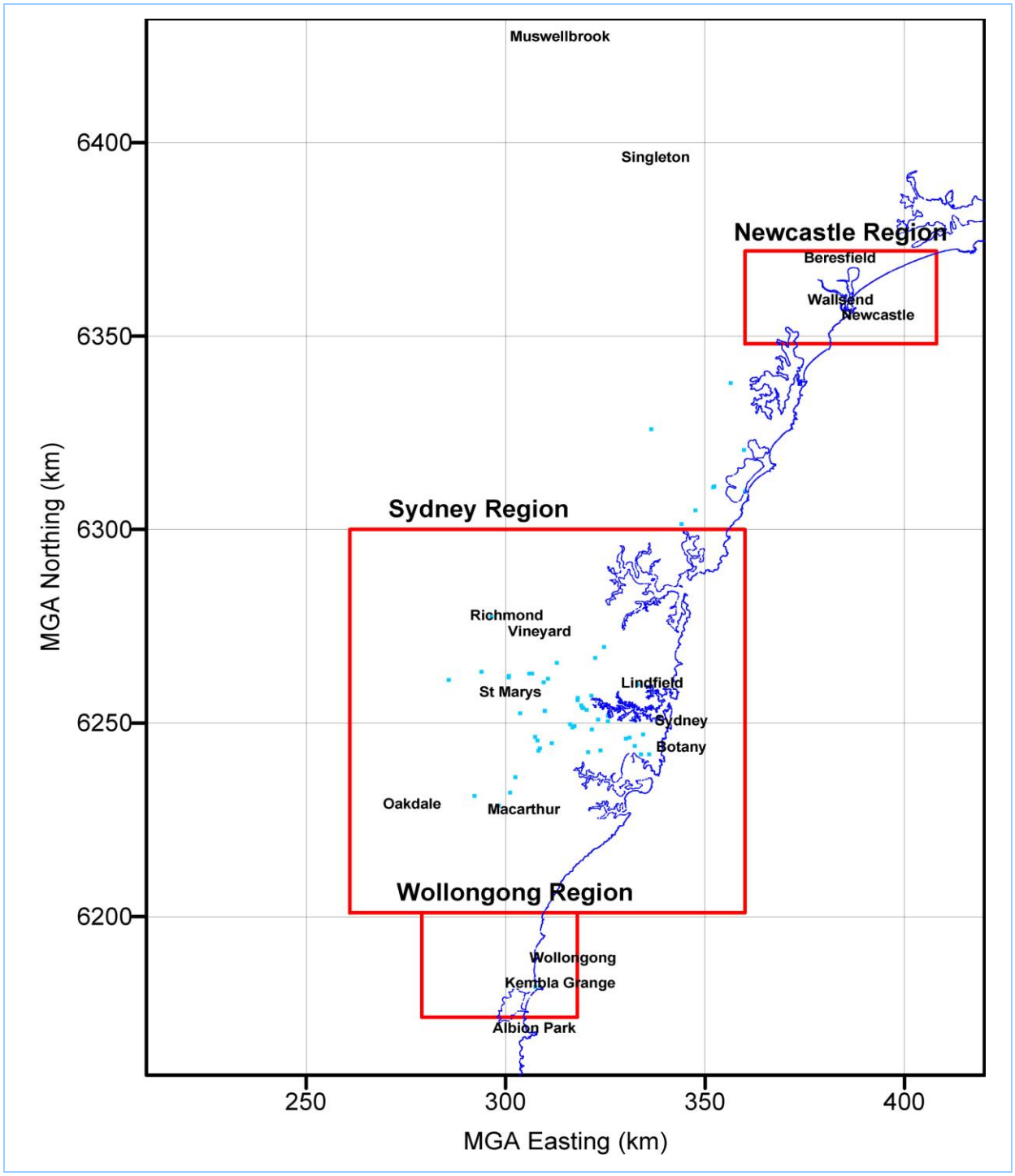

Figure 3-38: Food manufacturing n.e.c. businesses within the GMR

3.16.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from chemical product manufacturing businesses are provided in Table 3-97.

Table 3-108: Emission and speciation factors for all substances from food manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (coal)	AP42 Chapter 1.1 Bituminous and Subbituminous Coal Combustion (USEPA, 1998a)
	Boiler (diesel)	AP42 Chapter 1.3 Fuel Oil Combustion (USEPA, 1999)
	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
	Fugitive emissions - VOC	Site specific emission estimates
	Snack chip deep fat frying (other chips)	AP42 Chapter 9.13.3 Snack Chip Deep Fat Frying (USEPA, 1995c)
	Wastewater treatment	NGGIC Workbook for Waste (NGGIC, 1996)
$PM_{2.5}$, PM_{10} & TSP	Boiler (coal)	AP42 Chapter 1.1 Bituminous and Subbituminous Coal Combustion (USEPA, 1998a)
	Boiler (diesel)	AP42 Chapter 1.3 Fuel Oil Combustion (USEPA, 1999)
	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
Speciated organics (including methane)	Boiler (coal)	SPECIATEv4.2 (Profile ID=1178) (USEPA, 2008c)
	Boiler (diesel)	SPECIATEv4.2 (Profile ID=0002) (USEPA, 2008c)
	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001b)
	Fugitive emissions - VOC	Site specific emission estimates
	Snack chip deep fat frying (other chips)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Wastewater treatment	CEIDARS Organic Gas Speciation Profiles (Profile ID=1402) (assuming that unidentified portion is methane) (CARB, 2005)
Speciated particulate matter	Boiler (coal)	AP42 Chapter 1.1 Bituminous and Subbituminous Coal Combustion (USEPA, 1998a)
	Boiler (diesel)	CEIDARS PM profile 114 for speciated metals (CARB, 2007)
	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System – Paved Road Dust, 1997 (CARB, 2007)
Ammonia	Boiler (coal)	NPI EET Manual for Fossil Fuel Electric Power Generation v2.4 (DEH, 2005)
	Boiler (diesel)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
	Boiler (LPG)	
	Boiler (natural gas)	
	Wastewater treatment	

Substance	Emission Source	Emission Factor Source
Sulfuric or hydrochloric acid	Boiler (coal)	NPI EET Manual for Fossil Fuel Electric Power Generation v2.4 (DEH, 2005)
PAH	Boiler (coal)	AP42 Chapter 1.1 Bituminous and Subbituminous Coal Combustion (USEPA, 1998a)
	Boiler (diesel)	AP42 Chapter 1.3 Fuel Oil Combustion (USEPA, 1999)
	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b)
PCDD/PCDF	Boiler (coal)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
	Boiler (diesel)	
	Boiler (LPG)	
	Boiler (natural gas)	
Greenhouse gases (CO_2 and N_2O)	Boiler (coal)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)
	Boiler (diesel)	
	Boiler (LPG)	
	Boiler (natural gas)	

3.16.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaires for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. Five non-respondent businesses that reported emissions to the NPI but did not respond to the commercial survey have also been included in the emissions inventory. No emission estimates have been performed for non-respondent businesses that do not report to the NPI as there are no relevant sources of estimation data available in the public arena.

The number of businesses identified and included in the emissions inventory is provided in Table 3-109.

Table 3-109: Number of food manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Food manufacturing n.e.c.	59	6	5

3.16.4 Temporal Variation of Emissions

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions for respondent businesses. Process emissions have been assumed to vary in direct proportion to the change in production rates over a typical year which was supplied in returned commercial survey questionnaires. Businesses with emissions estimated using reported NPI emissions have been assumed to operate 24 hours a day.

3.16.5 Emission Estimates

Estimated emissions from food manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-110.

Table 3-110: Estimated emissions from food manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	52	0	0	51.8	104
CARBON MONOXIDE	6,900	0	0	6,050	13,000
FORMALDEHYDE	114	0	0	106	220
ISOMERS OF XYLENE	62.1	0	0	28.5	90.6
LEAD & COMPOUNDS	0.0522	0	0	0.444	0.497
OXIDES OF NITROGEN	8,220	0	0	21,000	29,200
PARTICULATE MATTER ≤ 10 µm	642	0	0	1,010	1,650
PARTICULATE MATTER ≤ 2.5 µm	629	0	0	738	1,370
PERCHLOROETHYLENE	72.5	0	0	1.96	74.5
POLYCYCLIC AROMATIC HYDROCARBONS	0.0565	0	0	0.0772	0.134
SULFUR DIOXIDE	42.9	0	0	17,800	17,800
TOLUENE	67.4	0	0	30.2	97.6
TOTAL SUSPENDED PARTICULATE	714	0	0	1,650	2,370
TOTAL VOLATILE ORGANIC COMPOUNDS	5,720	0	0	489	6,210
TRICHLOROETHYLENE	10.4	0	0	0.28	10.6

[a] Totals may not appear additive due to rounding

3.16.6 Emission Projection Methodology

Projection factors for food manufacturing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

3.17 Port Operators

3.17.1 Emission Sources and Associated Releases to Air

One commercial port operating business has been identified within the GMR using the NSW WorkCover database for hazardous materials and the telephone directory for NSW.

The commercial business within the GMR that is included in the emissions inventory under this category is outlined in Table 3-111.

Table 3-111: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
P&O PORTS PORT BOTANY TERMINAL	5430	42 FRIENDSHIP ROAD	MATRAVILLE	2036

The emission sources and associated releases to air from port operators are outlined in Table 3-112.

Table 3-112: Port operator – emission sources

Source	Emissions to Air
Combustion	Combustion products

The location of commercial port operator is shown in Figure 3-39.

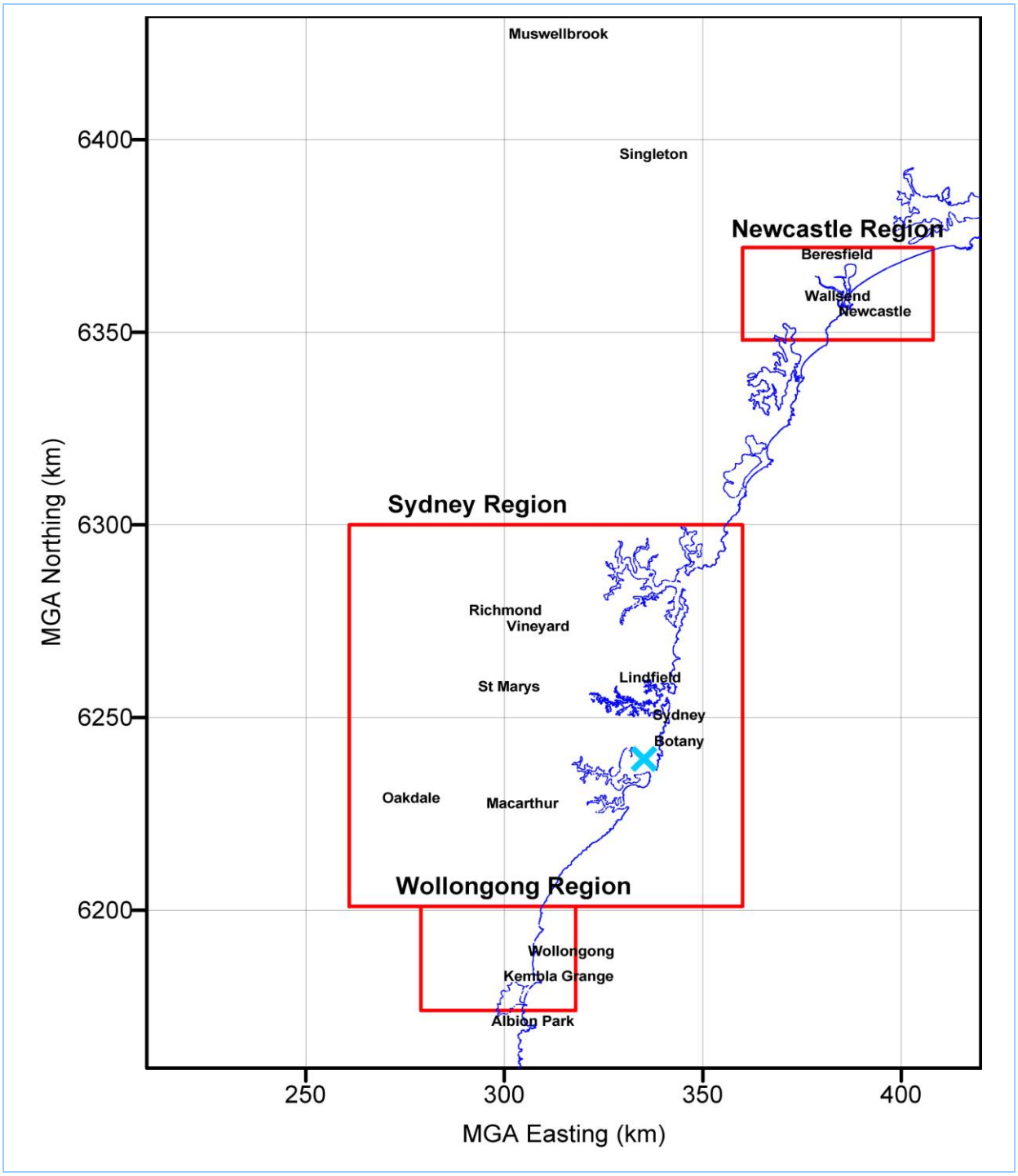

Figure 3-39: Commercial port operators within the GMR

3.17.2 Emission Estimation Methodology

Emissions from the commercial port operating business have been estimated using information published on the NPI and data supplied in the commercial survey questionnaire.

3.17.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaire from the respondent business has been used for emissions estimation.

3.17.4 Temporal Variation of Emissions

Data provided in the returned commercial survey questionnaire was used to estimate temporal variation of the emissions. It was assumed that emissions remain constant throughout the operating hours of the business.

3.17.5 Emission Estimates

Estimated emissions from port operators within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-113.

Table 3-113: Estimated emissions from port operators

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	1,250	0	0	0	1,250
CARBON MONOXIDE	31,300	0	0	0	31,300
FORMALDEHYDE	2,500	0	0	0	2,500
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.4	0	0	0	0.4
OXIDES OF NITROGEN	102,000	0	0	0	102,000
PARTICULATE MATTER ≤ 10 µm	8,950	0	0	0	8,950
PARTICULATE MATTER ≤ 2.5 µm	8,950	0	0	0	8,950
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.38	0	0	0	0.38
SULFUR DIOXIDE	9,940	0	0	0	9,940
TOLUENE	624	0	0	0	624
TOTAL SUSPENDED PARTICULATE	8,950	0	0	0	8,950
TOTAL VOLATILE ORGANIC COMPOUNDS	13,700	0	0	0	13,700
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.17.6 Emission Projection Methodology

Projection factors for port operators have been derived based on final energy consumption projections for water transport in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-114 and illustrated in Figure 3-40.

Table 3-114: Projection factors for water transport related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0062	2023	1.0532
2010	1.0115	2024	1.0559
2011	1.0160	2025	1.0584
2012	1.0198	2026	1.0607
2013	1.0233	2027	1.0631
2014	1.0268	2028	1.0655
2015	1.0300	2029	1.0678
2016	1.0330	2030	1.0719
2017	1.0361	2031	1.0763
2018	1.0390	2032	1.0793
2019	1.0419	2033	1.0823
2020	1.0448	2034	1.0853
2021	1.0477	2035	1.0883
2022	1.0505	2036	1.0913

Source: ABARE (2006)

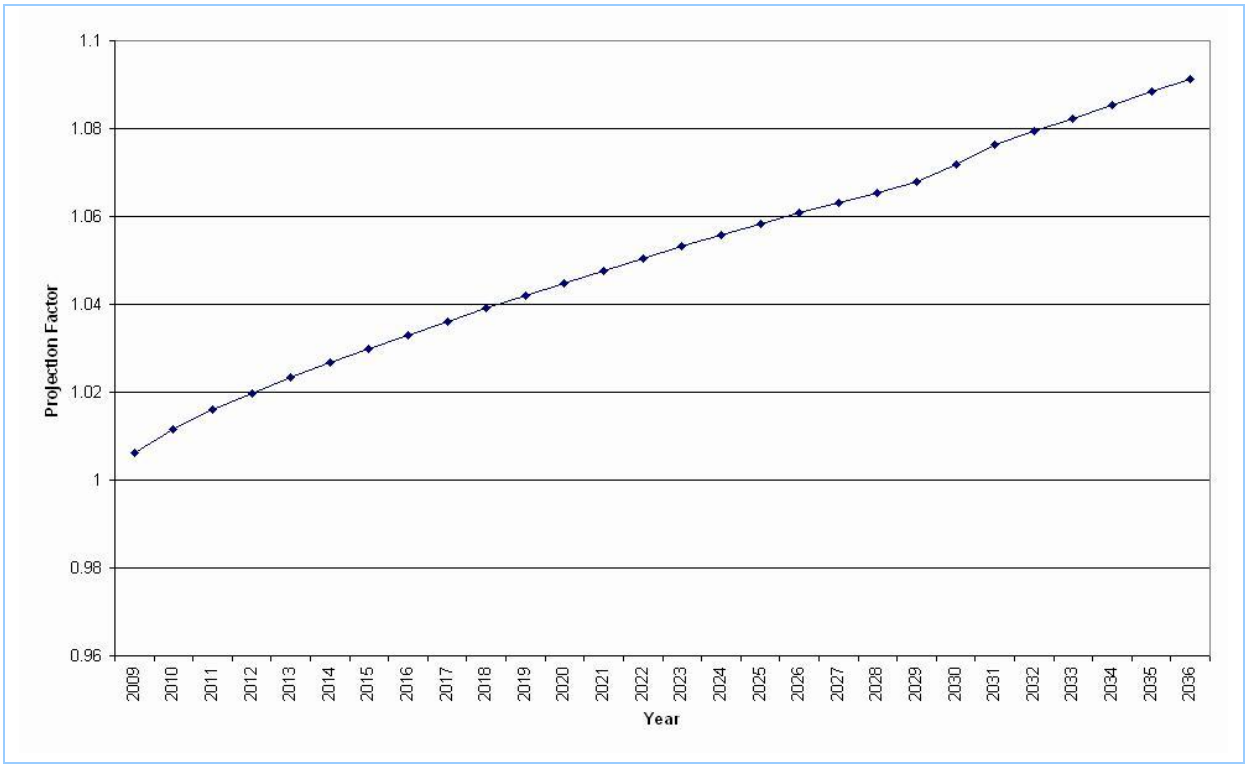

Figure 3-40: Projection factors for water transport related sources

3.18 Plaster Product Manufacturing

3.18.1 Emission Sources and Associated Releases to Air

Plaster product manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of two commercial plaster product manufacturing businesses have been identified from these sources to be within the GMR.

The commercial business within the GMR that is included in the emissions inventory under this category is outlined in Table 3-115.

Table 3-115: Commercial business included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
CSR GYPROCK & FIBRE CEMENT	3416	376-394 VICTORIA ST	WETHERILL PARK	2164

The emission sources and associated releases to air from plaster product manufacturing activities are outlined in Table 3-116.

Table 3-116: Emission sources of plaster product manufacturing

Source	Emissions to Air
Boiler (natural gas)	Combustion products
Plaster product manufacturing (gypsum processing plant)	Combustion products
Wind erosion	PM

The location of the commercial plaster product manufacturing business is shown in Figure 3-41.

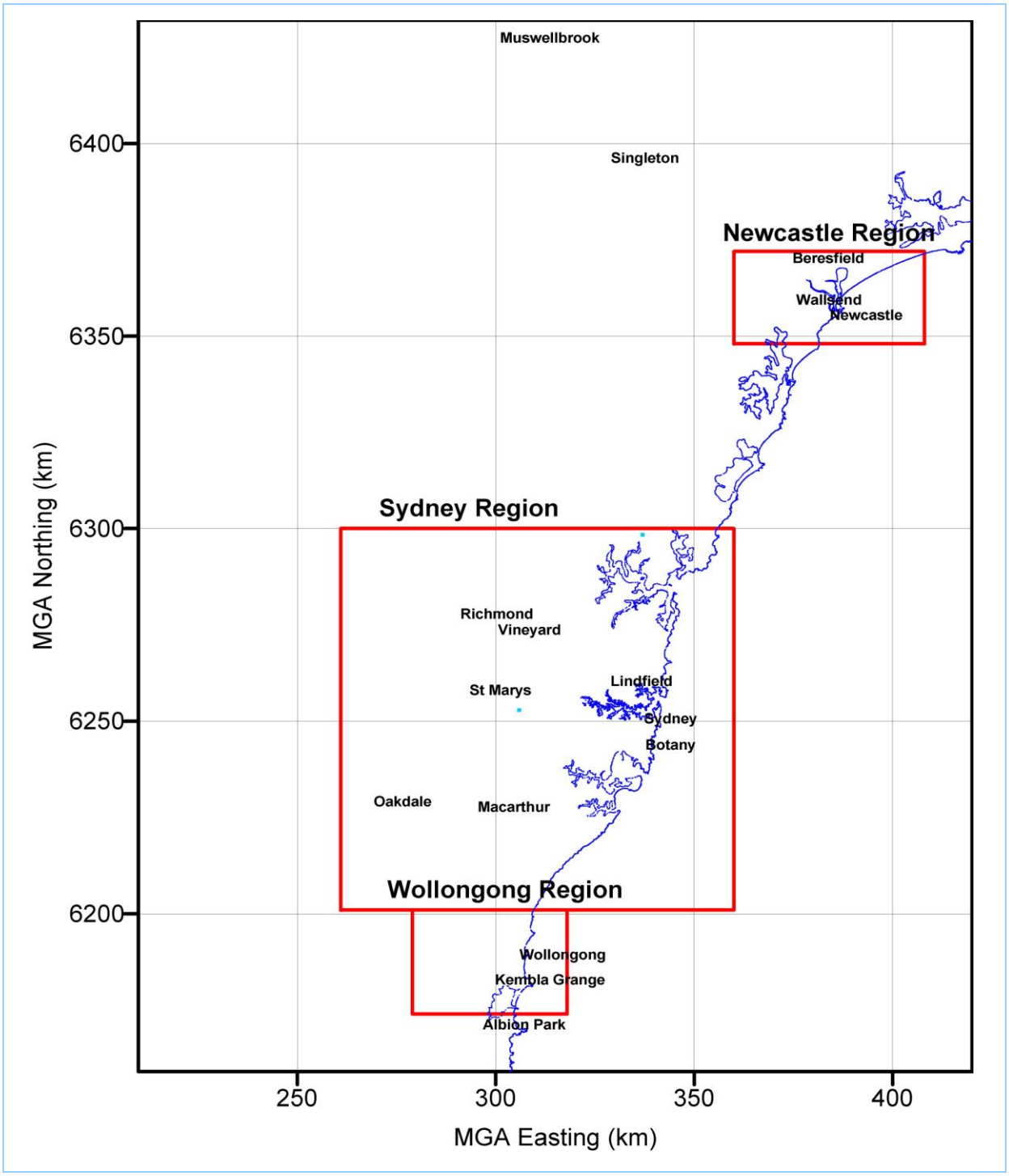

Figure 3-41: Plaster product manufacturers within the GMR

3.18.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from plaster product manufacturing businesses are provided in Table 3-117.

Table 3-117: Emission and speciation factors for all substances from plaster product manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Plaster product manufacturing (gypsum processing plant)	NPI EET Manual for Plasterboard and Plaster Manufacturing v1.2 (DEH, 2004b)
$PM_{2.5}$, PM_{10} & TSP	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Plaster product manufacturing (gypsum processing plant)	NPI EET Manual for Plasterboard and Plaster Manufacturing v1.2 (DEH, 2004b)
	Wind erosion	NPI EET Manual for Mining v2.3 (EA, 2003b)
Speciated organics (including methane)	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Plaster product manufacturing (gypsum processing plant)	
Speciated particulate matter	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Plaster product manufacturing (gypsum processing plant)	NPI EET Manual for Plasterboard and Plaster Manufacturing v1.2 (DEH, 2004b)
Ammonia	Boiler (natural gas)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources – Draft Final Report (Pechan, 2004)
	Plaster product manufacturing (gypsum processing plant)	NPI EET Manual for Plasterboard and Plaster Manufacturing v1.2 (DEH, 2004b)
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Plaster product manufacturing (gypsum processing plant)	NPI EET Manual for Plasterboard and Plaster Manufacturing v1.2 (DEH, 2004b)
PCDD/PCDF	Boiler (natural gas)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
	Plaster product manufacturing (gypsum processing plant)	NPI EET Manual for Plasterboard and Plaster Manufacturing v1.1 (EA, 2002b)
Greenhouse gases (CO_2 and N_2O)	Boiler (natural gas)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)
	Plaster product manufacturing (gypsum processing plant)	

3.18.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaire from one business for the 2003 air emissions inventory has been used to estimate emissions for the 2008 calendar year. No emission estimates have been performed for non-respondent businesses as there are no relevant sources of estimation data available in the public arena.

The number of respondent businesses is provided in Table 3-118.

Table 3-118: Number of plaster product manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Plaster product manufacturing	2	1	0

3.18.4 Temporal Variation of Emissions

Data provided in the returned commercial survey questionnaire have been used to estimate temporal variation of emissions. Monthly variations have been accounted for if data have been provided. It has been assumed that emissions remain constant throughout the operating hours of the business.

3.18.5 Emission Estimates

Estimated emissions from plaster product manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-119.

Table 3-119: Estimated emissions from plaster product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	229	0	0	0	229
CARBON MONOXIDE	138,000	0	0	0	138,000
FORMALDEHYDE	1,150	0	0	0	1,150
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	12.6	0	0	0	12.6
OXIDES OF NITROGEN	37,300	0	0	0	37,300
PARTICULATE MATTER ≤ 10 µm	13,600	0	0	0	13,600
PARTICULATE MATTER ≤ 2.5 µm	7,810	0	0	0	7,810
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	10.2	0	0	0	10.2
SULFUR DIOXIDE	3,400	0	0	0	3,400
TOLUENE	114	0	0	0	114
TOTAL SUSPENDED PARTICULATE	16,100	0	0	0	16,100
TOTAL VOLATILE ORGANIC COMPOUNDS	3,410	0	0	0	3,410
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.18.6 Emission Projection Methodology

Projection factors for plaster product manufacturing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

3.19 Glass and Glass Product Manufacturing

3.19.1 Emission Sources and Associated Releases to Air

Glass and glass product manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of six commercial glass and glass product manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-120.

Table 3-120: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
OGISHI CRAFT CENTRE	3394	LOT 2 DP 842313 BRANXTON RD	ROTHBURY	2320
CSR BRADFORD INSULATION	3395	55 STENNETT ROAD	INGLEBURN	2565
PILKINGTON (AUSTRALIA) LIMITED	7047	133-145 NEWTON ROAD	WETHERILL PARK	2164

The emission sources and associated releases to air from glass and glass product manufacturing are outlined in Table 3-121.

Table 3-121: Glass product manufacturing – emission sources

Source	Emissions to Air
Boiler (LPG)	Combustion products
Boiler (natural gas)	Combustion products
Glass production (melting furnace (container))	Combustion products
Glass production (pressed and blown)	Combustion products

The locations of commercial glass and glass product manufacturing businesses are shown in Figure 3-42.

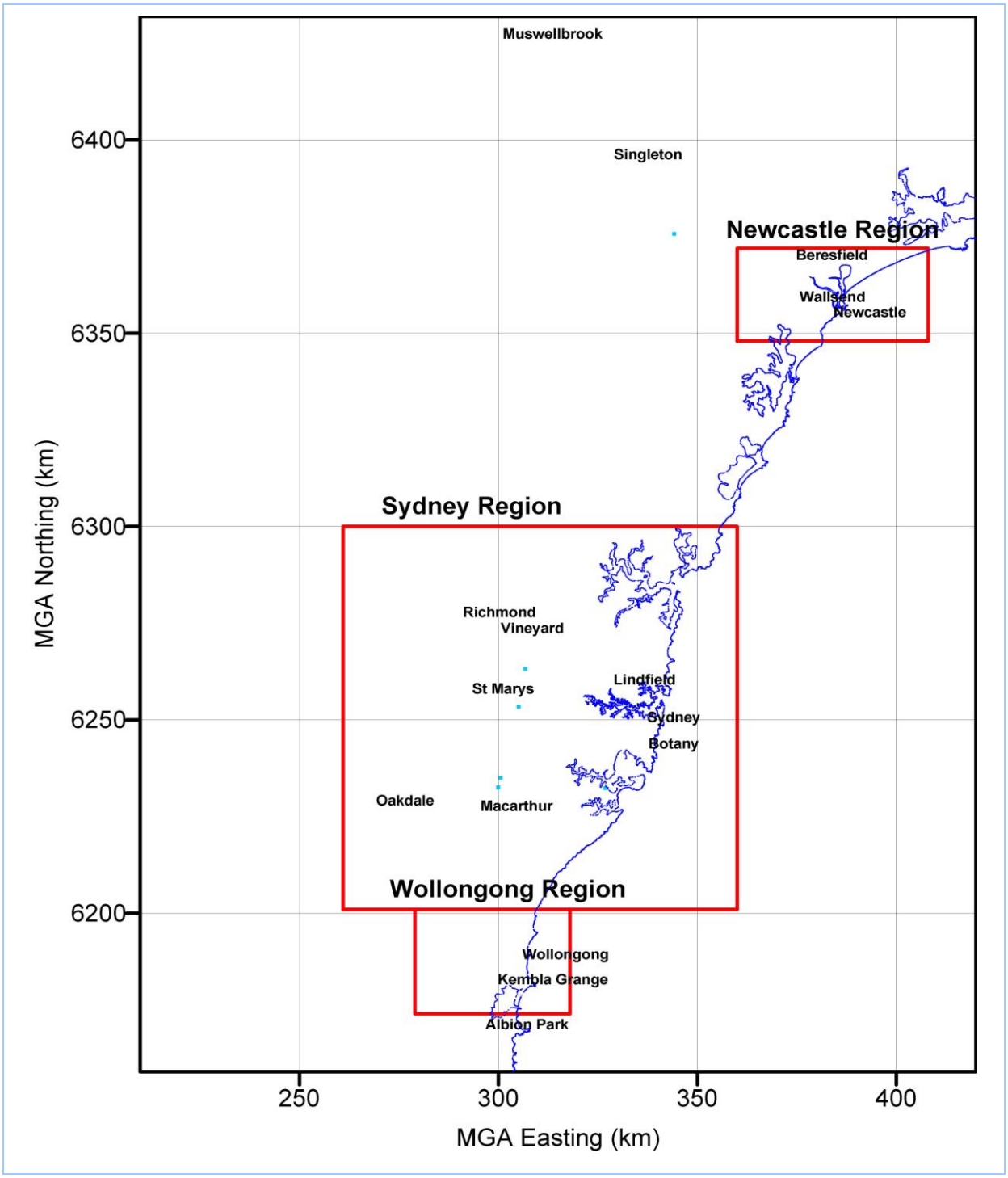

Figure 3-42: Glass and glass product manufacturers within the GMR

3.19.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from glass product manufacturing businesses are provided in Table 3-117.

Table 3-122: Emission and speciation factors for all substances from glass and glass product manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Glass production (melting furnace (container))	AP42 Chapter 11.15 Glass Manufacturing (USEPA, 1986a)
	Glass production (pressed and blown)	
$PM_{2.5}$, PM_{10} & TSP	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Glass production (melting furnace (container))	AP42 Chapter 11.15 Glass Manufacturing (USEPA, 1986a)
	Glass production (pressed and blown)	
Speciated organics (including methane)	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Glass production (melting furnace (container))	SPECIATEv4.2 (Profile ID=9011) (USEPA, 2008c)
	Glass production (pressed and blown)	
Speciated particulate matter	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Glass production (melting furnace (container))	NPI EET Manual for Glass and Glass Fibre Manufacturing (DEH, 2004a)
	Glass production (pressed and blown)	
Ammonia	Boiler (LPG)	Estimating Ammonia Emissions from Anthropogenic Non-agricultural Sources - Draft Final Report (Pechan, 2004)
	Boiler (natural gas)	
Sulfuric or hydrochloric acid	NA	NA
PAH	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
PCDD/PCDF	Boiler (LPG)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
	Boiler (natural gas)	
	Glass production (melting furnace (container))	
	Glass production (pressed and blown)	
Greenhouse gases (CO_2 and N_2O)	Boiler (LPG)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009) and mass balance
	Boiler (natural gas)	
	Glass production (melting furnace (container))	
	Glass production (pressed and blown)	

3.19.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaire from two businesses for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. One non-respondent business that reported emissions to the NPI but did not respond to the commercial survey has also been included in the emissions inventory. The number of respondent businesses is provided in Table 3-123.

Table 3-123: Number of glass and glass product manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Glass & glass product manufacturing	6	2	1

No emission estimates have been performed for non-respondent businesses that do not report to the NPI as there are no relevant sources of estimation data available in the public arena.

3.19.4 Temporal Variation of Emissions

Data provided in the returned commercial survey questionnaire have been used to estimate temporal variation of emissions. Monthly variations have been accounted for where data has been provided. The business with emissions estimated using reported NPI emissions has been assumed to operate 24 hours a day. It has been assumed that emissions remain constant throughout the operating hours of the business.

3.19.5 Emission Estimates

Estimated emissions from glass and glass product manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-124.

Table 3-124: Estimated emissions from glass and glass product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	104	0	0	0.196	104
CARBON MONOXIDE	3,710	0	0	4.42	3,720
FORMALDEHYDE	65.9	0	0	0.382	66.3
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	151	0	0	0.0121	151
OXIDES OF NITROGEN	3,880	0	0	35.6	3,920
PARTICULATE MATTER ≤ 10 µm	8,400	0	0	8.95	8,410
PARTICULATE MATTER ≤ 2.5 µm	8,250	0	0	1.96	8,260
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00746	0	0	0.000134	0.00759
SULFUR DIOXIDE	174	0	0	2.8	176
TOLUENE	29.5	0	0	0.0963	29.6

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TOTAL SUSPENDED PARTICULATE	8,570	0	0	9.14	8,580
TOTAL VOLATILE ORGANIC COMPOUNDS	2,860	0	0	0.956	2,860
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.19.6 *Emission Projection Methodology*

Projection factors for glass and glass product manufacturing have been derived based on final energy consumption projections for non-metallic minerals in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-83 and illustrated in Figure 3-31.

3.20 Paint Manufacturing

3.20.1 *Emission Sources and Associated Releases to Air*

Commercial paint manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of 24 commercial paint manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-125.

Table 3-125: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
ROBERTSON'S PAINTS	2964	6 CHRISTIE ST & POWER ST	ST MARYS	2760
LACNAM PAINTS AUST	2970	78-80 MANDOON RD	GIRRAWEEN	2145
BARLOWORLD COATINGS (AUST) PTY LTD	2971	11-13 POWERS RD	SEVEN HILLS	2147
AUSTRALIAN PRINTERS SUPPLIES PTY LTD	2972	77 GOVERNOR MACQUARIE DR	CHIPPING NORTON	2170
AMERON COATINGS	2985	183 PROSPECT HIGHWAY	SEVEN HILLS	2147
HANNAH ZEV HOLDINGS PTY LIMITED	7073	44 ORCHARD ROAD	BROOKVALE	2100

The emission sources and associated releases to air from commercial paint manufacturing are outlined in Table 3-126.

Table 3-126: Paint manufacturing – emission sources

Source	Emissions to Air
Direct entry - PM measurement	PM
Direct entry - VOC measurement	VOC
Fuel storage (diesel)	VOC
Fuel storage (jet fuel)	VOC
Fuel storage (light fuel oil)	VOC
Paint production (paint grinding & mixing)	PM, VOC
Paint production (varnish grinding & mixing)	VOC
Printing ink manufacturing	PM, VOC
Surface coating (enamel)	VOC
Surface coating (paint - solvent based)	VOC
Wheel generated dust (paved roads)	PM
Wheel generated dust (unpaved roads)	PM

The locations of commercial paint manufacturing businesses are shown in Figure 3-43.

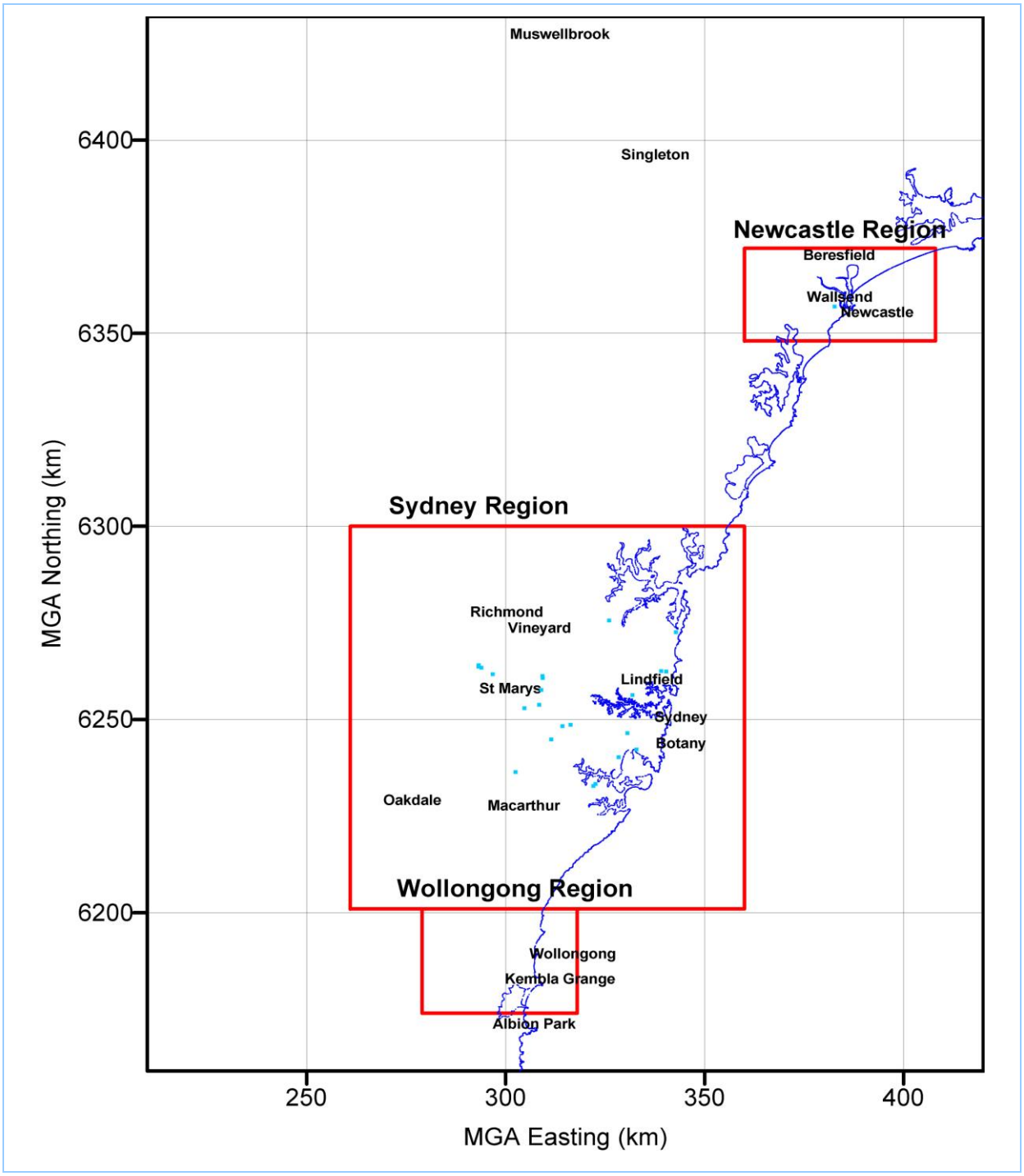

Figure 3-43: Paint manufacturers within the GMR

3.20.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from paint manufacturing businesses are provided in Table 3-127.

Table 3-127: Emission and speciation factors for all substances from paint manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Direct entry - VOC measurement	Site specific emission estimates
	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
	Fuel storage (jet fuel)	
	Fuel storage (light fuel oil)	
	Paint production (paint grinding & mixing)	AP42 Chapter 6.4 Paint and Varnish (USEPA, 1983)
	Paint production (varnish grinding & mixing)	
	Printing ink manufacturing	
	Surface coating (enamel)	VOCs from Surface Coatings Final Report (ENVIRON, 2009)
	Surface coating (paint - solvent based)	
$PM_{2.5}$, PM_{10} & TSP	Direct entry - PM measurement	Site specific emission estimates
	Paint production (paint grinding & mixing)	AP42 Chapter 6.4 Paint and Varnish (USEPA, 1983)
	Printing ink manufacturing	
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
	Wheel generated dust (unpaved roads)	AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006c)
Speciated organics (including methane)	Direct entry - VOC measurement	Site specific emission estimates
	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001)
	Fuel storage (jet fuel)	SPECIATEv4.2 (Profile ID=0100) (USEPA, 2008c)
	Fuel storage (light fuel oil)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001b)
	Paint production (paint grinding & mixing)	SPECIATEv4.2 (Profile ID=1094) (USEPA, 2008c)
	Paint production (varnish grinding & mixing)	
	Printing ink manufacturing	
	Surface coating (enamel)	SPECIATEv4.2 (Profile ID=1018) (USEPA, 2008c)
	Surface coating (paint - solvent based)	SPECIATEv4.2 (Profile ID=1003) (USEPA, 2008c)
Speciated particulate matter	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
	Wheel generated dust (unpaved roads)	California Emissions Inventory and Reporting System - Unpaved Road Dust, 1997 (CARB, 2007)
Ammonia	NA	NA
Sulfuric or hydrochloric acid	NA	NA
PAH	NA	NA
PCDD/PCDF	NA	NA
Greenhouse gases (CO_2 and N_2O)	NA	NA

3.20.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaire from six businesses for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. The number of respondent businesses is provided in Table 3-123.

Table 3-128: Number of paint manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Paint manufacturing	24	6	0

No emission estimates have been performed for non-respondent businesses as there are no relevant sources of estimation data available in the public arena.

3.20.4 Temporal Variation of Emissions

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions. Monthly variations have been accounted for if data have been provided. It has been assumed that emissions remain constant throughout the operating hours of the business.

3.20.5 Emission Estimates

Estimated emissions from commercial paint manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-129.

Table 3-129: Estimated emissions from paint manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	4,490	0	0	0	4,490
LEAD & COMPOUNDS	138	0	0	0	138
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	29,300	0	0	0	29,300
PARTICULATE MATTER ≤ 2.5 µm	28,300	0	0	0	28,300
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	41,000	0	0	0	41,000
TOTAL SUSPENDED PARTICULATE	34,300	0	0	0	34,300
TOTAL VOLATILE ORGANIC COMPOUNDS	124,000	0	0	0	124,000
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

3.20.6 Emission Projection Methodology

Projection factors for paint manufacturing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

3.21 Steel Pipe and Tube Manufacturing

3.21.1 Emission Sources and Associated Releases to Air

Commercial steel pipe and tube manufacturing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of seven commercial steel pipe and tube manufacturing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-130.

Table 3-130: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
ONESTEEL TRADING PTY LIMITED	3586	WEST DAPTO RD	KEMBLA GRANGE	2526
ROLADUCT SPIRAL TUBING PL	3587	1820-1880 ELIZABETH DRIVE	KEMPS CREEK	2171
AAP DISTRIBUTORS P/L	3591	31 MONRO AVE	SUTHERLAND	2232

The emission sources and associated releases to air from commercial steel pipe and tube manufacturing are outlined in Table 3-131.

Table 3-131: Steel pipe and tube manufacturing – emission sources

Source	Emissions to Air
Metal cutting (mild steel, 8 mm)	NO_x, magnesium oxide fume
Steel production (furnace, electric induction)	PM, PCDD/F
Wastewater treatment	VOC, ammonia
Welding	PM
Wheel generated dust (paved roads)	PM
Wheel generated dust (unpaved roads)	PM

The locations of commercial steel pipe and tube manufacturing businesses are shown in Figure 3-44.

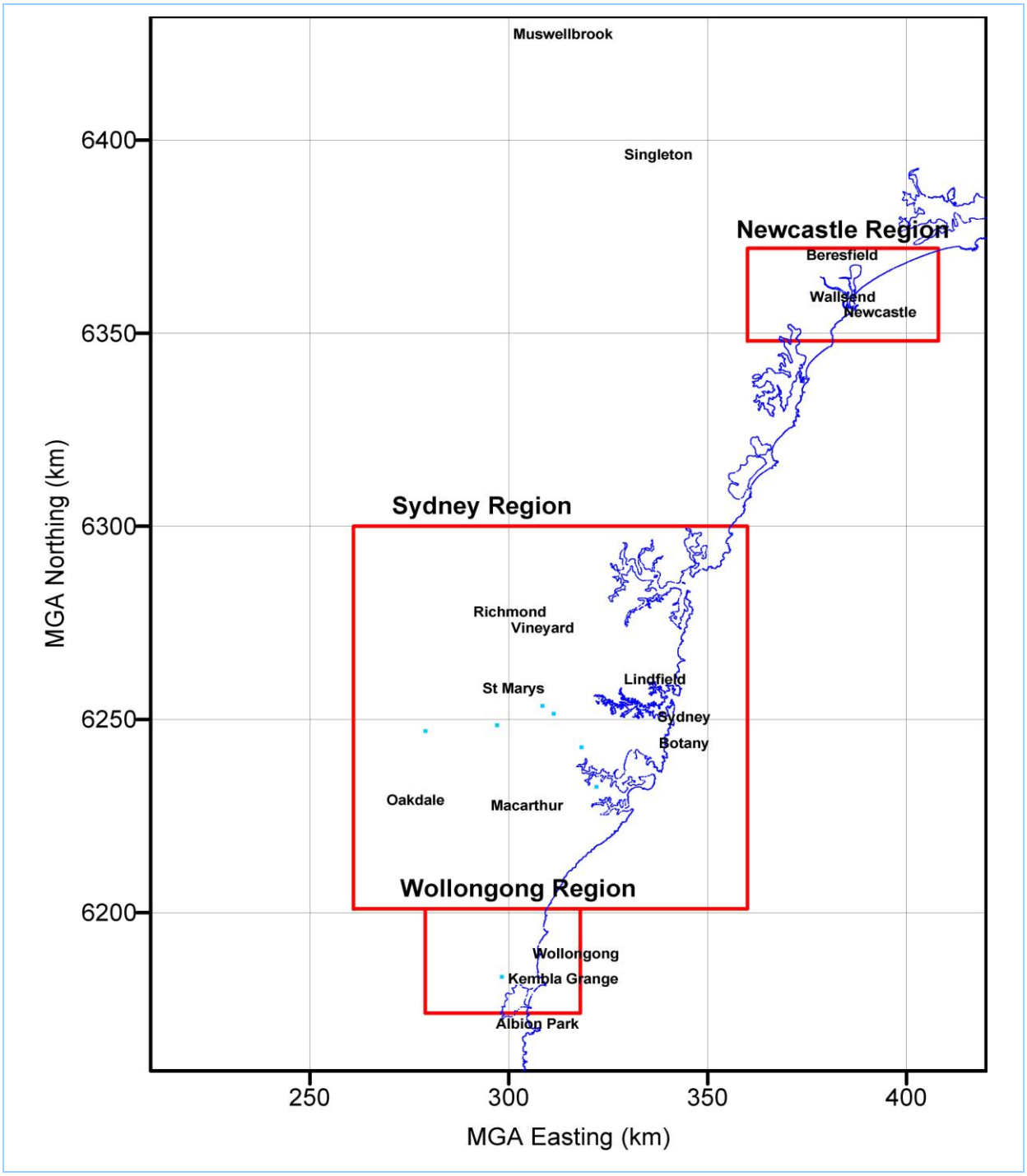

Figure 3-44: Steel pipe and tube manufacturers within the GMR

3.21.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from steel pipe and tube manufacturing businesses are provided in Table 3-132.

Table 3-132: Emission and speciation factors for all substances from steel pipe and tube manufacturing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Metal cutting (mild steel, 8 mm)	NPI EET Manual for Structural and Fabricated Metal Product Manufacture (EA, 1999i)
	Wastewater treatment	NGGIC Workbook for Waste (NGGIC, 1996)
$PM_{2.5}$, PM_{10} & TSP	Steel production (furnace, electric induction)	AP42 Chapter 12.5 Iron and Steel Production (USEPA, 1986b)
	Welding	NPI EET Manual for Fugitive Emissions (assuming manual metal arc welding and electrode type 14Mn-4Cr) (EA, 1999f)
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
	Wheel generated dust (unpaved roads)	AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006c)
Speciated organics (including methane)	Wastewater treatment	CEIDARS Organic Gas Speciation Profiles (Profile ID=9016) (assuming that unidentified portion is methane) (CARB, 2005)
Speciated particulate matter	Wheel generated dust – paved roads	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
	Wheel generated dust – unpaved roads	California Emissions Inventory and Reporting System - Unpaved Road Dust, 1997 (CARB, 2007)
Ammonia	Wastewater treatment	Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report (Pechan, 2004)
Sulfuric or hydrochloric acid	NA	NA
PAH	NA	NA
PCDD/PCDF	Steel production (furnace, electric induction)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
Greenhouse gases (CO_2 and N_2O)	NA	NA

3.21.3 Activity Data

Site specific data supplied in the returned commercial survey questionnaire from six businesses for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. No emission estimates have been performed for non-respondent businesses as there are no relevant sources of estimation data available in the public arena.

The number of respondent businesses is provided in Table 3-133.

Table 3-133: Number of iron and steel manufacturing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Steel pipe and tube manufacturing	7	3	0

3.21.4 Temporal Variation of Emissions

Data provided in returned commercial survey questionnaires have been used to estimate temporal variation of emissions. Monthly variations have been accounted for if data has been provided. It has been assumed that emissions remain constant throughout the operating hours of the business.

3.21.5 Emission Estimates

Estimated emissions from commercial steel pipe and tube manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-134.

Table 3-134: Estimated emissions from steel pipe and tube manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0.0286	0	0	0	0.0286
ISOMERS OF XYLENE	0.171	0	0	0	0.171
LEAD & COMPOUNDS	0.115	0	0	0	0.115
OXIDES OF NITROGEN	744	0	0	0	744
PARTICULATE MATTER ≤ 10 µm	1,270	0	3,510	0	4,780
PARTICULATE MATTER ≤ 2.5 µm	1,050	0	3,510	0	4,560
PERCHLOROETHYLENE	0.2	0	0	0	0.2
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0.114	0	0	0	0.114
TOTAL SUSPENDED PARTICULATE	1,910	0	3,900	0	5,810
TOTAL VOLATILE ORGANIC COMPOUNDS	1.23	0	0	0	1.23
TRICHLOROETHYLENE	0.0286	0	0	0	0.0286

[a] Totals may not appear additive due to rounding

3.21.6 Emission Projection Methodology

Projection factors for steel pipe and tube manufacturing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

3.22 Metal Coating and Finishing

3.22.1 Emission Sources and Associated Releases to Air

Commercial metal coating and finishing businesses have been identified using the NSW WorkCover database for hazardous materials and the telephone directory for NSW. A total of 111 commercial metal coating and finishing businesses have been identified from these sources to be within the GMR.

Commercial businesses within the GMR that are included in the emissions inventory under this category are outlined in Table 3-135.

Table 3-135: Commercial businesses included in the emissions inventory

Business	Business ID	Business Street	Business Suburb	Business Post Code
N/A	3630	LYTTON RD & LACKEY RD	MOSS VALE	2577
THE BRONZING STUDIO	3644	UNIT 40 / 5 ANELLA AVENUE	CASTLE HILL	2154
GOWS HEAT TREATMENT P/L	3646	18 DAISY ST	REVESBY	2212
URETHANE COATINGS P/L	3658	10 POWELLS RD	BROOKVALE	2100
SANKEY AUSTRALIA P/L	3663	INGALL ST	MAYFIELD	2304
A-1 HARD CHROME PTY LTD	3665	14 WETHERILL ST	LIDCOMBE	2141
BLU-CHROME PTY LTD	3676	137 ELDRIDGE RD	BANKSTOWN	2200
CAPRAL ALUMINIUM MILPERRA	3680	61 ASHFORD AVENUE	MILPERRA	2214
CHROME FACTORY	3687	64 WOODFIELD BLV	CARINGBAH	2229
DIAMOND HARD CHROME PTY LTD	3691	27 COSGROVE RD	ENFIELD	2136
GONINAN PLATERS	3702	2 GEORGETOWN RD	GEORGETOWN	2298
GONINAN PLATERS PTY LTD	3703	7 COORABAN RD	MILPERRA	2214
HUNTER GALVANIZING PTY LTD	3705	13 OLD PUNT RD	TOMAGO	2322
INDUSTRIAL GALVANIZERS	3709	312 PACIFIC HWY	HEXHAM	2322
INDUSTRIAL HARDCHROME PTY LTD	3712	41 EGERTON ST	SILVERWATER	2128
RACK ZINC PLATING PTY LTD	3720	113 WOODPARK RD	SMITHFIELD	2164
ROLL SURFACE TECHNOLOGIES PTY LIMITED	3723	SPRINGHILL RD	WOLLONGONG	2500
SEC PLATING PTY LTD	3724	105 LAKEMBA ST	BELMORE	2192
SWIFT ELECTROPLATERS	3732	53 VORE ST	SILVERWATER	2128
SYDNEY GALVANIZING PTY LTD	3733	2/12 ASH RD	PRESTONS	2170
ANZPAC SERVICES	7031	32 BRITTON STREET	SMITHFIELD	2164
VULKAN INDUSTRIES	7040	3 GARNET STREET	ROCKDALE	2216
DIAMOND HARD CHROME PTY LTD	7046	27 COSGROVE ROAD	ENFIELD	2136
A1 HARD CHROME	7052	14 WETHERILL STREET	LIDCOMBE	2141
INDUSTRIAL & DECORATIVE GOLD PLATING	7062	79-81 MARS ROAD	LANE COVE	2066
ALEXANDRIA PLATING PTY LTD	7063	74 PRINCESS AVE	ROSEBERRY	2018
REGENTS PARK ELECTROPLATING PTY LTD	7076	41 CARLINGFORD STREET	REGENTS PARK	2143
BLU-CHROME PTY LIMITED	7077	137 ELDRIDGE ROAD	BANKSTOWN	2200
R.E. BATGER PTY LTD	7078	200 RAILWAY TERRACE	GUILDFORD	2161
APPAREL FITTINGS AUSTRALASIA PTY LTD	7087	67 JOHN STREET	LEICHHARDT	2040
EATON ELECTRIC SYSTEMS PTY LTD	7092	10 KENT ROAD	MASCOT	2020

Business	Business ID	Business Street	Business Suburb	Business Post Code
ALL PAINT POWDER COATERS	7095	131 ELDRIDGE ROAD	CONDELL PARK	2200
LACHLAN ELECTROPLATERS AND DIECASTERS	7098	39-41 FITZPATRICK STREET	REVESBY	2212
ASTOR BASE METALS	7106	512 PUNCHBOWL ROAD	LAKEMBA	2195
PIONEER PLATING	7107	1 MITCHELL ROAD	MOOREBANK	2170

The emission sources and associated releases to air from metal coating and finishing are outlined in Table 3-136.

Table 3-136: Metal coating and finishing – emission sources

Source	Emissions to Air
Acid storage (hydrochloric)	Hydrochloric acid
Acid storage (sulfuric)	Sulfuric acid
Boiler (LPG)	Combustion products
Boiler (natural gas)	Combustion products
Chromic acid anodising	PM
Electroplating (copper sulphate)	PM
Electroplating (hard chromium)	PM
Fuel storage (diesel)	VOC
Fuel storage (ethanol)	VOC
Fugitive emissions (VOC)	VOC
Galvanising	PM
Internal combustion engine (natural gas, 4-stroke lean-burn)	Combustion products
Metal cutting (mild steel, 8 mm)	Magnesium oxide fume, NO_x
Steel production (furnace, electric induction)	PM, PCDD/F
Surface coating (enamel)	VOC
Surface coating (lacquer)	VOC
Surface coating (paint - solvent based)	VOC
Surface coating (primer)	VOC
Surface coating (thinner)	VOC
Wastewater treatment	VOC, ammonia
Welding	PM
Wheel generated dust (paved roads)	PM
Wheel generated dust (unpaved roads)	PM
Zinc production (crucible melting furnace, fugitive)	PM
Zinc production (kettle pot melting furnace, fugitive)	PM
Zinc production (kettle pot melting furnace, point)	PM, PCDD/F, SO_2, NO_x

The locations of commercial metal coating and finishing businesses are shown in Figure 3-44.

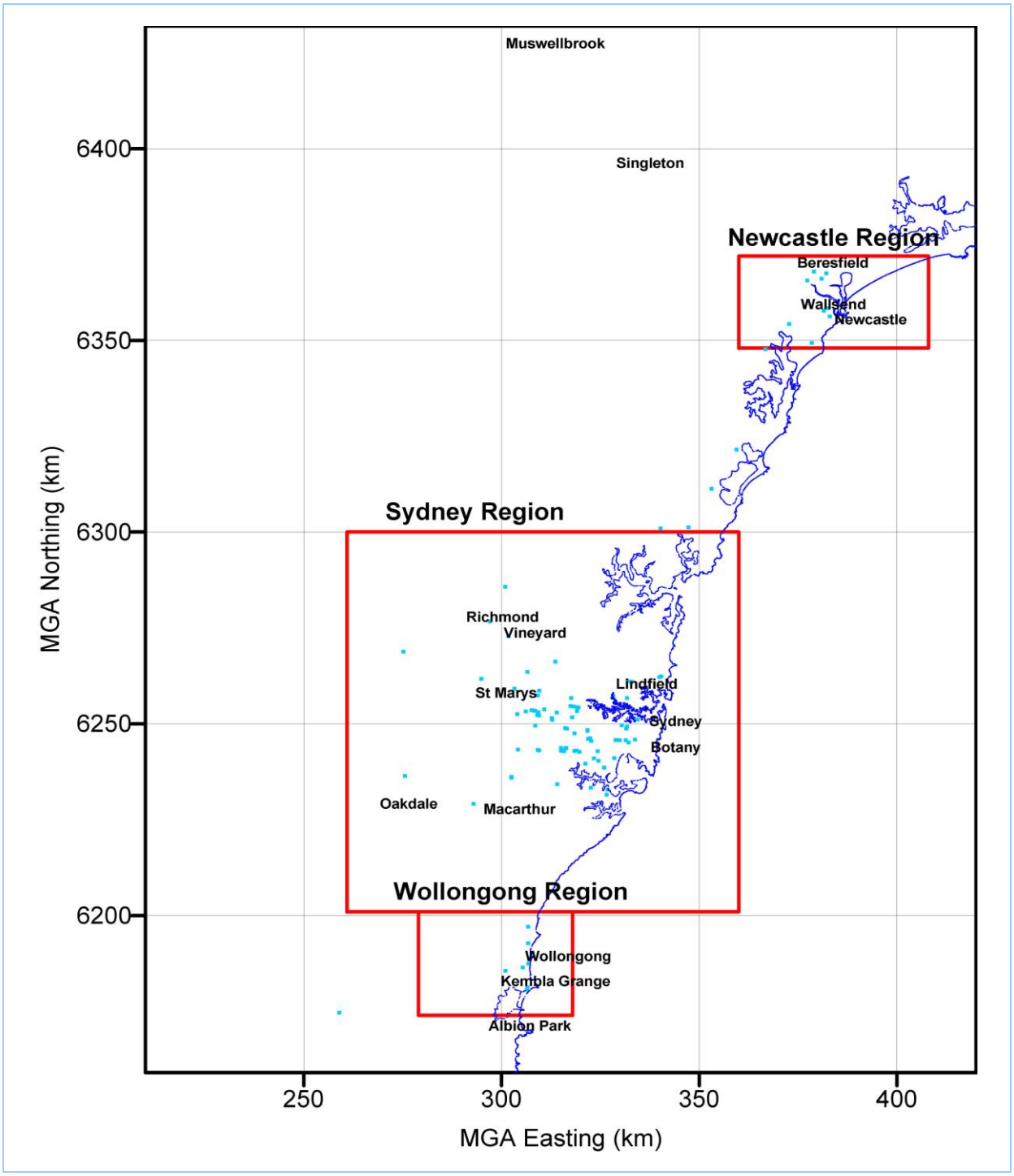

Figure 3-45: Metal coating and finishing businesses within the GMR

3.22.2 Emission Estimation Methodology

Data sources for emission and speciation factors used to estimate emissions from metal coating and finishing businesses are provided in Table 3-137.

Table 3-137: Emission and speciation factors for all substances from metal coating and finishing

Substance	Emission Source	Emission Factor Source
CO, NO_x[1], SO_2 & VOC	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Fuel storage (diesel)	TANKS 4.09D software (USEPA, 2006d)
	Fuel storage (ethanol)	
	Fugitive emissions (VOC)	Site specific emission estimates
	Internal combustion engine (natural gas, 4-stroke lean-burn)	NPI EET Manual for Combustion Engines v3.0 (DEWHA, 2008)
	Metal cutting (mild steel, 8 mm)	NPI EET Manual for Structural and Fabricated Metal Product Manufacture (EA, 1999i)
	Surface coating (enamel)	VOCs from Surface Coatings Final Report (ENVIRON, 2009)
	Surface coating (lacquer)	
	Surface coating (paint - solvent based)	
	Surface coating (primer)	
	Surface coating (thinner)	
	Wastewater treatment	NGGIC Workbook for Waste (NGGIC, 1996)
	Zinc production (kettle pot melting furnace, point)	NPI EET Manual for Non-Ferrous Foundries, v1.0 (EA, 1999h)
$PM_{2.5}$, PM_{10} & TSP	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Chromic acid anodising	AP42 Chapter 12.20 Electroplating (USEPA, 1996c)
	Electroplating (copper sulphate)	
	Electroplating (hard chromium)	
	Galvanising	NPI EET Manual for Galvanising v1.1 (EA, 2001a)
	Internal combustion engine (natural gas, 4-stroke lean-burn)	NPI EET Manual for Combustion Engines v3.0 (DEWHA, 2008)
	Steel production (furnace, electric induction)	AP42 Chapter 12.13 Steel Foundries (USEPA, 1995d)
	Welding	NPI EET Manual for Fugitive Emissions (assuming manual metal arc welding and electrode type 14Mn-4Cr) (EA, 1999f)
	Wheel generated dust (paved roads)	AP42 Chapter 13.2.1 Paved Roads (USEPA, 2011)
	Wheel generated dust (unpaved roads)	AP42 Chapter 13.2.2 Unpaved Roads (USEPA, 2006c)
	Zinc production (crucible melting furnace, fugitive)	NPI EET Manual for Non-Ferrous Foundries, v1.0 (EA, 1999h)
	Zinc production (kettle pot melting furnace, fugitive)	
	Zinc production (kettle pot melting furnace, point)	
Speciated organics (including methane)	Boiler (LPG)	AP42 Chapter 1.5 LPG Combustion (USEPA, 2008a)
	Boiler (natural gas)	SPECIATEv4.2 (Profile ID=0003) (USEPA, 2008c)
	Fuel storage (diesel)	Average diesel vapour concentration from diesel produced at BP refineries around Australia (BP, 2001b)
	Fuel storage (ethanol)	Mass balance (100% ethanol)

Substance	Emission Source	Emission Factor Source
	Fugitive emissions (VOC)	Mass balance
	Internal combustion engine (natural gas, 4-stroke lean-burn)	SPECIATEv4.2 (Profile ID=1001) (USEPA, 2008c)
	Surface coating (enamel)	SPECIATEv4.2 (Profile ID=1018) (USEPA, 2008c)
	Surface coating (lacquer)	SPECIATEv4.2 (Profile ID=1017) (USEPA, 2008c)
	Surface coating (paint - solvent based)	SPECIATEv4.2 (Profile ID=1003) (USEPA, 2008c)
	Surface coating (primer)	SPECIATEv4.2 (Profile ID=1019) (USEPA, 2008c)
	Surface coating (thinner)	SPECIATEv4.2 (Profile ID=1016) (USEPA, 2008c)
	Wastewater treatment	CEIDARS Organic Gas Speciation Profiles (Profile ID=1402) (assuming that unidentified portion is methane) (CARB, 2005)
Speciated particulate matter	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP42 Chapter 1.4 Natural Gas Combustion (USEPA, 1998b)
	Chromic acid anodising	AP42 Chapter 12.20 Electroplating (USEPA, 1996c)
	Electroplating (copper sulphate)	
	Electroplating (hard chromium)	
	Galvanising	NPI EET Manual for Galvanising v1.1 (EA, 2001a)
	Internal combustion engine (natural gas, 4-stroke lean-burn)	CEIDARS PM Profile 123 for speciated metals (CARB, 2007)
	Welding	NPI EET Manual for Fugitive Emissions (assuming manual metal arc welding and electrode type 14Mn-4Cr) (EA, 1999f)
	Wheel generated dust (paved roads)	California Emissions Inventory and Reporting System - Paved Road Dust, 1997 (CARB, 2007)
	Wheel generated dust (unpaved roads)	California Emissions Inventory and Reporting System - Unpaved Road Dust, 1997 (CARB, 2007)
Ammonia	Boiler (LPG)	Estimating Ammonia Emissions from Anthropogenic Nonagricultural Sources - Draft Final Report (Pechan, 2004)
	Boiler (natural gas)	
	Internal combustion engine (natural gas, 4-stroke lean-burn)	
	Wastewater treatment	
Sulfuric or hydrochloric acid	Acid storage (hydrochloric)	Raoult's law (Raoult, M, 1882a; 1882b, 1887a; 1887b), using chemical properties from Perry and Green (1997)
	Acid storage (sulfuric)	
PAH	Boiler (LPG)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b) (assuming the same emissions per joule combusted as natural gas)
	Boiler (natural gas)	AP-42 Chapter 1.4, Natural Gas Combustion (USEPA, 1998b)
	Internal combustion engine (natural gas, 4-stroke lean-burn)	AP-42 Chapter 3.2, Natural Gas-fired Reciprocating Engines (USEPA, 2000)
PCDD/PCDF	Boiler (LPG)	Technical Report Number 3, Inventory of Dioxin Emissions in Australia, 2004 (Bawden et al, 2004)
	Boiler (natural gas)	

Substance	Emission Source	Emission Factor Source
	Steel production (furnace, electric induction)	
	Zinc production (kettle pot melting furnace, point)	
Greenhouse gases (CO_2 and N_2O)	Boiler (LPG)	National Greenhouse Accounts (NGA) Factors June 2009, (DCC, 2009)
	Boiler (natural gas)	
	Internal combustion engine (natural gas, 4-stroke lean-burn)	

3.22.3 *Activity Data*

Site specific data supplied in the returned commercial survey questionnaire from 34 businesses for the 2003 air emissions inventory have been used to estimate emissions for the 2008 calendar year. One non-respondent business that reported emissions to the NPI but did not respond to the commercial survey has also been included in the emissions inventory. The number of respondent businesses is provided in Table 3-123.

Table 3-138: Number of metal coating and finishing businesses in the GMR

ANZSIC Class	Number of Businesses Identified	Number of Businesses Responded	Number of Non-Respondent NPI Businesses
Metal coating and finishing	111	34	1

No emission estimates have been performed for non-respondent businesses that do not report to the NPI as there are no relevant sources of estimation data available in the public arena.

3.22.4 *Temporal Variation of Emissions*

Data provided in the returned commercial survey questionnaire have been used to estimate temporal variation of emissions. Monthly variations have been accounted for where data has been provided. The business with emissions estimated using reported NPI emissions has been assumed to operate 24 hours a day. It has been assumed that emissions remain constant throughout the operating hours of the business.

3.22.5 *Emission Estimates*

Estimated emissions from commercial metal coating and finishing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-139.

Table 3-139: Estimated emissions from metal coating and finishing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	16.1	14.6	0	0	30.7
CARBON MONOXIDE	2,700	2,460	0	0	5,160
FORMALDEHYDE	53.6	29.3	0	0	82.9
ISOMERS OF XYLENE	1,670	77.8	0	0	1,750
LEAD & COMPOUNDS	0.211	1.37	0	0	1.58
OXIDES OF NITROGEN	3,830	28,600	0	0	32,400
PARTICULATE MATTER ≤ 10 µm	9,850	4,790	0	0	14,600
PARTICULATE MATTER ≤ 2.5 µm	9,280	3,190	0	0	12,500
PERCHLOROETHYLENE	150	0.00488	0	0	150
POLYCYCLIC AROMATIC HYDROCARBONS	0.0221	0.0201	0	0	0.0422
SULFUR DIOXIDE	16.8	15.3	0	0	32.1
TOLUENE	7,190	94.2	0	0	7,280
TOTAL SUSPENDED PARTICULATE	11,300	13,700	0	0	25,000
TOTAL VOLATILE ORGANIC COMPOUNDS	20,900	590	0	0	21,500
TRICHLOROETHYLENE	21.4	0.000697	0	0	21.4

[a] Totals may not appear additive due to rounding

3.22.6 Emission Projection Methodology

Projection factors for metal coating and finishing have been derived based on final energy consumption projections for other (manufacturing) industry in NSW published by ABARE (ABARE, 2006).

Derived projection factors are provided in Table 3-75 and illustrated in Figure 3-28.

3.23 Other ANZSIC Classes

3.23.1 Emission Sources and Associated Releases to Air

Businesses were identified using the following sources (DECC, 2007):

- NSW WorkCover database for hazardous materials; and
- NSW telephone directory.

Summary statistics for each ANZSIC Class included in this section are presented in Table 3-140.

Table 3-140: Summary statistics for commercial businesses included in 'Other ANZSIC' classes

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Agricultural machinery manufacturing	1	1	1	0	1	100%
Aircraft manufacturing	6	6	0	1	1	17%
Aluminium rolling, drawing, extruding	2	0	0	2	2	100%
Architectural aluminium product manufacturing	3	3	0	0	0	0%
Automotive component manufacturing n.e.c.	11	11	4	0	4	36%
Basic non-ferrous metal manufacturing n.e.c.	6	5	3	0	3	50%
Battery manufacturing	4	4	1	0	1	25%
Beer and malt manufacturing	3	0	0	3	3	100%
Biscuit manufacturing	2	2	0	2	2	100%
Cake and pastry manufacturing	2	2	1	0	1	50%
Ceramic product manufacturing n.e.c.	7	7	1	0	1	14%
Ceramic tile and pipe manufacturing	2	2	0	0	0	0%
Chemical wholesaling	30	27	6	0	6	20%
Clay brick manufacturing	4	4	0	0	0	0%
Clothing manufacturing n.e.c.	4	4	0	0	0	0%
Confectionery manufacturing	7	5	4	1	5	71%
Corrugated paperboard container manufacturing	2	1	0	2	2	100%
Dairy product manufacturing n.e.c.	1	1	0	0	0	0%
Electric cable and wire manufacturing	2	2	1	0	1	50%
Electrical and equipment manufacturing n.e.c.	20	20	3	0	3	15%
Electronic equipment manufacturing n.e.c.	4	4	1	0	1	25%
Explosive manufacturing	5	3	0	2	2	40%
Fabricated metal product manufacturing n.e.c.	46	32	22	0	22	48%
Fabricated wood manufacturing	1	1	0	0	0	0%
Fertiliser manufacturing	1	1	0	0	0	0%
Fruit and vegetable processing	3	3	1	0	1	33%

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Furniture manufacturing n.e.c.	38	38	4	0	4	11%
Gas supply	6	6	0	6	6	100%
Ice cream manufacturing	1	1	1	0	1	100%
Industrial gas manufacturing	10	10	2	0	2	20%
Ink manufacturing	7	7	2	0	2	29%
Inorganic industrial chemical manufacturing n.e.c.	2	1	0	1	1	50%
Iron and steel casting and forging	1	1	0	0	0	0%
Leather tanning and fur dressing	2	2	0	0	0	0%
Lifting and material handling equipment manufacturing	1	1	1	0	1	100%
Log sawmilling	1	0	1	0	1	100%
Medicinal and pharmaceutical product manufacturing	15	15	3	0	3	20%
Metal container manufacturing	3	3	0	0	0	0%
Milk and cream processing	1	1	1	0	1	100%
Mining and construction machinery manufacturing	9	9	2	0	2	22%
Non-building construction n.e.c.	13	13	2	0	2	15%
Non-ferrous metal casting	1	1	1	0	1	100%
Non-metallic mineral product manufacturing n.e.c.	1	0	1	0	1	100%
Nursing homes	373	0	0	0	0	0%
Oil and fat manufacturing	1	0	1	0	1	100%
Organic industrial chemical manufacturing n.e.c.	2	1	1	0	1	50%
Paper product manufacturing n.e.c.	5	5	2	1	3	60%
Petroleum product wholesaling	86	80	11	20	31	36%
Plastic bag and film manufacturing	10	10	3	0	3	30%
Plastic injection moulded product manufacturing	155	153	13	1	14	9%
Prepared animal and bird feed manufacturing	4	3	1	2	3	75%
Professional and scientific equipment manufacturing n.e.c.	1	0	0	1	1	100%
Rail transport	1	1	1	0	1	100%
Railway equipment manufacturing	1	0	0	1	1	100%

ANZSIC Class	Number of Businesses Identified [a]	Number of Businesses Surveyed [b]	Number of Businesses Responded [c]	Number of Non-Respondent NPI Businesses [d]	Number of Businesses Included in the Inventory [e]	Percentage of Businesses Included in the Inventory
Road and bridge construction	26	23	9	0	9	35%
Rubber product manufacturing n.e.c.	8	8	6	0	6	75%
Scientific research	1	0	0	1	1	100%
Services to air transport	1	0	1	0	1	100%
Shipbuilding	1	1	0	0	0	0%
Soap and other detergent manufacturing	7	7	2	0	2	29%
Soft drink, cordial and syrup manufacturing	4	3	1	2	3	75%
Solid paperboard container manufacturing	3	3	2	0	2	67%
Spirit manufacturing	3	3	1	1	2	67%
Spring and wire product manufacturing	13	13	5	1	6	46%
Structural metal product manufacturing n.e.c.	4	3	2	1	3	75%
Structural steel fabricating	1	1	1	0	1	100%
Synthetic resin manufacturing	7	3	5	0	5	71%
Transport equipment manufacturing n.e.c.	1	1	0	0	0	0%
Waste disposal services	23	0	23	0	23	100%
Water supply	3	0	0	3	3	100%
Water transport terminals	2	2	0	0	0	0%
Wood product manufacturing n.e.c.	13	13	2	0	2	15%
Wooden furniture and upholstered seat manufacturing	11	11	1	0	1	9%
Wooden structural component manufacturing	14	14	1	0	1	7%
TOTAL	**1,076**	**622**	**165**	**55**	**220**	**20%**

a The number of businesses identified indicates the number of identified businesses operating in 2008.

b The number of businesses surveyed indicates the number of businesses surveyed for the 2003 air emissions inventory and includes facilities that have been 'de-scheduled' between 2003 and 2008 that were moved from the industrial emissions inventory to the commercial emissions inventory

c Indicates the number of businesses that responded to a questionnaire during the 2003 air emissions inventory. This includes businesses that were included in the 2003 industrial air emissions inventory that have been de-scheduled between 2003 and 2008 (and hence moved to from the 2003 industrial air emissions inventory to the 2008 commercial air emissions inventory

d Indicates the number of non-respondent NPI businesses based on NPI data published for the 2007/2008 NPI reporting period.

e Includes the number of businesses that were included in the 2003 commercial air emissions inventory based on either (i) response to the 2003 air emissions inventory questionnaire, (ii) reported air emissions to the NPI based on the 2007/2008 NPI reporting period; or (iii) based on a top-down approach detailed in this report (e.g. regional based activity data for the 2008 calendar year was used to estimate activity data for each commercial business).

f Construction material mining includes ANZSIC classes 'Gravel and Sand Quarrying' and 'Construction Material Mining n.e.c.'.

The locations of all businesses included in "Other ANZSIC Classes" are shown in Figure 3-46.

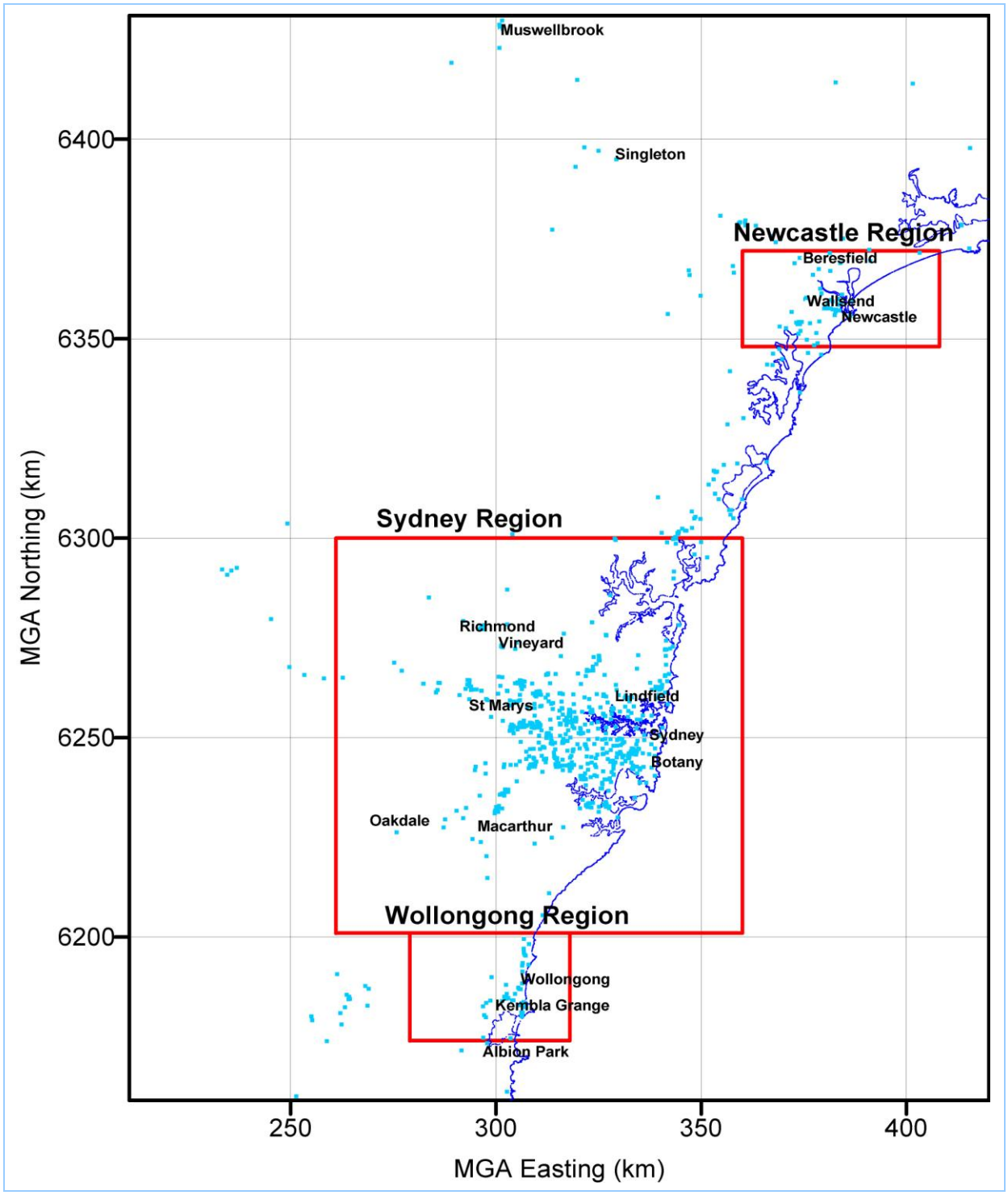

Figure 3-46: Commercial businesses included in "Other ANZSIC Classes" within the GMR

3.23.2 Emission Estimation Methodology

Emissions were estimated by using the broad methodology presented in Section 22.6.77.

3.23.3 Activity Data

Activity data provided in returned commercial survey questionnaires for the 2003 air emissions inventory have been used to estimate emissions from all sources. Businesses that did not respond to the commercial survey questionnaire and that report emissions to the NPI have also been included in the commercial emissions inventory.

3.23.4 Temporal Variation of Emissions

Process emissions have been assumed to vary in direct proportion to the change in production rates over a typical year which was supplied in returned commercial survey questionnaires. Temporal variations of evaporative emissions from fuel tanks have been calculated using the USEPA TANKS program (USEPA, 2006d).

3.23.5 Emission Estimates

Estimated emissions from agricultural machinery manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-141.

Table 3-141: Estimated emissions from agricultural machinery manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0.0208	0	0	0	0.0208
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0.00637	0	0	0	0.00637
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	0.23	0	0	0	0.23
TRICHLOROETHYLENE	0	0	0	0	0

[a] Totals may not appear additive due to rounding

Estimated emissions from aircraft manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-142.

Table 3-142: Estimated emissions from aircraft manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	14	0	0	0	14
CARBON MONOXIDE	2,350	0	0	0	2,350
FORMALDEHYDE	28	0	0	0	28
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.014	0	0	0	0.014
OXIDES OF NITROGEN	2,800	0	0	0	2,800
PARTICULATE MATTER ≤ 10 µm	213	0	0	0	213
PARTICULATE MATTER ≤ 2.5 µm	213	0	0	0	213
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0193	0	0	0	0.0193
SULFUR DIOXIDE	14.6	0	0	0	14.6
TOLUENE	7	0	0	0	7
TOTAL SUSPENDED PARTICULATE	213	0	0	0	213
TOTAL VOLATILE ORGANIC COMPOUNDS	154	0	0	0	154
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from aluminium rolling, drawing, extruding businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-143.

Table 3-143: Estimated emissions from aluminium rolling, drawing, extruding

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	1.2	69.3	0	70.5
PARTICULATE MATTER ≤ 2.5 µm	0	1.2	69.3	0	70.5
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	0	0
TOTAL SUSPENDED PARTICULATE	0	1.2	69.3	0	70.5
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	0	0
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from automotive component manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-144.

Table 3-144: Estimated emissions from automotive component manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	1.24	0	0.016	0	1.25
CARBON MONOXIDE	208	0	2.69	0	210
FORMALDEHYDE	2.54	0	0.032	0	2.57
ISOMERS OF XYLENE	768	0	66.7	29.6	864
LEAD & COMPOUNDS	0.149	0	0.000016	0	0.149
OXIDES OF NITROGEN	247	0	3.2	0	251
PARTICULATE MATTER ≤ 10 µm	250	0	0.243	0	250
PARTICULATE MATTER ≤ 2.5 µm	76.8	0	0.243	0	77.1
PERCHLOROETHYLENE	0.445	0	0	0	0.445
POLYCYCLIC AROMATIC HYDROCARBONS	0.0017	0	0.000022	0	0.00172
SULFUR DIOXIDE	1.29	0	0.0167	0	1.31
TOLUENE	3,000	0	309	140	3,450
TOTAL SUSPENDED PARTICULATE	1,210	0	0.243	0	1,210
TOTAL VOLATILE ORGANIC COMPOUNDS	12,700	0	807	429	14,000
TRICHLOROETHYLENE	0.0635	0	0	0	0.0635

[a] Totals may not appear additive due to rounding

Estimated emissions from basic non-ferrous metal manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-145.

Table 3-145: Estimated emissions from basic non-ferrous metal manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	1.24	0	0.016	0	1.25
CARBON MONOXIDE	208	0	2.69	0	210
FORMALDEHYDE	2.54	0	0.032	0	2.57
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.014	0	0	0	0.014
OXIDES OF NITROGEN	2,800	0	0	0	2,800
PARTICULATE MATTER ≤ 10 µm	213	0	0	0	213
PARTICULATE MATTER ≤ 2.5 µm	213	0	0	0	213
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0193	0	0	0	0.0193
SULFUR DIOXIDE	14.6	0	0	0	14.6
TOLUENE	7	0	0	0	7
TOTAL SUSPENDED PARTICULATE	213	0	0	0	213

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TOTAL VOLATILE ORGANIC COMPOUNDS	154	0	0	0	154
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from beer or malt manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-146.

Table 3-146: Estimated emissions from beer or malt manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	153	0	0	0	153
ACETALDEHYDE	192	0	0	0	192
BENZENE	671	0	0	0	671
CARBON MONOXIDE	4,770	0	0	0	4,770
FORMALDEHYDE	410	0	0	0	410
ISOMERS OF XYLENE	545	0	0	0	545
LEAD & COMPOUNDS	0.0284	0	0	0	0.0284
OXIDES OF NITROGEN	5,680	0	0	0	5,680
PARTICULATE MATTER ≤ 10 µm	3,390	0	0	0	3,390
PARTICULATE MATTER ≤ 2.5 µm	3,390	0	0	0	3,390
PERCHLOROETHYLENE	160	0	0	0	160
POLYCYCLIC AROMATIC HYDROCARBONS	0.0391	0	0	0	0.0391
SULFUR DIOXIDE	8,910	0	0	0	8,910
TOLUENE	479	0	0	0	479
TOTAL SUSPENDED PARTICULATE	3,390	0	0	0	3,390
TOTAL VOLATILE ORGANIC COMPOUNDS	21,900	0	0	0	21,900
TRICHLOROETHYLENE	98	0	0	0	98

a Totals may not appear additive due to rounding

Estimated emissions from biscuit manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-147.

Table 3-147: Estimated emissions from biscuit manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	41.3	0	0	0	41.3
CARBON MONOXIDE	6,940	0	0	0	6,940
FORMALDEHYDE	82.6	0	0	0	82.6
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.0413	0	0	0	0.0413
OXIDES OF NITROGEN	8,260	0	0	0	8,260
PARTICULATE MATTER ≤ 10 µm	628	0	0	0	628

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
PARTICULATE MATTER ≤ 2.5 µm	628	0	0	0	628
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0568	0	0	0	0.0568
SULFUR DIOXIDE	43.2	0	0	0	43.2
TOLUENE	20.7	0	0	0	20.7
TOTAL SUSPENDED PARTICULATE	628	0	0	0	628
TOTAL VOLATILE ORGANIC COMPOUNDS	454	0	0	0	454
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from cake and pastry manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-148.

Table 3-148: Estimated emissions from cake and pastry manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	7.96	0	0	0	7.96
CARBON MONOXIDE	1,340	0	0	0	1,340
FORMALDEHYDE	17.6	0	0	0	17.6
ISOMERS OF XYLENE	10.3	0	0	0	10.3
LEAD & COMPOUNDS	0.00796	0	0	0	0.00796
OXIDES OF NITROGEN	1,590	0	0	0	1,590
PARTICULATE MATTER ≤ 10 µm	121	0	0	0	121
PARTICULATE MATTER ≤ 2.5 µm	121	0	0	0	121
PERCHLOROETHYLENE	12	0	0	0	12
POLYCYCLIC AROMATIC HYDROCARBONS	0.0109	0	0	0	0.0109
SULFUR DIOXIDE	8.32	0	0	0	8.32
TOLUENE	10.8	0	0	0	10.8
TOTAL SUSPENDED PARTICULATE	121	0	0	0	121
TOTAL VOLATILE ORGANIC COMPOUNDS	12,200	0	0	0	12,200
TRICHLOROETHYLENE	1.71	0	0	0	1.71

a Totals may not appear additive due to rounding

Estimated emissions from ceramic product manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-149.

Table 3-149: Estimated emissions from ceramic product manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0.21	0	0	0.21
CARBON MONOXIDE	0	4.8	0	0	4.8
FORMALDEHYDE	0	0.421	0	0	0.421
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0	0.000107	0	0	0.000107
OXIDES OF NITROGEN	0	34.8	0	0	34.8
PARTICULATE MATTER ≤ 10 µm	0	1.08	0	0	1.08
PARTICULATE MATTER ≤ 2.5 µm	0	1.07	0	0	1.07
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0.000149	0	0	0.000149
SULFUR DIOXIDE	0	0.00018	0	0	0.00018
TOLUENE	0	0.105	0	0	0.105
TOTAL SUSPENDED PARTICULATE	0	1.11	0	0	1.11
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0.84	0	0	0.84
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from chemical wholesaling businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-150.

Table 3-150: Estimated emissions from chemical wholesaling

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	5,680	0	0	0	5,680
LEAD & COMPOUNDS	0.837	0.143	0	0	0.979
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	1,290	221	0	0	1,520
PARTICULATE MATTER ≤ 2.5 µm	313	53.4	0	0	367
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	26,100	0	0	0	26,100
TOTAL SUSPENDED PARTICULATE	6,750	1150	0	0	7,900
TOTAL VOLATILE ORGANIC COMPOUNDS	81,400	0	0	0	81,400
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from confectionary manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-151.

Table 3-151: Estimated emissions from confectionary manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	4.02	0	0	0	4.02
ACETALDEHYDE	5.04	0	0	0	5.04
BENZENE	21.5	0	0	0	21.5
CARBON MONOXIDE	353	0	0	0	353
FORMALDEHYDE	18.6	0	0	0	18.6
ISOMERS OF XYLENE	163	0	0	0	163
LEAD & COMPOUNDS	0.00518	0	0	0	0.00518
OXIDES OF NITROGEN	1410	0	0	0	1410
PARTICULATE MATTER ≤ 10 µm	70.8	0	0	0	70.8
PARTICULATE MATTER ≤ 2.5 µm	70.2	0	0	0	70.2
PERCHLOROETHYLENE	4.82	0	0	0	4.82
POLYCYCLIC AROMATIC HYDROCARBONS	0.00633	0	0	0	0.00633
SULFUR DIOXIDE	4.81	0	0	0	4.81
TOLUENE	150	0	0	0	150
TOTAL SUSPENDED PARTICULATE	74.6	0	0	0	74.6
TOTAL VOLATILE ORGANIC COMPOUNDS	1,350	0	0	0	1,350
TRICHLOROETHYLENE	2.67	0	0	0	2.67

a Totals may not appear additive due to rounding

Estimated emissions from corrugated paperboard container manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-152.

Table 3-152: Estimated emissions from corrugated paperboard container manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	28.7	0	0	0	28.7
CARBON MONOXIDE	4,820	0	0	0	4,820
FORMALDEHYDE	57.4	0	0	0	57.4
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.0287	0	0	0	0.0287
OXIDES OF NITROGEN	5,740	0	0	0	5,740
PARTICULATE MATTER ≤ 10 µm	436	0	0	0	436
PARTICULATE MATTER ≤ 2.5 µm	436	0	0	0	436
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0395	0	0	0	0.0395
SULFUR DIOXIDE	30	0	0	0	30
TOLUENE	14.4	0	0	0	14.4
TOTAL SUSPENDED PARTICULATE	436	0	0	0	436

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TOTAL VOLATILE ORGANIC COMPOUNDS	316	0	0	0	316
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from electric cable and wire manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-153.

Table 3-153: Estimated emissions from electric cable and wire manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	20,500	20,500
LEAD & COMPOUNDS	0	0	0	0.249	0.249
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	1,220	1,220
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	722	722
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	14,100	14,100
TOTAL SUSPENDED PARTICULATE	0	0	0	3,330	3,330
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	84,000	84,000
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from electric cable and equipment n.e.c. manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-154.

Table 3-154: Estimated emissions from electric cable and equipment n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.219	0	0	0	0.219
CARBON MONOXIDE	36.8	0	0	0	36.8
FORMALDEHYDE	0.438	0	0	0	0.438
ISOMERS OF XYLENE	206	0	0	0	206
LEAD & COMPOUNDS	0.000219	0	0	0	0.000219
OXIDES OF NITROGEN	422	0	0	0	422
PARTICULATE MATTER ≤ 10 µm	429	0	0	0	429
PARTICULATE MATTER ≤ 2.5 µm	429	0	0	0	429

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.000301	0	0	0	0.000301
SULFUR DIOXIDE	0.229	0	0	0	0.229
TOLUENE	556	0	0	0	556
TOTAL SUSPENDED PARTICULATE	429	0	0	0	429
TOTAL VOLATILE ORGANIC COMPOUNDS	4,180	0	0	0	4,180
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from explosive manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-155.

Table 3-155: Estimated emissions from explosive manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0.424	0.424
BENZENE	0	0	0	1.94	1.94
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0.00684	0.00684
ISOMERS OF XYLENE	0	0	0	0.105	0.105
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	0.411	0.411
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	21.3	21.3
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from fabricated metal product n.e.c. manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-156.

Table 3-156: Estimated emissions from fabricated metal product n.e.c. manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0.00995	0	0	0	0.00995
BENZENE	6.21	0	0	4.56	10.8
CARBON MONOXIDE	870	0	0	766	1,640
FORMALDEHYDE	12.3	0	0.0727	9.12	21.5
ISOMERS OF XYLENE	3,240	0.828	28.4	0	3,270

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
LEAD & COMPOUNDS	1.14	0.0291	0	0.00456	1.17
OXIDES OF NITROGEN	2,080	413	0	912	3,410
PARTICULATE MATTER ≤ 10 µm	4,540	237	0	69.3	4,850
PARTICULATE MATTER ≤ 2.5 µm	3,210	203	0	69.3	3,480
PERCHLOROETHYLENE	13.5	0	0.509	0	14
POLYCYCLIC AROMATIC HYDROCARBONS	0.00871	0	0	0.00627	0.015
SULFUR DIOXIDE	5.32	0	0	4.77	10.1
TOLUENE	14,700	8.39	313	2.28	15,000
TOTAL SUSPENDED PARTICULATE	11,900	427	0	69.3	12,400
TOTAL VOLATILE ORGANIC COMPOUNDS	103,000	24.7	1,390	58.6	105,000
TRICHLOROETHYLENE	54,800	0	0.0727	8.4	54,800

a Totals may not appear additive due to rounding

Estimated emissions from fruit and vegetable processing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-157.

Table 3-157: Estimated emissions from fruit and vegetable processing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	14.8	0	0	0	14.8
CARBON MONOXIDE	2,490	0	0	0	2,490
FORMALDEHYDE	29.6	0	0	0	29.6
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.0148	0	0	0	0.0148
OXIDES OF NITROGEN	1,480	0	0	0	1,480
PARTICULATE MATTER ≤ 10 µm	225	0	0	0	225
PARTICULATE MATTER ≤ 2.5 µm	225	0	0	0	225
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0204	0	0	0	0.0204
SULFUR DIOXIDE	15.5	0	0	0	15.5
TOLUENE	7.4	0	0	0	7.4
TOTAL SUSPENDED PARTICULATE	225	0	0	0	225
TOTAL VOLATILE ORGANIC COMPOUNDS	163	0	0	0	163
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from furniture manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-158.

Table 3-158: Estimated emissions from furniture manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	9.49	9.49
CARBON MONOXIDE	0	0	0	1,590	1,590
FORMALDEHYDE	0	0	0	19	19
ISOMERS OF XYLENE	279	326	0	0.0542	606
LEAD & COMPOUNDS	0.000107	0	0	0.0101	0.0102
OXIDES OF NITROGEN	0	0	0	1,900	1,900
PARTICULATE MATTER ≤ 10 µm	0.165	0	0	145	145
PARTICULATE MATTER ≤ 2.5 µm	0.04	0	0	144	144
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0.013	0.013
SULFUR DIOXIDE	0	0	0	9.91	9.91
TOLUENE	621	1,530	0	4.76	2,150
TOTAL SUSPENDED PARTICULATE	0.862	0	0	149	150
TOTAL VOLATILE ORGANIC COMPOUNDS	2,840	4,290	0	105	7,240
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from gas supply businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-159.

Table 3-159: Estimated emissions from gas supply

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	18.4	0	0	0	18.4
CARBON MONOXIDE	3,090	0	0	0	3,090
FORMALDEHYDE	36.8	0	0	0	36.8
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.0184	0	0	0	0.0184
OXIDES OF NITROGEN	3,680	0	0	0	3,680
PARTICULATE MATTER ≤ 10 µm	280	0	0	0	280
PARTICULATE MATTER ≤ 2.5 µm	280	0	0	0	280
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0253	0	0	0	0.0253
SULFUR DIOXIDE	19.2	0	0	0	19.2
TOLUENE	9.2	0	0	0	9.2
TOTAL SUSPENDED PARTICULATE	280	0	0	0	280
TOTAL VOLATILE ORGANIC COMPOUNDS	202	0	0	0	202
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from ice cream manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-160.

Table 3-160: Estimated emissions from ice cream manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	6.12	0	0	0	6.12
CARBON MONOXIDE	294	0	0	0	294
FORMALDEHYDE	20.9	0	0	0	20.9
ISOMERS OF XYLENE	51.7	0	0	0	51.7
LEAD & COMPOUNDS	0.00829	0	0	0	0.00829
OXIDES OF NITROGEN	2,080	0	0	0	2,080
PARTICULATE MATTER ≤ 10 µm	96.4	0	0	0	96.4
PARTICULATE MATTER ≤ 2.5 µm	93.8	0	0	0	93.8
PERCHLOROETHYLENE	60.3	0	0	0	60.3
POLYCYCLIC AROMATIC HYDROCARBONS	0.00841	0	0	0	0.00841
SULFUR DIOXIDE	6.39	0	0	0	6.39
TOLUENE	37.5	0	0	0	37.5
TOTAL SUSPENDED PARTICULATE	110	0	0	0	110
TOTAL VOLATILE ORGANIC COMPOUNDS	438	0	0	0	438
TRICHLOROETHYLENE	8.62	0	0	0	8.62

a Totals may not appear additive due to rounding

Estimated emissions from industrial gas manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-161.

Table 3-161: Estimated emissions from industrial gas manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.0824	0	0	0	0.0824
CARBON MONOXIDE	1.88	0	0	0	1.88
FORMALDEHYDE	0.165	0	0	0	0.165
ISOMERS OF XYLENE	633	0	0	0	633
LEAD & COMPOUNDS	0.358	0	0	0	0.358
OXIDES OF NITROGEN	13.6	0	0	0	13.6
PARTICULATE MATTER ≤ 10 µm	750	0	0	0	750
PARTICULATE MATTER ≤ 2.5 µm	86.8	0	0	0	86.8
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0000584	0	0	0	0.0000584
SULFUR DIOXIDE	0.0000706	0	0	0	0.0000706
TOLUENE	2,020	0	0	0	2,020
TOTAL SUSPENDED PARTICULATE	2,770	0	0	0	2,770
TOTAL VOLATILE ORGANIC COMPOUNDS	5,820	0	0	0	5,820

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from ink manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-162.

Table 3-162: Estimated emissions from ink manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0.0138	0	0	0	0.0138
LEAD & COMPOUNDS	0.00252	0	0	0	0.00252
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	619	0	0	0	619
PARTICULATE MATTER ≤ 2.5 µm	611	0	0	0	611
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	1,260	0	0	0	1,260
TOTAL SUSPENDED PARTICULATE	688	0	0	0	688
TOTAL VOLATILE ORGANIC COMPOUNDS	10,600	0	0	0	10,600
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from lifting and material handling equipment manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-163.

Table 3-163: Estimated emissions from lifting and material handling equipment manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.49	0	0	0	0.49
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	97	0	0	0	97
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	124	0	0	0	124
PARTICULATE MATTER ≤ 10 µm	24.5	0	0	0	24.5
PARTICULATE MATTER ≤ 2.5 µm	24.5	0	0	0	24.5
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	210	0	0	0	210
TOTAL SUSPENDED PARTICULATE	24.5	0	0	0	24.5
TOTAL VOLATILE ORGANIC COMPOUNDS	745	0	0	0	745
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from log sawmilling businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-164.

Table 3-164: Estimated emissions from log sawmilling

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	11	11
CARBON MONOXIDE	0	0	0	3,290	3,290
FORMALDEHYDE	0	0	0	32.6	32.6
ISOMERS OF XYLENE	0	0	0	16,100	16,100
LEAD & COMPOUNDS	0	0	0	1.23	1.23
OXIDES OF NITROGEN	0	0	0	64,800	64,800
PARTICULATE MATTER ≤ 10 µm	0	0	0	18,400	18,400
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	7,420	7,420
PERCHLOROETHYLENE	0	0	0	12.2	12.2
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0.0787	0.0787
SULFUR DIOXIDE	0	0	0	49,500	49,500
TOLUENE	0	0	0	12,500	12,500
TOTAL SUSPENDED PARTICULATE	0	0	0	45,200	45,200
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	90,000	90,000
TRICHLOROETHYLENE	0	0	0	1.74	1.74

a Totals may not appear additive due to rounding

Estimated emissions from medicinal or pharmaceutical product manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-165.

Table 3-165: Estimated emissions from medicinal or pharmaceutical manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	15.1	0	0	3.09	18.2
CARBON MONOXIDE	2,440	0	0	520	2,960
FORMALDEHYDE	30.1	0	0	6.19	36.3
ISOMERS OF XYLENE	0.0151	0	0	0	0.0151
LEAD & COMPOUNDS	0.0148	0	0	0.00318	0.0179
OXIDES OF NITROGEN	2,990	0	0	619	3,610

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
PARTICULATE MATTER ≤ 10 µm	223	0	0	47.1	270
PARTICULATE MATTER ≤ 2.5 µm	223	0	0	47	270
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0203	0	0	0.00425	0.0245
SULFUR DIOXIDE	15.1	0	0	3.23	18.3
TOLUENE	7.54	0	0	1.55	9.08
TOTAL SUSPENDED PARTICULATE	223	0	0	47.7	270
TOTAL VOLATILE ORGANIC COMPOUNDS	1,350	0	0	693	2,040
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from milk and cream processing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-166.

Table 3-166: Estimated emissions from milk and cream processing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	6.12	0	0	0	6.12
CARBON MONOXIDE	1,030	0	0	0	1,030
FORMALDEHYDE	12.2	0	0	0	12.2
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.00612	0	0	0	0.00612
OXIDES OF NITROGEN	1,220	0	0	0	1,220
PARTICULATE MATTER ≤ 10 µm	93	0	0	0	93
PARTICULATE MATTER ≤ 2.5 µm	93	0	0	0	93
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00842	0	0	0	0.00842
SULFUR DIOXIDE	6.4	0	0	0	6.4
TOLUENE	3.06	0	0	0	3.06
TOTAL SUSPENDED PARTICULATE	93	0	0	0	93
TOTAL VOLATILE ORGANIC COMPOUNDS	67.3	0	0	0	67.3
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from mining and construction machinery manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-167.

Table 3-167: Estimated emissions from mining and construction machinery manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0.799	0	0	0.799
CARBON MONOXIDE	0	0	0	0	0

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	28.8	0	197	226
LEAD & COMPOUNDS	0	0	0	0.000605	0.000605
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0.201	0	0.937	1.14
PARTICULATE MATTER ≤ 2.5 µm	0	0.201	0	0.227	0.427
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	134	0	136	270
TOTAL SUSPENDED PARTICULATE	0	0.201	0	4.88	5.08
TOTAL VOLATILE ORGANIC COMPOUNDS	0	475	0	806	1,280
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from non-building construction n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-168.

Table 3-168: Estimated emissions from non-building construction n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.721	0	0	0.31	1.03
CARBON MONOXIDE	16.5	0	0	7.09	23.6
FORMALDEHYDE	1.44	0	0	0.621	2.06
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.305	0	0	0.000157	0.306
OXIDES OF NITROGEN	119	0	0	51.4	171
PARTICULATE MATTER ≤ 10 µm	476	0	0	1.59	477
PARTICULATE MATTER ≤ 2.5 µm	118	0	0	1.58	119
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.000511	0	0	0.00022	0.000731
SULFUR DIOXIDE	0.000618	0	0	0.000266	0.000883
TOLUENE	0.36	0	0	0.155	0.515
TOTAL SUSPENDED PARTICULATE	2,460	0	0	1.63	2,470
TOTAL VOLATILE ORGANIC COMPOUNDS	2.88	0	0	1.24	4.12
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from non-ferrous metal casting businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-169.

Table 3-169: Estimated emissions from non-ferrous metal casting

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	7.2	7.2
FORMALDEHYDE	0	0	0	0.234	0.234
ISOMERS OF XYLENE	0	0	0	0.0144	0.0144
LEAD & COMPOUNDS	0	0	0	0.00181	0.00181
OXIDES OF NITROGEN	0	0	0	28.8	28.8
PARTICULATE MATTER ≤ 10 µm	0	0	0	244	244
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	183	183
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	21.7	21.7
TOLUENE	0	0	0	0.00443	0.00443
TOTAL SUSPENDED PARTICULATE	0	0	0	384	384
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	0.64	0.64
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from non-metallic mineral product manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-170.

Table 3-170: Estimated emissions from non-metallic mineral product manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	2.89	0	0	0	2.89
CARBON MONOXIDE	485	0	0	0	485
FORMALDEHYDE	5.77	0	0	0	5.77
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.00289	0	0	0	0.00289
OXIDES OF NITROGEN	577	0	0	0	577
PARTICULATE MATTER ≤ 10 µm	43.9	0	0	0	43.9
PARTICULATE MATTER ≤ 2.5 µm	43.9	0	0	0	43.9
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00397	0	0	0	0.00397
SULFUR DIOXIDE	3.02	0	0	0	3.02
TOLUENE	3,610	0	0	0	3,610
TOTAL SUSPENDED PARTICULATE	43.9	0	0	0	43.9
TOTAL VOLATILE ORGANIC COMPOUNDS	106,000	0	0	0	106,000
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from oil and fat manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-171.

Table 3-171: Estimated emissions from oil and fat manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	31.7	0	0	0	31.7
CARBON MONOXIDE	5,320	0	0	0	5,320
FORMALDEHYDE	63.4	0	0	0	63.4
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.0317	0	0	0	0.0317
OXIDES OF NITROGEN	11,400	0	0	0	11,400
PARTICULATE MATTER ≤ 10 µm	482	0	0	0	482
PARTICULATE MATTER ≤ 2.5 µm	482	0	0	0	482
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0436	0	0	0	0.0436
SULFUR DIOXIDE	33.1	0	0	0	33.1
TOLUENE	15.9	0	0	0	15.9
TOTAL SUSPENDED PARTICULATE	482	0	0	0	482
TOTAL VOLATILE ORGANIC COMPOUNDS	349	0	0	0	349
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from organic industrial chemical manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-172.

Table 3-172: Estimated emissions from organic industrial chemical manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.15	0	0	0	0.15
CARBON MONOXIDE	25.1	0	0	0	25.1
FORMALDEHYDE	0.299	0	0	0	0.299
ISOMERS OF XYLENE	83.1	0	0	0	83.1
LEAD & COMPOUNDS	0.00015	0	0	0	0.00015
OXIDES OF NITROGEN	29.9	0	0	0	29.9
PARTICULATE MATTER ≤ 10 µm	2.27	0	0	0	2.27
PARTICULATE MATTER ≤ 2.5 µm	2.27	0	0	0	2.27
PERCHLOROETHYLENE	0.00163	0	0	0	0.00163
POLYCYCLIC AROMATIC HYDROCARBONS	0.000206	0	0	0	0.000206
SULFUR DIOXIDE	0.156	0	0	0	0.156
TOLUENE	985	0	0	0	985
TOTAL SUSPENDED PARTICULATE	2.27	0	0	0	2.27
TOTAL VOLATILE ORGANIC COMPOUNDS	4,540	0	0	0	4,540

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TRICHLOROETHYLENE	0.000232	0	0	0	0.000232

a Totals may not appear additive due to rounding

Estimated emissions from paper product manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-173.

Table 3-173: Estimated emissions from paper product manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	2.18	2.18
ACETALDEHYDE	0	0	0	0	0
BENZENE	6.76	0	0	2.46	9.23
CARBON MONOXIDE	1,140	0	0	81.1	1,220
FORMALDEHYDE	13.5	0	0	0	13.5
ISOMERS OF XYLENE	38.6	0	0	0	38.6
LEAD & COMPOUNDS	0.00676	0	0	0.0478	0.0546
OXIDES OF NITROGEN	1350	0	0	377	1730
PARTICULATE MATTER ≤ 10 µm	103	0	0	26.5	129
PARTICULATE MATTER ≤ 2.5 µm	103	0	0	26.3	129
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0093	0	0	0.0144	0.0237
SULFUR DIOXIDE	7.07	0	0	24.8	31.9
TOLUENE	141	0	0	0	141
TOTAL SUSPENDED PARTICULATE	103	0	0	27.2	130
TOTAL VOLATILE ORGANIC COMPOUNDS	471	0	0	27.6	498
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from commercial petroleum product wholesaling businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-174.

Table 3-174: Estimated emissions from commercial petroleum product wholesaling

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	271	0	83.9	492	847
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0.000759	0	0.000759
ISOMERS OF XYLENE	192	8.08	73	348	621
LEAD & COMPOUNDS	0.22	0	0	0.0744	0.295
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	341	0	0	163	504
PARTICULATE MATTER ≤ 2.5 µm	82.5	0	0	16.3	98.8
PERCHLOROETHYLENE	0	0	0.00532	0	0.00532
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	661	2.48	209	1200	2070
TOTAL SUSPENDED PARTICULATE	1,780	0	0	572	2350
TOTAL VOLATILE ORGANIC COMPOUNDS	53,000	89.5	10,600	61,300	125,000
TRICHLOROETHYLENE	0	0	0.000759	0	0.000759

a Totals may not appear additive due to rounding

Estimated emissions from plastic bag and film manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-175.

Table 3-175: Estimated emissions from plastic bag and film manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0.368	0	0	0	0.368
BENZENE	1.11	0	0	0	1.11
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	2.04	0	0	0	2.04
ISOMERS OF XYLENE	18.5	0	0	0	18.5
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	899	0	0	0	899
PARTICULATE MATTER ≤ 2.5 µm	832	0	0	0	832
PERCHLOROETHYLENE	24.3	0	0	0	24.3
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	1150	0	0	0	1150
TOTAL SUSPENDED PARTICULATE	899	0	0	0	899
TOTAL VOLATILE ORGANIC COMPOUNDS	17,700	0	0	0	17,700
TRICHLOROETHYLENE	2.98	0	0	0	2.98

a Totals may not appear additive due to rounding

Estimated emissions from plastic injection moulded product manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-176.

Table 3-176: Estimated emissions from plastic injection moulded product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	18.2	0	0	0	18.2
CARBON MONOXIDE	2,960	0	0	0	2,960
FORMALDEHYDE	35.5	0	0	0	35.5
ISOMERS OF XYLENE	14.1	0	0	0	14.1
LEAD & COMPOUNDS	2.62	0	0	0	2.62
OXIDES OF NITROGEN	3,540	0	0	0	3,540

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
PARTICULATE MATTER ≤ 10 µm	5,960	0	0	0	5,960
PARTICULATE MATTER ≤ 2.5 µm	839	0	0	0	839
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0243	0	0	0	0.0243
SULFUR DIOXIDE	21.8	0	0	0	21.8
TOLUENE	58.1	0	0	0	58.1
TOTAL SUSPENDED PARTICULATE	20,300	0	0	0	20,300
TOTAL VOLATILE ORGANIC COMPOUNDS	441	0	0	0	441
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from prepared animal and bird feed manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-177.

Table 3-177: Estimated emissions from prepared animal and bird feed manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	7.74	7.74
CARBON MONOXIDE	1.44	0	0	1300	1300
FORMALDEHYDE	0.0468	0	0	15.5	15.5
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.000361	0	0	0.00774	0.00811
OXIDES OF NITROGEN	5.76	0	0	1550	1550
PARTICULATE MATTER ≤ 10 µm	0.312	0	0	118	118
PARTICULATE MATTER ≤ 2.5 µm	0.31	0	0	118	118
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0.0106	0.0106
SULFUR DIOXIDE	2.04	0	0	8.09	10.1
TOLUENE	0	0	0	3.87	3.87
TOTAL SUSPENDED PARTICULATE	0.319	0	0	118	118
TOTAL VOLATILE ORGANIC COMPOUNDS	0.096	0	0	85.2	85.3
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from rail transport businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-178.

Table 3-178: Estimated emissions from rail transport

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	0.226	0.226
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0.06	0.06
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	0.176	0.176
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	1.26	1.26
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from railway equipment manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-179.

Table 3-179: Estimated emissions from railway equipment manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0.36	0	0	0	0.36
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	1.41	0	0	0	1.41
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0.827	0	0	0	0.827
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	58	0	0	0	58
TRICHLOROETHYLENE	5.05	0	0	0	5.05

a Totals may not appear additive due to rounding

Estimated emissions from road and bridge construction businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-180.

Table 3-180: Estimated emissions from road and bridge construction

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0.0566	0	0.0627	0.119
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0.0399	0	0.0501	0.09
LEAD & COMPOUNDS	1.62	1.52x10^{-06}	0	0.0000157	1.62
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	3,440	32.6	0	32.5	3,500
PARTICULATE MATTER ≤ 2.5 µm	394	6.56	0	6.51	407
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0.138	0	0.155	0.292
TOTAL SUSPENDED PARTICULATE	12,600	65.2	0	65	12,700
TOTAL VOLATILE ORGANIC COMPOUNDS	0	7.02	0	7.84	14.9
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from rubber product manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-181.

Table 3-181: Estimated emissions from rubber product manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0.000006	0	0	0	0.000006
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	7.2	0	7.2
FORMALDEHYDE	0	0	0.234	0	0.234
ISOMERS OF XYLENE	0.996	0	0.0348	0	1.03
LEAD & COMPOUNDS	0.000105	0	0.0371	0	0.0372
OXIDES OF NITROGEN	0	0	28.8	0	28.8
PARTICULATE MATTER ≤ 10 µm	5.78	0	71.1	0	76.9
PARTICULATE MATTER ≤ 2.5 µm	0	0	11.1	0	11.1
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	10.2	0	10.2
TOLUENE	0.926	0	0.0107	0	0.937
TOTAL SUSPENDED PARTICULATE	1.91	0	278	0	280
TOTAL VOLATILE ORGANIC COMPOUNDS	6	0	0.866	0	6.87
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from scientific research businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-182.

Table 3-182: Estimated emissions from scientific research

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	5.52	0	0	0	5.52
CARBON MONOXIDE	927	0	0	0	927
FORMALDEHYDE	11	0	0	0	11
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.00552	0	0	0	0.00552
OXIDES OF NITROGEN	552	0	0	0	552
PARTICULATE MATTER ≤ 10 µm	83.9	0	0	0	83.9
PARTICULATE MATTER ≤ 2.5 µm	83.9	0	0	0	83.9
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00759	0	0	0	0.00759
SULFUR DIOXIDE	5.77	0	0	0	5.77
TOLUENE	2.76	0	0	0	2.76
TOTAL SUSPENDED PARTICULATE	83.9	0	0	0	83.9
TOTAL VOLATILE ORGANIC COMPOUNDS	60.7	0	0	0	60.7
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from services to air transport businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-183.

Table 3-183: Estimated emissions from services to air transport

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	13.4	0	0	0	13.4
CARBON MONOXIDE	2,240	0	0	0	2,240
FORMALDEHYDE	26.7	0	0	0	26.7
ISOMERS OF XYLENE	12,800	0	0	0	12,800
LEAD & COMPOUNDS	0.0134	0	0	0	0.0134
OXIDES OF NITROGEN	2,670	0	0	0	2,670
PARTICULATE MATTER ≤ 10 µm	203	0	0	0	203
PARTICULATE MATTER ≤ 2.5 µm	203	0	0	0	203
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.0184	0	0	0	0.0184
SULFUR DIOXIDE	14	0	0	0	14
TOLUENE	9,960	0	0	0	9,960
TOTAL SUSPENDED PARTICULATE	203	0	0	0	203
TOTAL VOLATILE ORGANIC COMPOUNDS	71,400	0	0	0	71,400

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from soap and other detergent manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-184.

Table 3-184: Estimated emissions from soap and other detergent manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0.000648	0	0	0	0.000648
ISOMERS OF XYLENE	0.00389	0	0	0	0.00389
LEAD & COMPOUNDS	0.305	0	0	0	0.305
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	665	0	0	0	665
PARTICULATE MATTER ≤ 2.5 µm	67.4	0	0	0	67.4
PERCHLOROETHYLENE	0.00454	0	0	0	0.00454
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0.0026	0	0	0	0.0026
TOTAL SUSPENDED PARTICULATE	2,350	0	0	0	2,350
TOTAL VOLATILE ORGANIC COMPOUNDS	28.9	0	0	0	28.9
TRICHLOROETHYLENE	0.000648	0	0	0	0.000648

a Totals may not appear additive due to rounding

Estimated emissions from soft drink, cordial and syrup manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-185.

Table 3-185: Estimated emissions from soft drink, cordial and syrup manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	20.6	0	0	0	20.6
CARBON MONOXIDE	3,460	0	0	0	3,460
FORMALDEHYDE	88.1	0	0	0	88.1
ISOMERS OF XYLENE	281	0	0	0	281
LEAD & COMPOUNDS	0.0206	0	0	0	0.0206
OXIDES OF NITROGEN	4,120	0	0	0	4,120
PARTICULATE MATTER ≤ 10 µm	313	0	0	0	313
PARTICULATE MATTER ≤ 2.5 µm	313	0	0	0	313
PERCHLOROETHYLENE	328	0	0	0	328
POLYCYCLIC AROMATIC HYDROCARBONS	0.0283	0	0	0	0.0283

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
SULFUR DIOXIDE	21.5	0	0	0	21.5
TOLUENE	198	0	0	0	198
TOTAL SUSPENDED PARTICULATE	313	0	0	0	313
TOTAL VOLATILE ORGANIC COMPOUNDS	2,240	0	0	0	2,240
TRICHLOROETHYLENE	46.9	0	0	0	46.9

a Totals may not appear additive due to rounding

Estimated emissions from solid paperboard container manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-186.

Table 3-186: Estimated emissions from soil paperboard container manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	524	0	0	0	524
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	15,300	0	0	0	15,300
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from spirit manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-187.

Table 3-187: Estimated emissions from spirit manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	0	0
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	66,800	0	0	0	66,800
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from spring and wire product manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-188.

Table 3-188: Estimated emissions from spring and wire product manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.0269	0	0.0263	0	0.0532
CARBON MONOXIDE	4.52	0	0.6	0	5.12
FORMALDEHYDE	0.0586	0	0.0526	0	0.111
ISOMERS OF XYLENE	0.0293	0	0	14	14
LEAD & COMPOUNDS	0.03	0	0.0000133	0.632	0.662
OXIDES OF NITROGEN	5.38	0	4.35	772	781
PARTICULATE MATTER ≤ 10 µm	46.8	5	0.135	1,110	1,160
PARTICULATE MATTER ≤ 2.5 µm	11.6	5	0.134	366	383
PERCHLOROETHYLENE	0.0342	0	0	0	0.0342
POLYCYCLIC AROMATIC HYDROCARBONS	0.000037	0	0.0000186	0	0.0000556
SULFUR DIOXIDE	0.0281	0	0.0000225	0	0.0281
TOLUENE	0.033	0	0.0131	168	169
TOTAL SUSPENDED PARTICULATE	242	5	0.138	5,230	5,480
TOTAL VOLATILE ORGANIC COMPOUNDS	0.506	0	0.105	380	381
TRICHLOROETHYLENE	0.00488	0	0	0	0.00488

a Totals may not appear additive due to rounding

Estimated emissions from structural metal product manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-189.

Table 3-189: Estimated emissions from structural metal product manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	134	0	0	0	134
LEAD & COMPOUNDS	0.085	0	0	0	0.085
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	7	0	0	0	7
PARTICULATE MATTER ≤ 2.5 µm	7	0	0	0	7
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	579	0	0	0	579
TOTAL SUSPENDED PARTICULATE	7	0	0	0	7
TOTAL VOLATILE ORGANIC COMPOUNDS	2,490	0	0	0	2,490
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from structural steel fabricating businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-190.

Table 3-190: Estimated emissions from structural steel fabricating

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	0	0	0	0	0
LEAD & COMPOUNDS	0.252	0	0	0	0.252
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	400	0	0	0	400
PARTICULATE MATTER ≤ 2.5 µm	104	0	0	0	104
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	0	0	0	0	0
TOTAL SUSPENDED PARTICULATE	2040	0	0	0	2040
TOTAL VOLATILE ORGANIC COMPOUNDS	0	0	0	0	0
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from synthetic resin manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-191.

Table 3-191: Estimated emissions from synthetic resin manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	2,360	0	0	0	2,360
BENZENE	10,800	0	0.0088	3.3	10,800
CARBON MONOXIDE	900	0	1.48	554	1,460
FORMALDEHYDE	41.3	0	0.0176	6.6	48
ISOMERS OF XYLENE	9,980	0	0	0	9,980
LEAD & COMPOUNDS	0.00536	0	0.0000088	3.65	3.66
OXIDES OF NITROGEN	1,070	0	1.76	660	1,730
PARTICULATE MATTER ≤ 10 µm	191,000	0	0.134	53.8	191,000
PARTICULATE MATTER ≤ 2.5 µm	189,000	0	0.134	53.8	189,000
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00736	0	0.0000121	0.00454	0.0119
SULFUR DIOXIDE	5.6	0	0.0092	3.45	9.05
TOLUENE	11,000	0	0.0044	1.65	11,000
TOTAL SUSPENDED PARTICULATE	212,000	0	0.134	53.8	212,000
TOTAL VOLATILE ORGANIC COMPOUNDS	268,000	0	0.0968	1290	270,000
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from waste disposal services businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-192.

Table 3-192: Estimated emissions from waste disposal services

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	27.3	0	0	0	27.3
ACETALDEHYDE	0	0	0	0	0
BENZENE	110	0.0365	0	0	110
CARBON MONOXIDE	9,220	6.13	0	0	9,220
FORMALDEHYDE	175	0.073	0	0	175
ISOMERS OF XYLENE	622	885	0	0	1,510
LEAD & COMPOUNDS	0.641	0.0000365	0	0	0.641
OXIDES OF NITROGEN	13,000	7.3	0	0	13,000
PARTICULATE MATTER ≤ 10 µm	1,700	0.555	0	0	1,700
PARTICULATE MATTER ≤ 2.5 µm	1,670	0.555	0	0	1,670
PERCHLOROETHYLENE	135	0	0	0	135
POLYCYCLIC AROMATIC HYDROCARBONS	0.236	0.0000502	0	0	0.236
SULFUR DIOXIDE	353	0.0382	0	0	353
TOLUENE	2,850	3,640	0	0	6,490
TOTAL SUSPENDED PARTICULATE	1,770	0.555	0	0	1,770
TOTAL VOLATILE ORGANIC COMPOUNDS	17,300	16,000	0	0	33,200
TRICHLOROETHYLENE	136	0	0	0	136

a Totals may not appear additive due to rounding

Estimated emissions from wood product manufacturing n.e.c. businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-193.

Table 3-193: Estimated emissions from wood product manufacturing n.e.c.

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0.00298	0	0	0	0.00298
CARBON MONOXIDE	0.5	0	0	0	0.5
FORMALDEHYDE	0.00595	0	0	0	0.00595
ISOMERS OF XYLENE	0	0	0	298	298
LEAD & COMPOUNDS	0.133	0	0	0.0164	0.15
OXIDES OF NITROGEN	0.595	0	0	0	0.595
PARTICULATE MATTER ≤ 10 µm	206	0	0	25.4	232
PARTICULATE MATTER ≤ 2.5 µm	49.9	0	0	6.14	56.1
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0.00000409	0	0	0	0.00000409
SULFUR DIOXIDE	0.00311	0	0	0	0.00311
TOLUENE	0.00149	0	0	1,140	1,140
TOTAL SUSPENDED PARTICULATE	1,070	0	0	132	1,210
TOTAL VOLATILE ORGANIC COMPOUNDS	0.0327	0	0	5,420	5,420
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

Estimated emissions from wooden furniture and upholstered seat manufacturing businesses within the GMR, Sydney, Newcastle, Wollongong and Non Urban regions are provided in Table 3-194.

Table 3-194: Estimated emissions from wooden furniture and upholstered seat manufacturing

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
1,3 BUTADIENE	0	0	0	0	0
ACETALDEHYDE	0	0	0	0	0
BENZENE	0	0	0	0	0
CARBON MONOXIDE	0	0	0	0	0
FORMALDEHYDE	0	0	0	0	0
ISOMERS OF XYLENE	86.4	0	0	0	86.4
LEAD & COMPOUNDS	0	0	0	0	0
OXIDES OF NITROGEN	0	0	0	0	0
PARTICULATE MATTER ≤ 10 µm	0	0	0	0	0
PARTICULATE MATTER ≤ 2.5 µm	0	0	0	0	0
PERCHLOROETHYLENE	0	0	0	0	0
POLYCYCLIC AROMATIC HYDROCARBONS	0	0	0	0	0
SULFUR DIOXIDE	0	0	0	0	0
TOLUENE	647	0	0	0	647
TOTAL SUSPENDED PARTICULATE	0	0	0	0	0
TOTAL VOLATILE ORGANIC COMPOUNDS	1,770	0	0	0	1,770

Substance	Estimated Emissions (kg/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR a
TRICHLOROETHYLENE	0	0	0	0	0

a Totals may not appear additive due to rounding

3.23.6 Emission Projection Methodology

Derived projection factors based on air transport (final energy consumption) are provided in Table 3-195 and illustrated in Figure 3-47.

Table 3-195: Projection factors for air transport related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0442	2023	1.6516
2010	1.0868	2024	1.7010
2011	1.1281	2025	1.7507
2012	1.1681	2026	1.8010
2013	1.2085	2027	1.8526
2014	1.2494	2028	1.9056
2015	1.2906	2029	1.9601
2016	1.3323	2030	1.9954
2017	1.3749	2031	2.0258
2018	1.4182	2032	2.0713
2019	1.4628	2033	2.1168
2020	1.5086	2034	2.1623
2021	1.5554	2035	2.2077
2022	1.6030	2036	2.2532

Source: ABARE (2006)

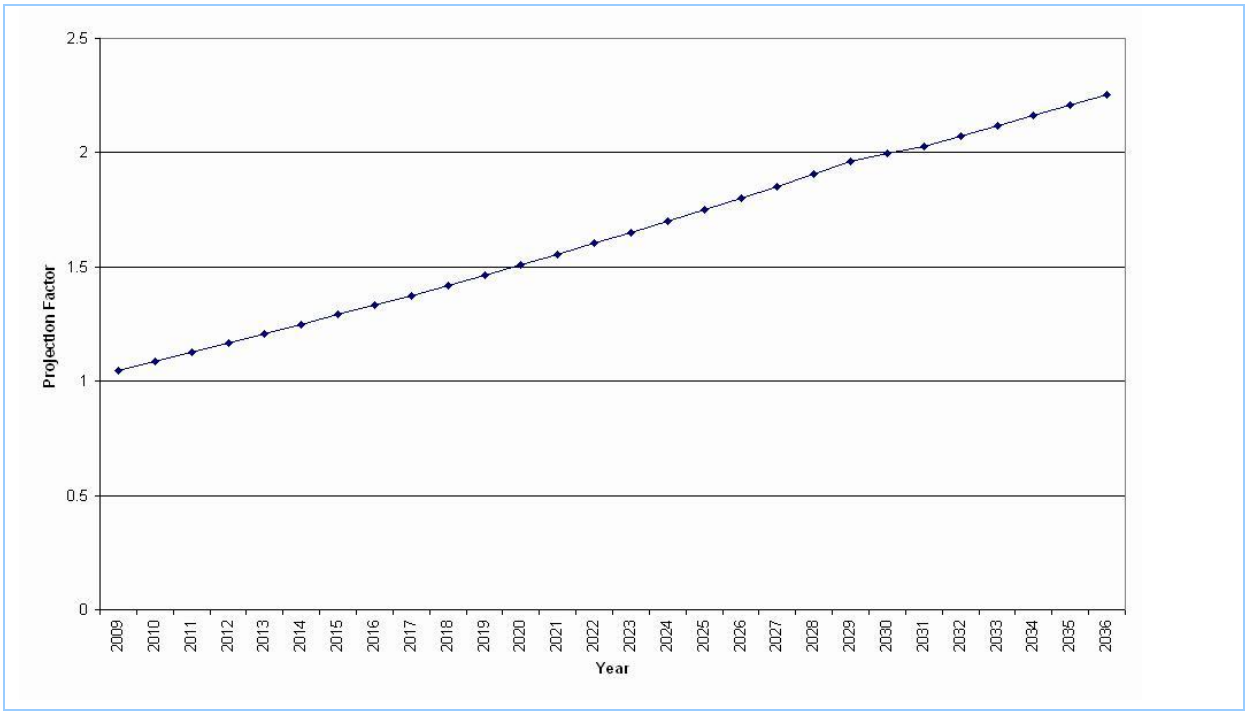

Figure 3-47: Projection factors for air transport related sources

Derived projection factors based on basic non-ferrous metals products (final energy consumption) are provided in Table 3-196 and illustrated in Figure 3-48.

Table 3-196: Projection factors for basic non-ferrous metals products related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0064	2023	1.1224
2010	1.0129	2024	1.1315
2011	1.0206	2025	1.1406
2012	1.0287	2026	1.1498
2013	1.0367	2027	1.1592
2014	1.0448	2028	1.1688
2015	1.0532	2029	1.1785
2016	1.0616	2030	1.1859
2017	1.0700	2031	1.1926
2018	1.0784	2032	1.2013
2019	1.0870	2033	1.2099
2020	1.0958	2034	1.2185
2021	1.1045	2035	1.2272
2022	1.1134	2036	1.2358

Source: ABARE (2006)

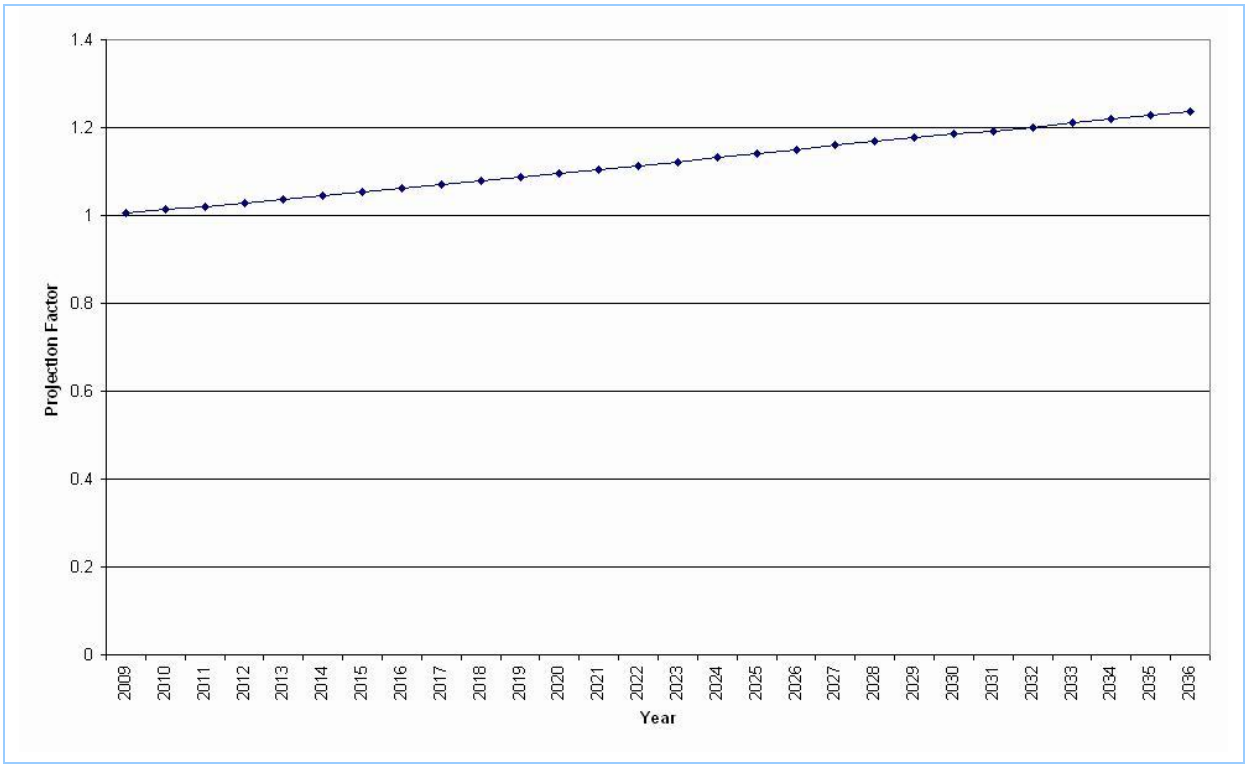

Figure 3-48: Projection factors for basic non-ferrous metals products related sources

Derived projection factors based on iron and steel (final energy consumption) are provided in Table 3-197 and illustrated in Figure 3-49.

Table 3-197: Projection factors for iron and steel (final energy) related sources

Year	Projection Factor	Year	Projection Factor
2009	0.9975	2023	0.9945
2010	0.9965	2024	0.9946
2011	0.9961	2025	0.9946
2012	0.9953	2026	0.9946
2013	0.9950	2027	0.9947
2014	0.9947	2028	0.9947
2015	0.9944	2029	0.9948
2016	0.9943	2030	0.9943
2017	0.9944	2031	0.9939
2018	0.9944	2032	0.9938
2019	0.9944	2033	0.9937
2020	0.9944	2034	0.9936
2021	0.9945	2035	0.9935
2022	0.9945	2036	0.9934

Source: ABARE (2006)

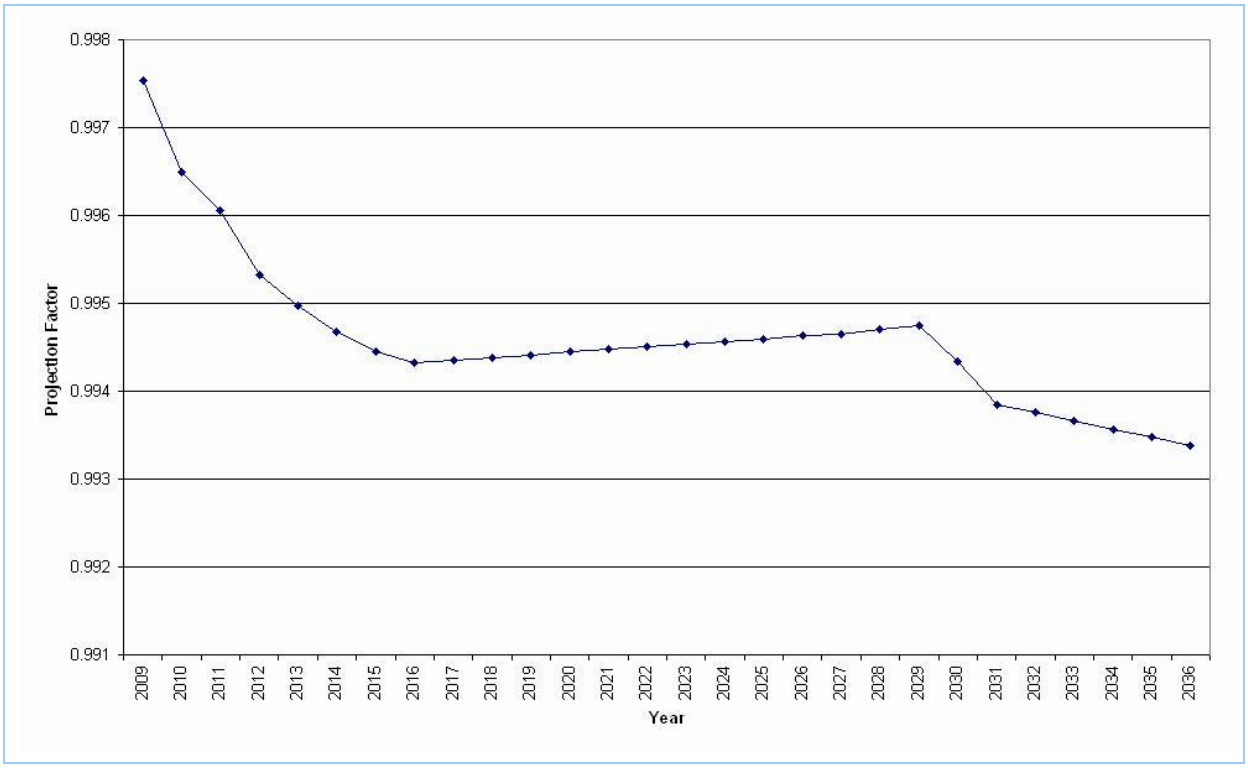

Figure 3-49: Projection factors for iron and steel (final energy) related sources

Derived projection factors based on other basic non-ferrous metals (final energy consumption) are provided in Table 3-198 and illustrated in Figure 3-50.

Table 3-198: Projection factors for other basic non-ferrous metals related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0243	2023	1.3528
2010	1.0479	2024	1.3778
2011	1.0714	2025	1.4028
2012	1.0941	2026	1.4280
2013	1.1166	2027	1.4537
2014	1.1394	2028	1.4798
2015	1.1622	2029	1.5064
2016	1.1852	2030	1.5277
2017	1.2083	2031	1.5475
2018	1.2315	2032	1.5714
2019	1.2552	2033	1.5954
2020	1.2792	2034	1.6194
2021	1.3035	2035	1.6434
2022	1.3280	2036	1.6673

Source: ABARE (2006)

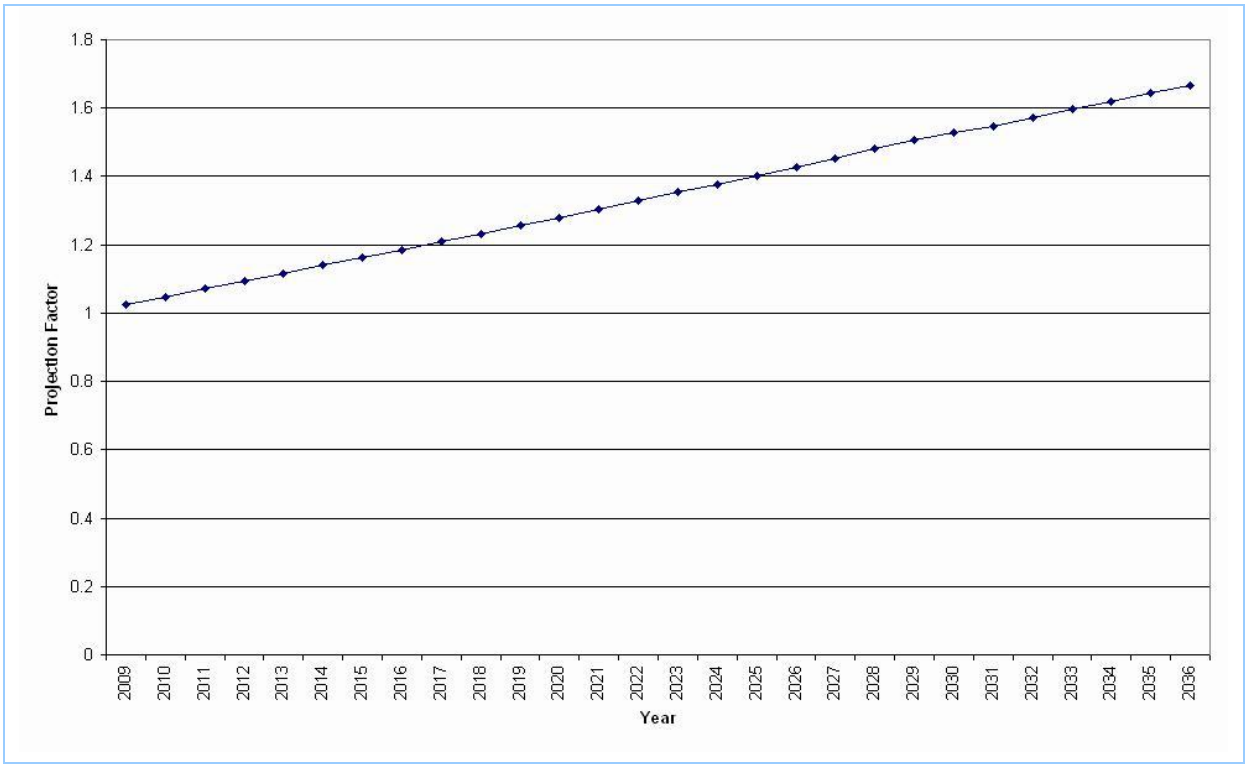

Figure 3-50: Projection factors for other basic non-ferrous metals related sources

Derived projection factors based on pipeline transport (final energy consumption) are provided in Table 3-199 and illustrated in Figure 3-51.

Table 3-199: Projection factors for pipeline transport related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0347	2023	2.0894
2010	1.0924	2024	2.1463
2011	1.1944	2025	2.2047
2012	1.3429	2026	2.2646
2013	1.4582	2027	2.3200
2014	1.5292	2028	2.3651
2015	1.5883	2029	2.3991
2016	1.6415	2030	2.4906
2017	1.6948	2031	2.6010
2018	1.7487	2032	2.6683
2019	1.7975	2033	2.7356
2020	1.8537	2034	2.8030
2021	1.9416	2035	2.8703
2022	2.0281	2036	2.9376

Source: ABARE (2006)

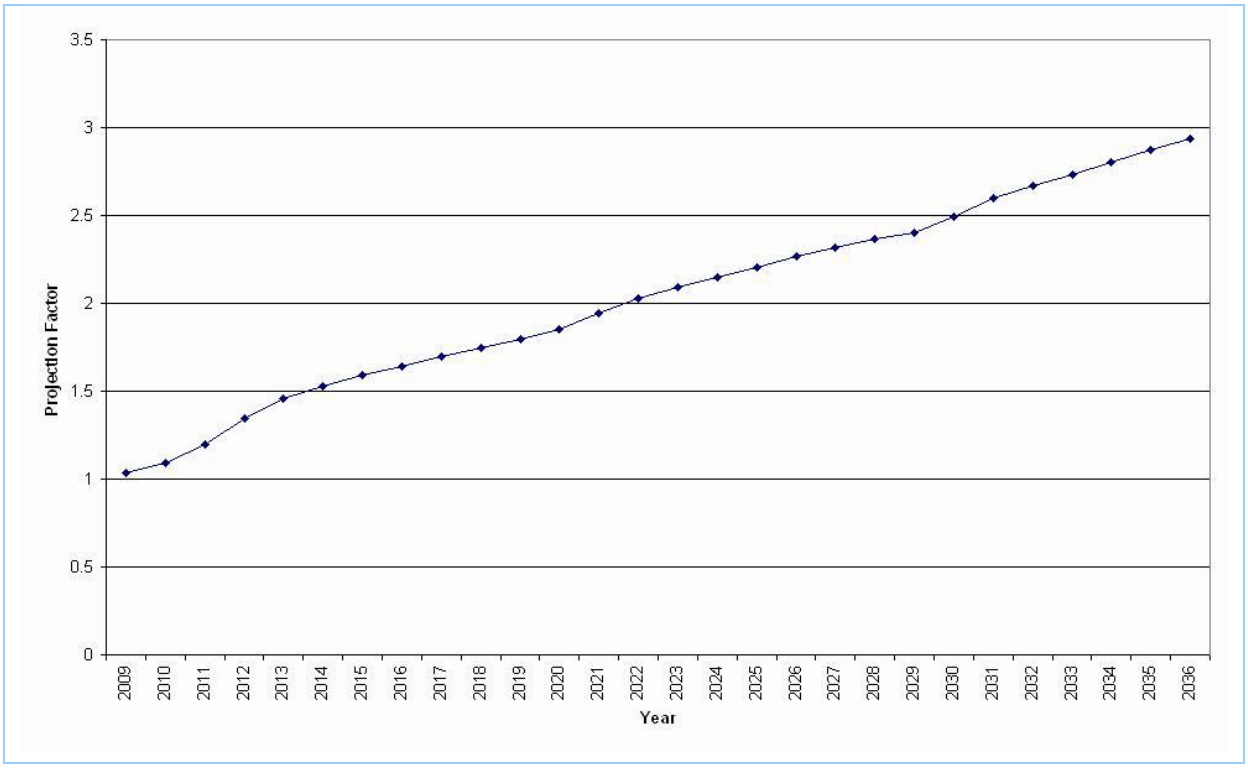

Figure 3-51: Projection factors for pipeline transport related sources

Derived projection factors based on rail transport (final energy consumption) are provided in Table 3-200 and illustrated in Figure 3-52.

Table 3-200: Projection factors for rail transport related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0151	2023	1.1989
2010	1.0296	2024	1.2116
2011	1.0438	2025	1.2241
2012	1.0574	2026	1.2365
2013	1.0707	2027	1.2490
2014	1.0838	2028	1.2616
2015	1.0968	2029	1.2743
2016	1.1095	2030	1.2878
2017	1.1222	2031	1.3013
2018	1.1348	2032	1.3142
2019	1.1475	2033	1.3271
2020	1.1604	2034	1.3400
2021	1.1733	2035	1.3528
2022	1.1861	2036	1.3657

Source: ABARE (2006)

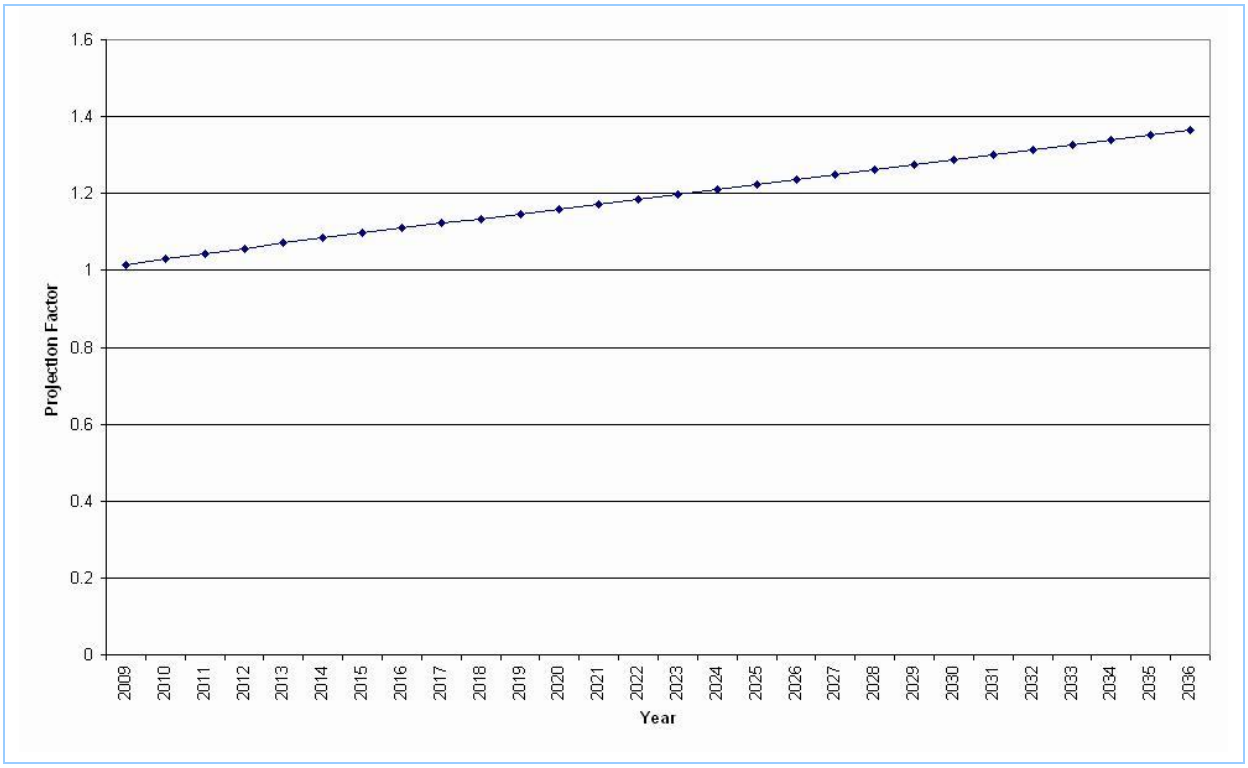

Figure 3-52: Projection factors for rail transport related sources

Derived projection factors based on road transport are provided in Table 3-201 and illustrated in Figure 3-53.

Table 3-201: Projection factors for road transport related sources

Year	Projection Factor	Year	Projection Factor
2009	1.0048	2023	1.0238
2010	1.0085	2024	1.0243
2011	1.0105	2025	1.0248
2012	1.0116	2026	1.0252
2013	1.0129	2027	1.0256
2014	1.0141	2028	1.0260
2015	1.0152	2029	1.0263
2016	1.0164	2030	1.0284
2017	1.0179	2031	1.0309
2018	1.0192	2032	1.0319
2019	1.0206	2033	1.0330
2020	1.0217	2034	1.0340
2021	1.0224	2035	1.0350
2022	1.0231	2036	1.0360

Source: ABARE (2006)

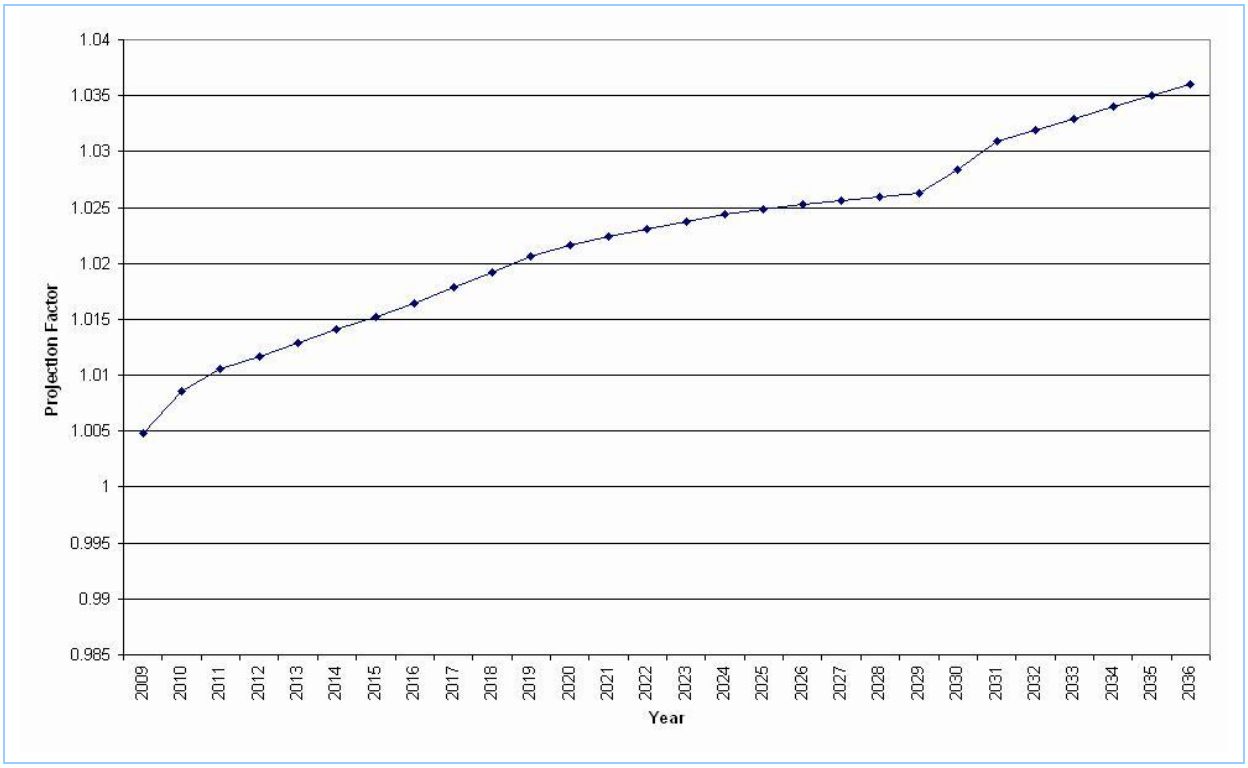

Figure 3-53: Projection factors for road transport related sources

4 RESULTS SUMMARY

4.1 Source Summary

The commercial emissions inventory includes emissions from 5,153 businesses. A total of 23,228 emission sources have been included in the commercial emissions inventory, consisting of 459 point sources and 22,769 fugitive sources. Table 4-1 presents the number and type of emission sources included in the commercial emissions inventory for each area considered.

Table 4-1: Emission source summary

Area	Point Sources	Fugitive Sources	Total Sources
Sydney	330	16,089	16,419
Newcastle	32	1436	1468
Wollongong	15	867	882
Non Urban	82	4377	4459
GMR	459	22,769	23,228

The pollutants inventoried include criteria pollutants specified in the Air NEPM, air toxics associated with the National Pollutant Inventory and the Air Toxics NEPM and any other pollutants associated with state specific programs, i.e. Load Based Licensing (Protection of the Environment Operations (General) Regulation 1998 (DEC, 2002 & PCO, 1998)) and Protection of the Environment Operations (Clean Air) Regulation 2010 (PCO, 2011).

The location of each emission source included in the commercial air emissions inventory is shown in Figure 4-1.

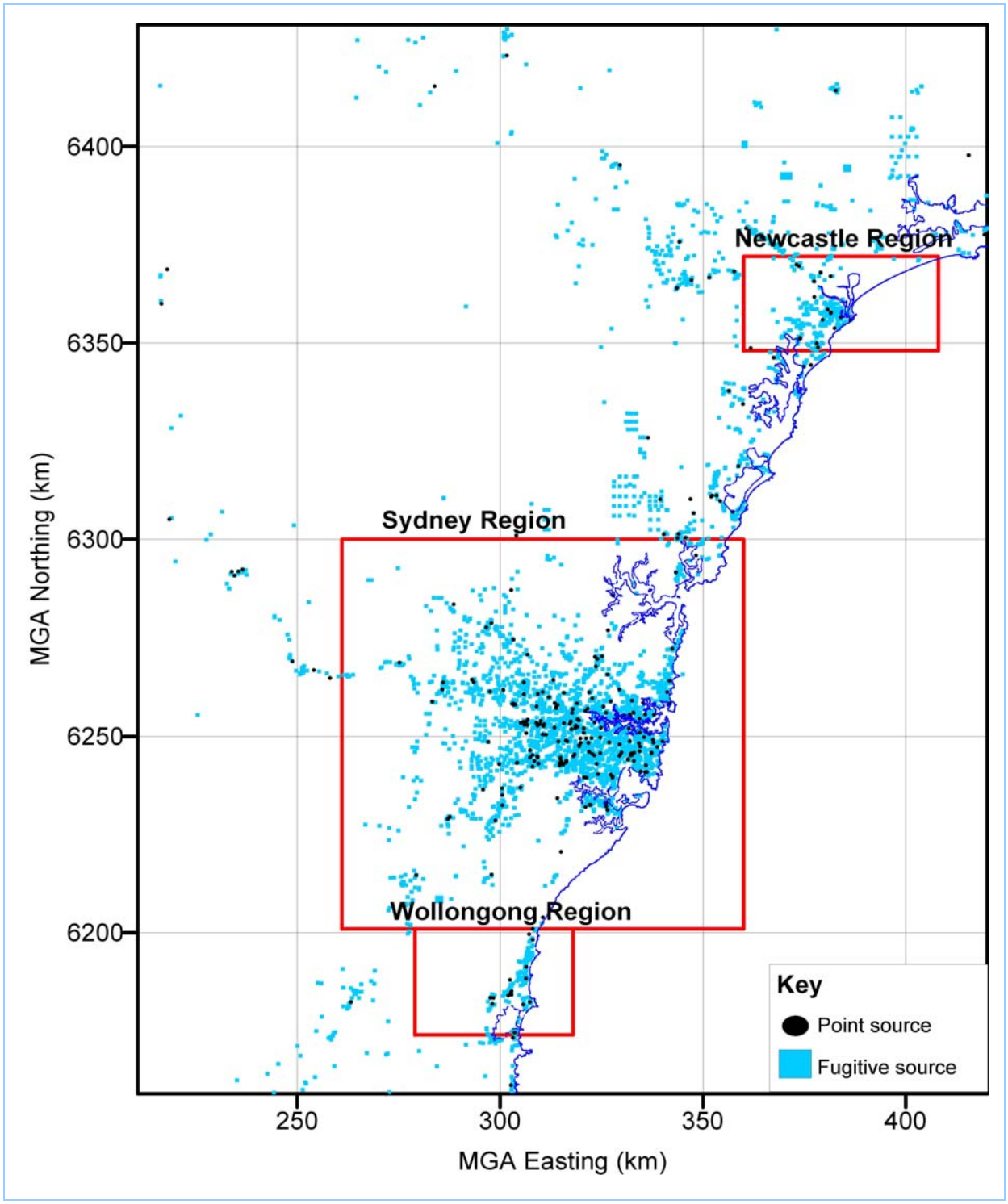

Figure 4-1: Commercial emission sources in the GMR

4.2 Activity Summary

Table 4-2 shows annual fuel consumption by commercial activity type for the 2008 calendar year in the GMR.

Table 4-2: Annual fuel consumption by commercial activity

Activity	Fuel Consumed (TJ/year)				
	Diesel	Natural Gas	LPG	Coal	Total
Aircraft manufacturing	0	67.0	0	0	**67.0**
Automotive component manufacturing n.e.c.	0	6.00	0	0	**6.00**
Basic iron and steel manufacturing	0	155	0	0	**155**
Basic non-ferrous metal manufacturing n.e.c.	0	26.7	0	0	**26.7**
Beer and malt manufacturing	0	136	0	0	**136**
Biscuit manufacturing	0	198	0	0	**198**
Bread manufacturing	0	378	0	0	**378**
Cake and pastry manufacturing	0	38.1	0	0	**38.1**
Ceramic product manufacturing	0	29.3	0	0	**29.3**
Ceramic product manufacturing n.e.c.	0	0	0.514	0	**0.514**
Chemical product manufacturing n.e.c.	0	133	0	0	**133**
Confectionery manufacturing	0	22.0	0	0	**22.0**
Corrugated paperboard container manufacturing	0	137	0	0	**137**
Electrical and equipment manufacturing n.e.c.	0	1.05	0	0	**1.05**
Fabricated metal product manufacturing n.e.c.	0	46.2	0.0272	0	**46.2**
Food manufacturing n.e.c.	3.27	340	53.4	43.5	**440**
Fruit and vegetable processing	0	70.9	0	0	**70.9**
Furniture manufacturing n.e.c.	0	45.4	0	0	**45.4**
Gas supply	0	88.1	0	0	**88.1**
Glass and glass product manufacturing	0	165	0.463	0	**165**
Hospitals	1.39	1,529	4.13	0	**1,534**
Ice cream manufacturing	0	29.3	0	0	**29.3**
Industrial gas manufacturing	0	0	0.201	0	**0.201**
Laundries and dry-cleaners	0	112	0	0	**112**
Log sawmilling	0	52.4	0	135	**188**
Medicinal and pharmaceutical product manufacturing	0	83.9	1.542	0	**85.4**
Metal coating and finishing	0	147	0.0293	0	**147**
Milk and cream processing	0	29.3	0	0	**29.3**
Non-building construction n.e.c.	0	0	2.52	0	**2.52**
Non-ferrous metal casting	0.463	0	0	0	**0.463**
Non-metallic mineral product manufacturing n.e.c.	0	13.8	0	0	**13.8**
Oil and fat manufacturing	0	152	0	0	**152**
Organic industrial chemical manufacturing n.e.c.	0	0.716	0	0	**0.716**
Paper product manufacturing n.e.c.	0.201	32.4	0	0	**32.6**
Plaster product manufacturing	0	390	0	0	**390**
Plastic injection moulded product manufacturing	0.154	84.3	0.227	0	**84.6**
Plastic product, rigid fibre reinforced, manufacturing	0	39.8	0	0	**39.8**
Poultry farming (meat)	0	32.9	0	0	**32.9**
Prepared animal and bird feed manufacturing	0.0926	37.1	0	0	**37.2**
Printing	0.0386	404	0	0	**404**
Rubber product manufacturing n.e.c.	0.463	0	0	0	**0.463**

Activity	Fuel Consumed (TJ/year)				
	Diesel	Natural Gas	LPG	Coal	Total
Scientific research	0	26.4	0	0	**26.4**
Services to air transport	0	64.0	0	0	**64.0**
Soft drink, cordial and syrup manufacturing	0	98.5	0	0	**98.5**
Spring and wire product manufacturing	0	0.129	0.0643	0	**0.193**
Synthetic resin manufacturing	0	41.5	0	0	**41.5**
Waste disposal services	2.51	197	0.247	0	**199**
Wine manufacturing	0	0	0.0258	0	**0.0258**
Wood product manufacturing n.e.c.	0	0.0142	0	0	**0.0142**
Grand Total	**8.59**	**5,680**	**63.4**	**179**	**5,931**

a Energy values used: Diesel: 38.6 MJ/L; Natural gas: 38.3 MJ/m³; LPG: 25.7 MJ/L; Black coal: 23.4 GJ/t; (ABARE, 2009b)

Figure 4-2 shows the proportion of total fuel consumption by commercial activity type for the 2008 calendar year in the GMR.

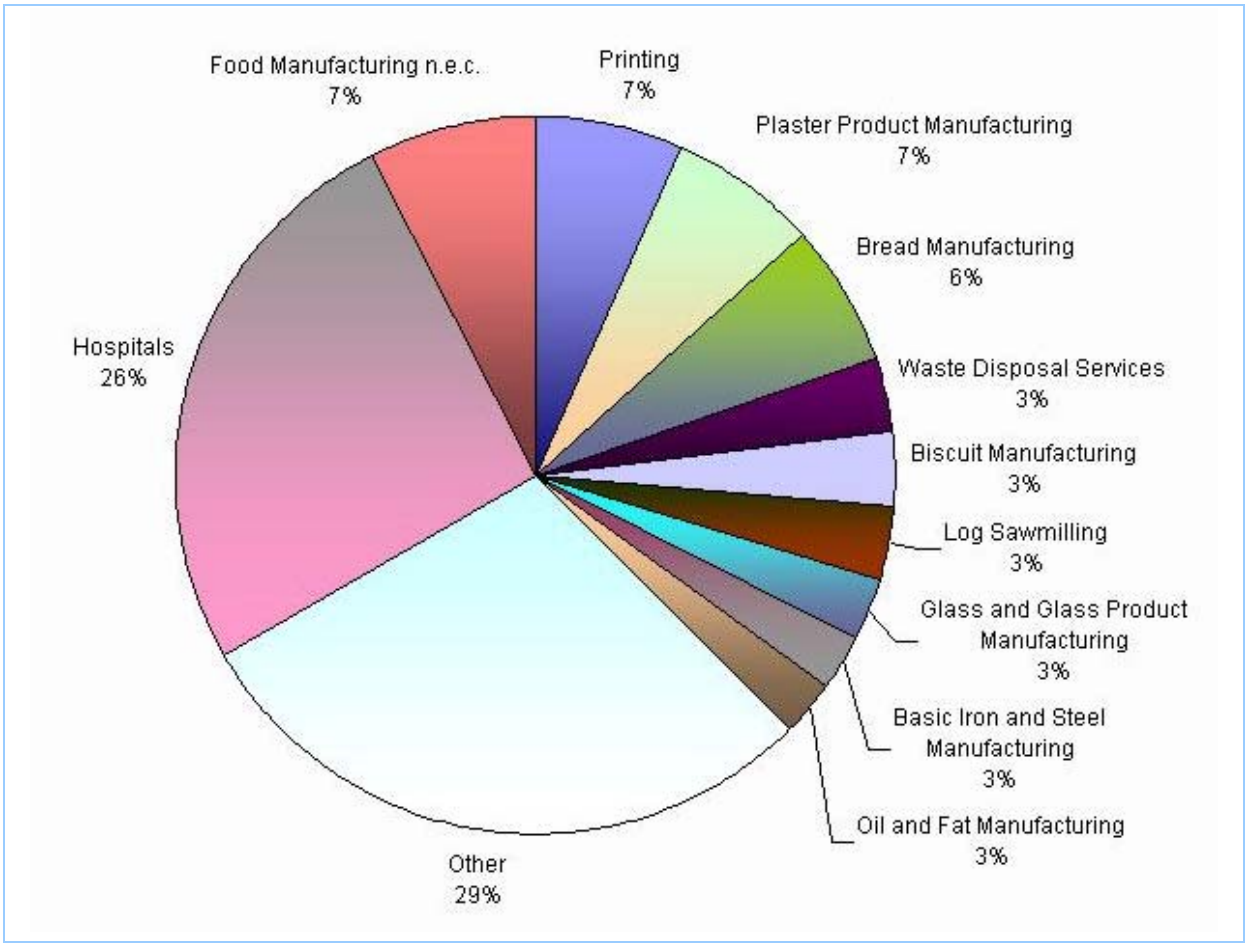

Figure 4-2: Proportion of total fuel consumption by commercial activity type in the GMR

4.3 Emissions Summary

Table 4-3 shows the total estimated annual emissions (for selected substances) from all commercial sources in the GMR, Sydney, Newcastle, Wollongong and Non Urban regions.

Table 4-3: Total estimated annual emissions from commercial sources in each region

Substance	Emissions (tonne/year)				
	Sydney	Newcastle	Wollongong	Non Urban	GMR
1,3 BUTADIENE	1.52	0.210	0.0637	0.323	2.12
ACETALDEHYDE	2.58	0.002	0.0007	0.0042	2.59
BENZENE	38.2	3.23	2.54	11.1	55.1
CARBON MONOXIDE	335	9.20	19.7	24.3	389
FORMALDEHYDE	48.4	0.110	0.168	0.50	49.2
ISOMERS OF XYLENE	87.9	4.70	2.77	47.7	143
LEAD AND COMPOUNDS	0.394	0.0045	0.0013	0.0362	0.436
OXIDES OF NITROGEN	344	38.5	12.1	106	501
PARTICULATE MATTER ≤ 10 µm	1,111	129	47.7	732	2,020
PARTICULATE MATTER ≤ 2.5 µm	485	30.0	13.9	167	695
POLYCYCLIC AROMATIC HYDROCARBONS	0.012	0.0001	0.0002	0.0004	0.013
SULFUR DIOXIDE	108	1.62	0.73	69.8	180
TETRACHLOROETHYLENE	358	21.4	16.9	59.7	456
TOLUENE	424	18.1	10.3	66.8	520
TOTAL SUSPENDED PARTICULATE	3,332	327	121	2,416	6,195
TOTAL VOLATILE ORGANIC COMPOUNDS	6,652	476	358	1,689	9,176
TRICHLOROETHYLENE	58.7	0.00004	0.0001	0.016	58.7

Figure 4-3 shows the proportion of total estimated annual emissions (for selected substances) from all commercial sources in the GMR, Sydney, Newcastle, Wollongong and Non Urban regions.

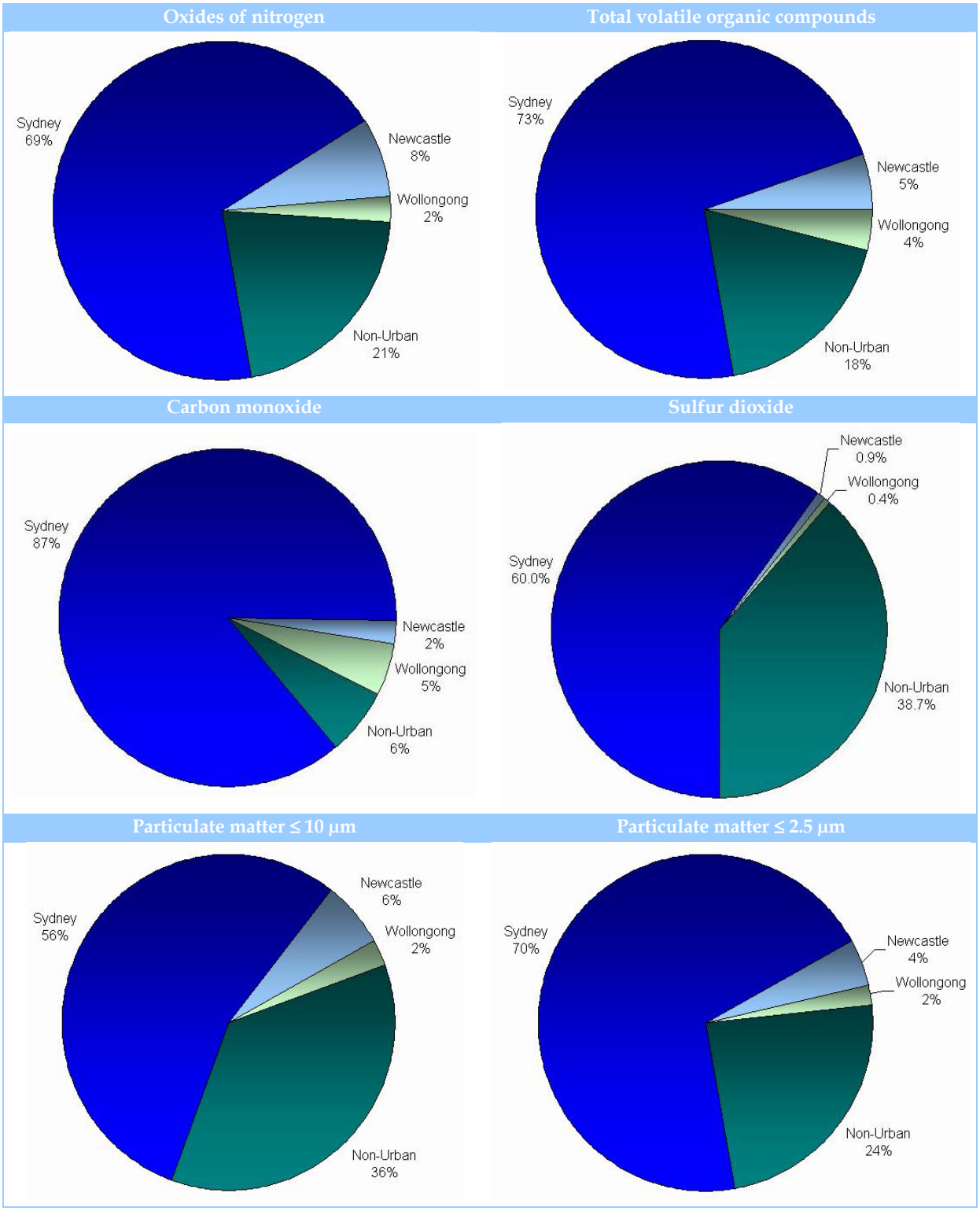

Figure 4-3: Proportion of total estimated annual emissions from commercial sources in each region

Table 4-4 shows total estimated annual emissions (for selected substances) from each commercial source type in the GMR.

Table 4-4: Total estimated annual emissions by commercial source type in the GMR

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Agricultural machinery manufacturing	0	0	0	0	0	0	0.00023
Aircraft manufacturing	2.35	2.8	0.213	0.213	0.213	0.0146	0.154
Aluminium rolling, drawing, extruding	0	0	0.0705	0.0705	0.0705	0	0
Automotive component manufacturing n.e.c.	0.21	0.251	1.21	0.25	0.0771	0.00131	14
Automotive fuel retailing	0	0	0	0	0	0	4,910
Basic iron and steel manufacturing	5.42	8.6	14.9	9.91	8.32	0.0337	12.3
Basic non-ferrous metal manufacturing n.e.c.	0.936	1.12	15.8	10	7.55	0.134	0.965
Beer and malt manufacturing	4.77	5.68	3.39	3.39	3.39	8.91	21.9
Biscuit manufacturing	6.94	8.26	0.628	0.628	0.628	0.0432	0.454
Bread manufacturing	13.3	15.8	2.25	1.53	1.39	0.0826	143
Cake and pastry manufacturing	1.34	1.59	0.121	0.121	0.121	0.00832	12.2
Ceramic product manufacturing	28.6	6.44	49.6	30.8	23.2	47.7	0.63
Ceramic product manufacturing n.e.c.	0.0048	0.0348	0.00111	0.00108	0.00107	0	0.00084
Chemical product manufacturing n.e.c.	4.54	5.54	30.8	9.52	1.92	29.6	520
Chemical wholesaling	0	0	7.9	1.52	0.367	0	81.4
Concrete slurry manufacturing	0	0	20.2	7.06	1.12	0	0.00006
Confectionery manufacturing	0.353	1.41	0.0746	0.0708	0.0702	0.00481	1.35
Construction material mining n.e.c.	0	0	106	50.3	10.3	0	0.00603
Corrugated paperboard container manufacturing	4.82	5.74	0.436	0.436	0.436	0.03	0.316
Electric cable and wire manufacturing	0	0	3.33	1.22	0.722	0	84
Electrical and equipment manufacturing n.e.c.	0.0368	0.422	0.429	0.429	0.429	0.00023	4.18
Explosive manufacturing	0	0	0	0	0	0	0.0213
Fabricated metal product manufacturing n.e.c.	1.64	3.41	12.4	4.85	3.48	0.0101	105
Food manufacturing n.e.c.	13	29.2	2.37	1.65	1.37	17.8	6.21
Fruit and vegetable processing	2.49	1.48	0.225	0.225	0.225	0.0155	0.163
Funeral directors,	3.07	6.73	0.318	0.0955	0.0636	11.9	0.283

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
crematoria and cemeteries							
Furniture manufacturing n.e.c.	1.59	1.9	0.15	0.145	0.144	0.00991	7.24
Gas supply	3.09	3.68	0.28	0.28	0.28	0.0192	0.202
Glass and glass product manufacturing	3.72	3.92	8.58	8.41	8.26	0.176	2.86
Gravel and sand quarrying	0	0	5,080	1,390	306	0	0.105
Hospitals	54.2	66.5	5.01	5	5	0.469	3.79
Ice cream manufacturing	0.294	2.08	0.11	0.0964	0.0938	0.00639	0.438
Industrial gas manufacturing	0.00188	0.0136	2.77	0.75	0.0868	0	5.82
Ink manufacturing	0	0	0.688	0.619	0.611	0	10.6
Laundries and dry-cleaners	3.87	4.68	0.356	0.356	0.356	0.0245	474
Lifting and material handling equipment manufacturing	0	0.124	0.0245	0.0245	0.0245	0	0.745
Log sawmilling	3.29	64.8	45.2	18.4	7.42	49.5	90
Medicinal and pharmaceutical product manufacturing	2.96	3.61	0.27	0.27	0.27	0.0183	2.04
Metal coating and finishing	5.16	32.4	25	14.6	12.5	0.0321	21.5
Milk and cream processing	1.03	1.22	0.093	0.093	0.093	0.0064	0.0673
Mining and construction machinery manufacturing	0	0	0.00508	0.00114	0.00043	0	1.28
Non-building construction n.e.c.	0.0236	0.171	2.47	0.477	0.119	0	0.00412
Non-ferrous metal casting	0.0072	0.0288	0.384	0.244	0.183	0.0217	0.00064
Non-metallic mineral product manufacturing n.e.c.	0.485	0.577	0.0439	0.0439	0.0439	0.00302	106
Oil and fat manufacturing	5.32	11.4	0.482	0.482	0.482	0.0331	0.349
Organic industrial chemical manufacturing n.e.c.	0.0251	0.0299	0.00227	0.00227	0.00227	0.00016	4.54
Paint manufacturing	0	0	34.3	29.3	28.3	0	124
Paper product manufacturing n.e.c.	1.22	1.73	0.13	0.129	0.129	0.0319	0.498
Petroleum product wholesaling	0	0	2.35	0.504	0.0988	0	125
Plaster product manufacturing	138	37.3	16.1	13.6	7.81	3.4	3.41
Plastic bag and film manufacturing	0	0	0.899	0.899	0.832	0	17.7
Plastic injection moulded product manufacturing	2.96	3.54	20.3	5.96	0.839	0.0218	0.441

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Plastic product, rigid fibre reinforced, manufacturing	1.4	1.66	0.433	0.194	0.139	0.00869	43.4
Port operators	31.3	102	8.95	8.95	8.95	9.94	13.7
Poultry farming (eggs)	0	0	116	50.5	11.6	0	0
Poultry farming (meat)	1.16	1.38	303	132	30.3	0.00719	0.0757
Prepared animal and bird feed manufacturing	1.3	1.55	0.118	0.118	0.118	0.0101	0.0853
Printing	14.9	26	1.46	1.46	1.46	0.0933	1,320
Rail transport	0	0	0	0	0	0	0.00126
Railway equipment manufacturing	0	0	0	0	0	0	0.058
Road and bridge construction	0	0	12.7	3.5	0.407	0	0.0149
Rubber product manufacturing n.e.c.	0.0072	0.0288	0.28	0.0769	0.0111	0.0102	0.00687
Scientific research	0.927	0.552	0.0839	0.0839	0.0839	0.00577	0.0607
Services to air transport	2.24	2.67	0.203	0.203	0.203	0.014	71.4
Smash repairing	0	0	0	0	0	0	393
Soap and other detergent manufacturing	0	0	2.35	0.665	0.0674	0	0.0289
Soft drink, cordial and syrup manufacturing	3.46	4.12	0.313	0.313	0.313	0.0215	2.24
Solid paperboard container manufacturing	0	0	0	0	0	0	15.3
Spirit manufacturing	0	0	0	0	0	0	66.8
Spring and wire product manufacturing	0.00512	0.781	5.48	1.16	0.383	0.00003	0.381
Steel pipe and tube manufacturing	0	0.744	5.81	4.78	4.56	0	0.00123
Structural metal product manufacturing n.e.c.	0	0	0.007	0.007	0.007	0	2.49
Structural steel fabricating	0	0	2.04	0.4	0.104	0	0
Synthetic resin manufacturing	1.46	1.73	212	191	189	0.00905	270
Waste disposal services	9.22	13	1.77	1.7	1.67	0.353	33.2
Wine manufacturing	0.00024	0.00175	0.00006	0.00005	0.00005	0	24.1
Wood product manufacturing n.e.c.	0.0005	0.0006	1.21	0.232	0.0561	0	5.42
Wooden furniture and upholstered seat manufacturing	0	0	0	0	0	0	1.77
Grand Total	**389**	**501**	**6,190**	**2,020**	**695**	**180**	**9,180**

The proportion of total estimated annual emissions (for selected substances) from each commercial source type in the GMR are shown in Figure 4-4 to Figure 4-9.

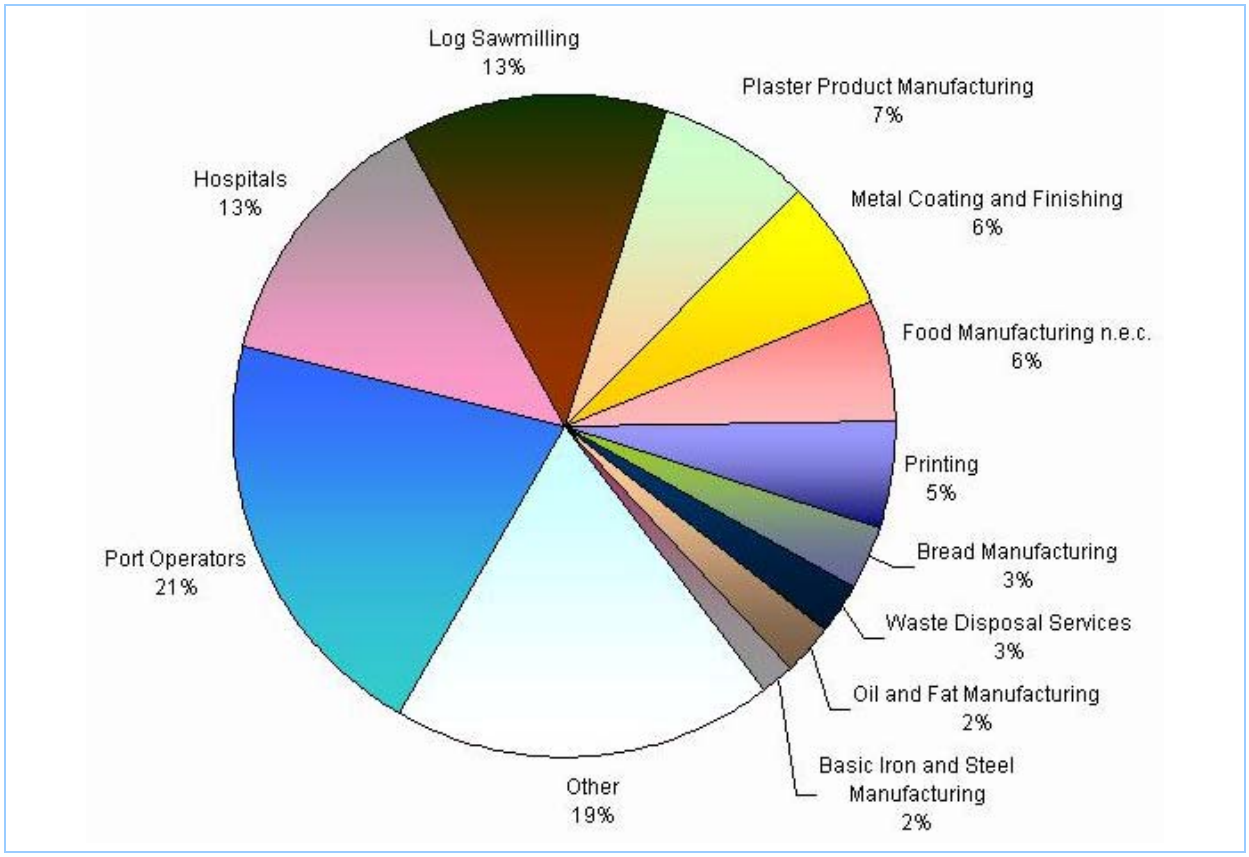

Figure 4-4: Proportion of NO_x emissions by commercial activity type in the GMR

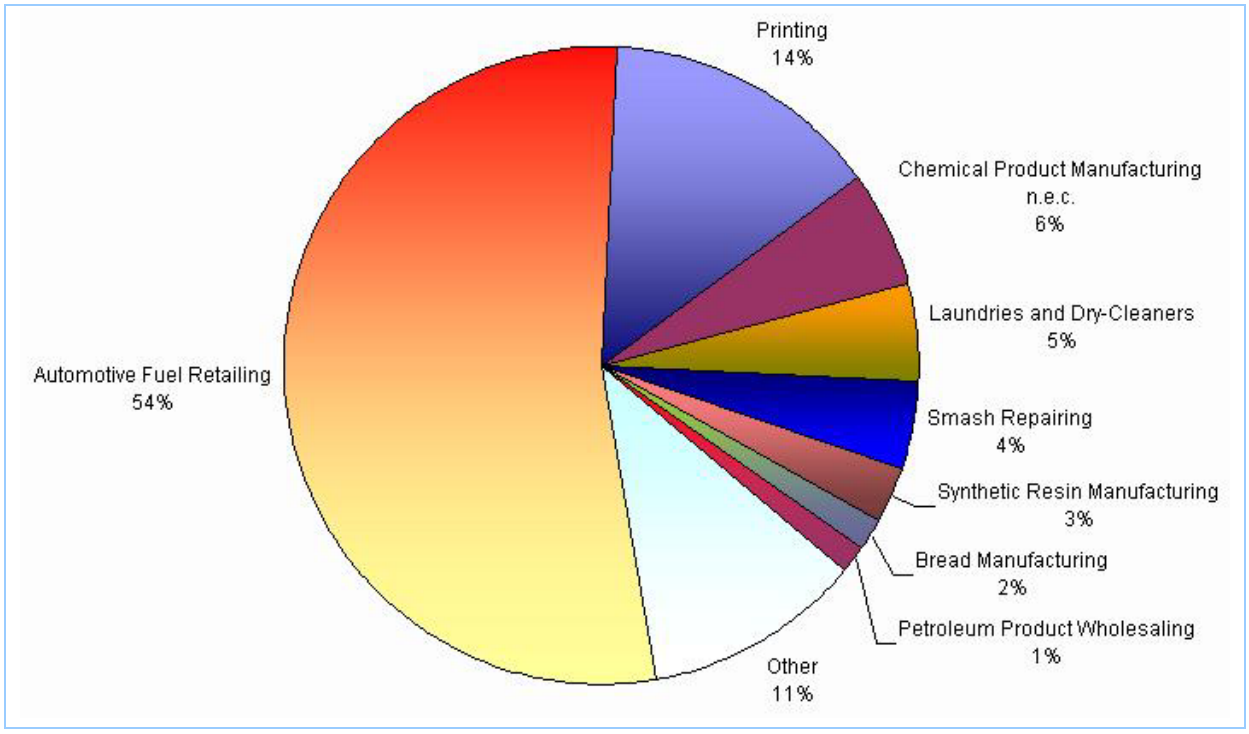

Figure 4-5: Proportion of VOC emissions by commercial activity type in the GMR

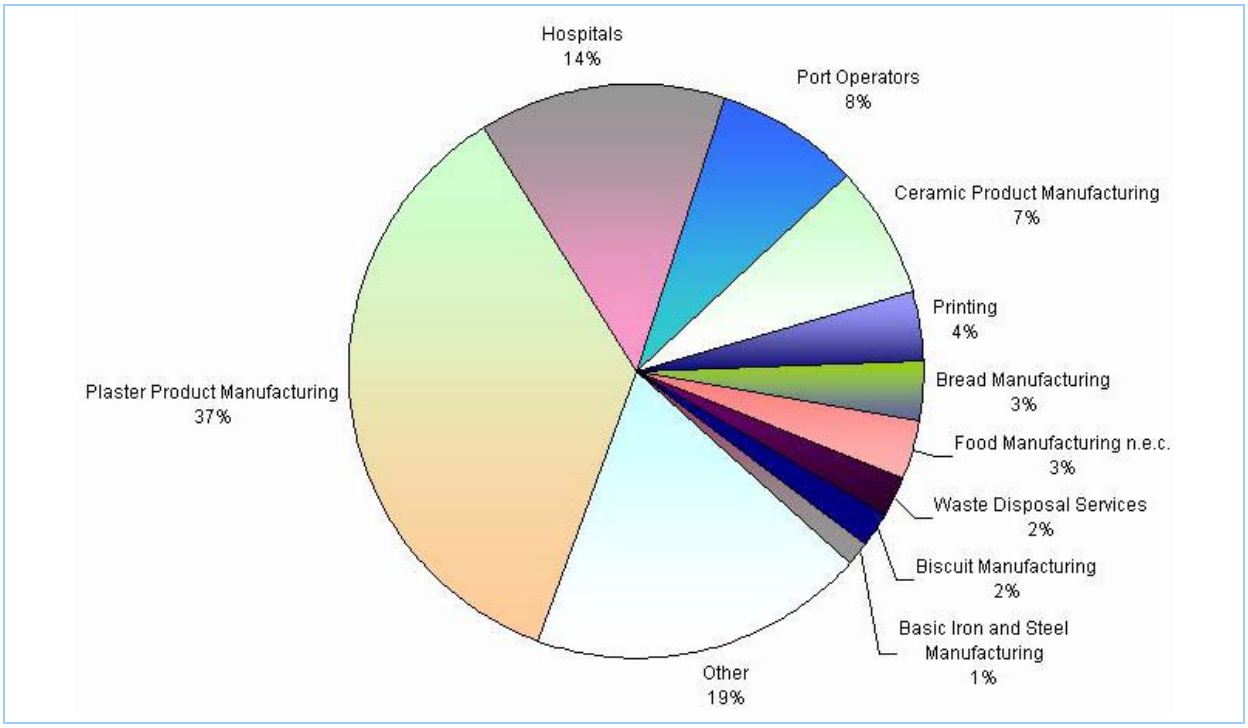

Figure 4-6: Proportion of CO emissions by commercial activity type in the GMR

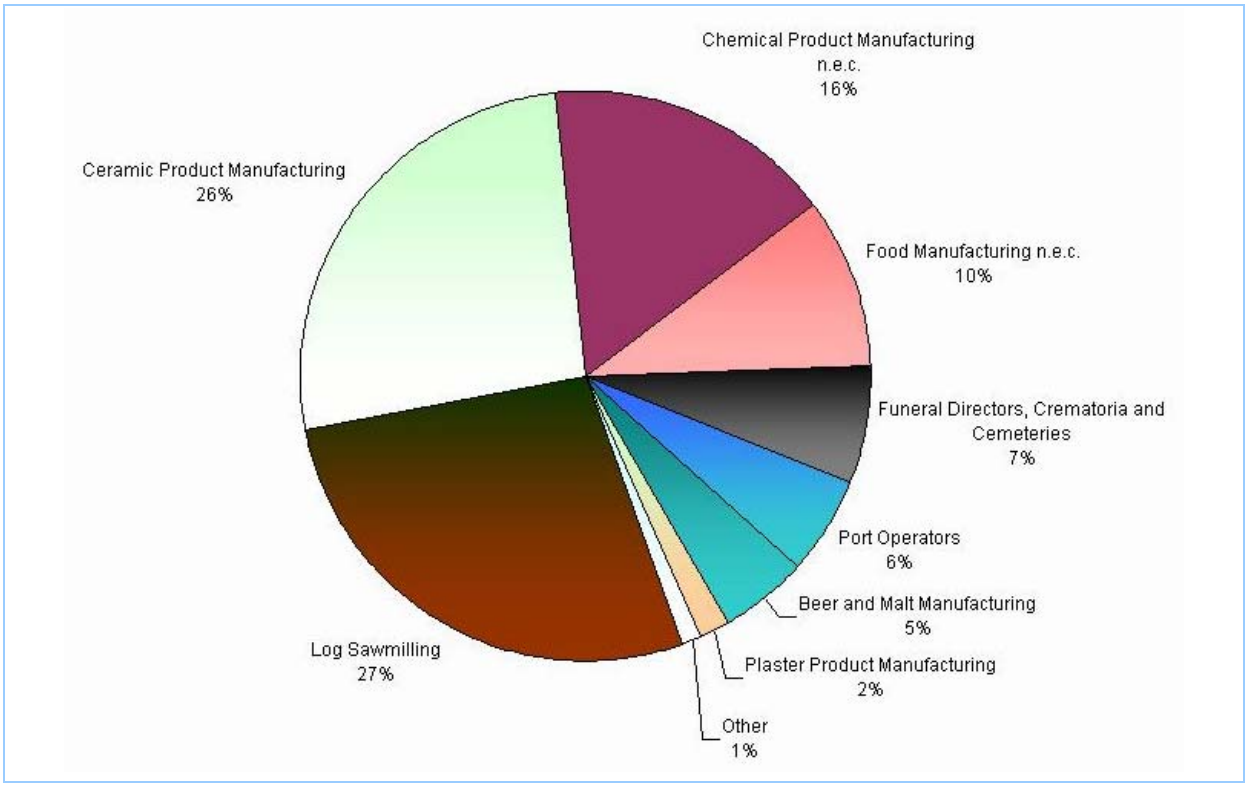

Figure 4-7: Proportion of SO_2 emissions by commercial activity type in the GMR

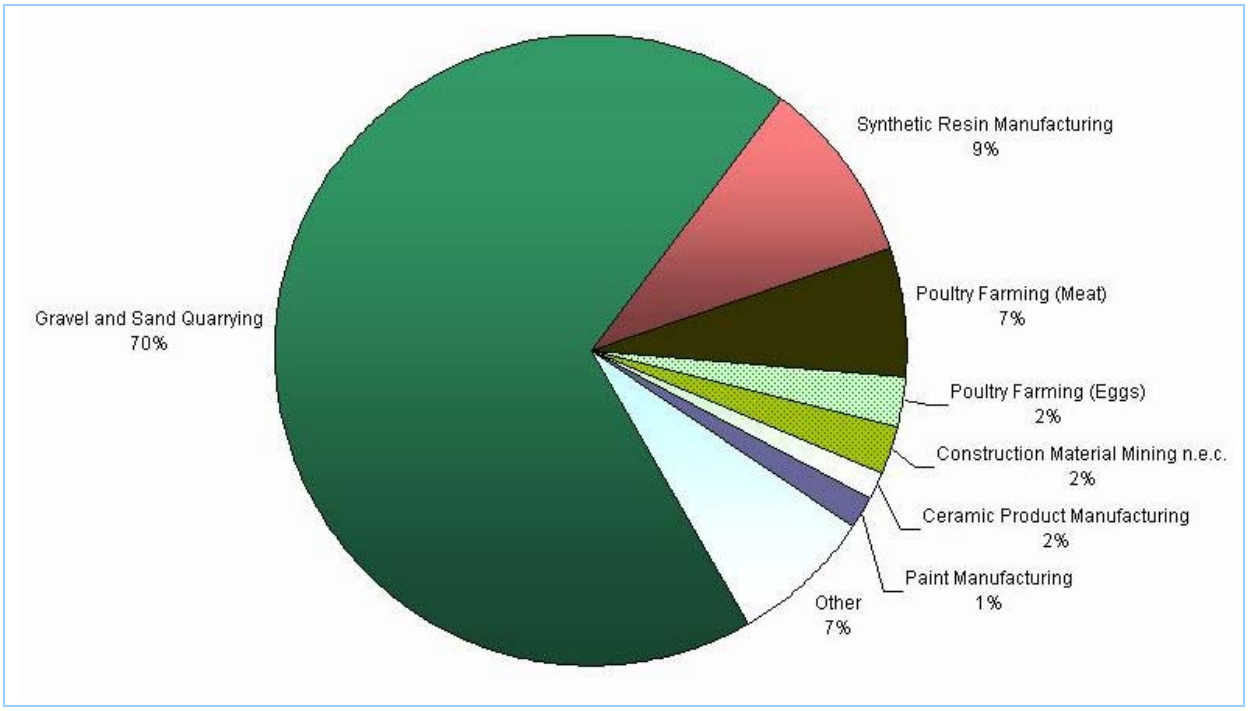

Figure 4-8: Proportion of PM_{10} emissions by commercial activity type in the GMR

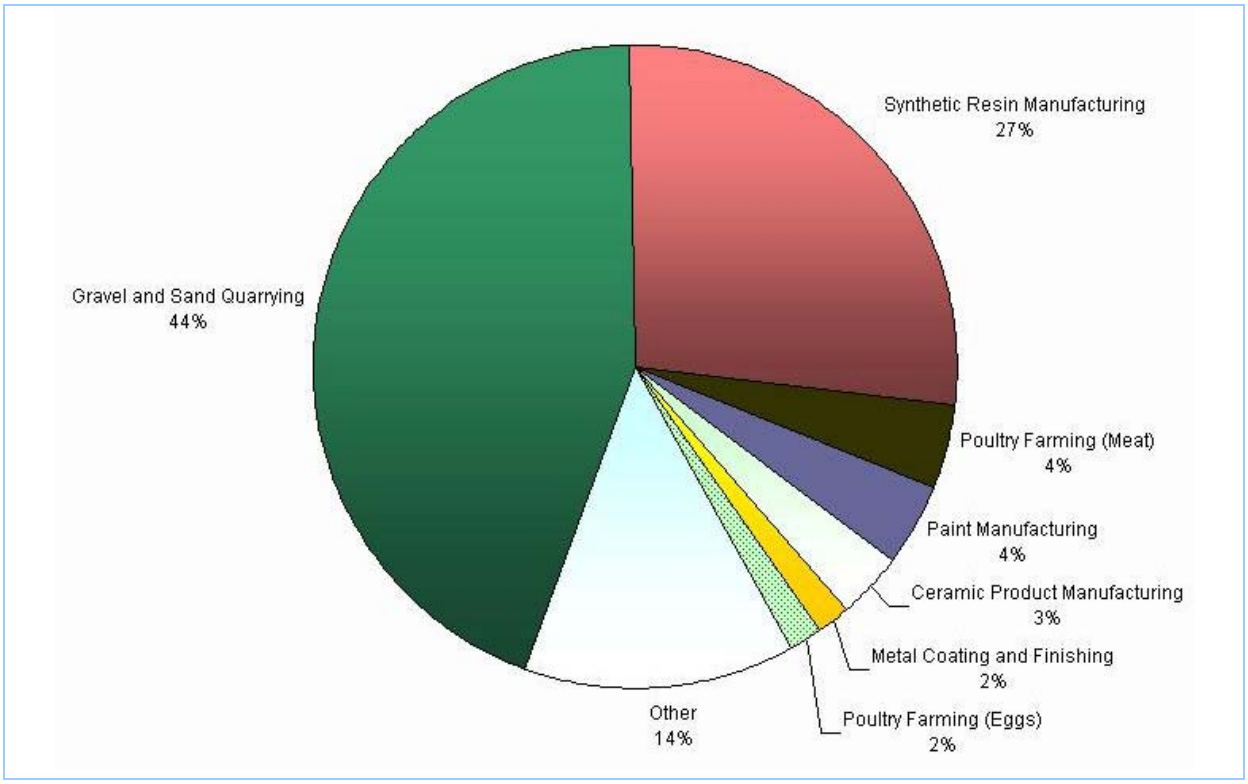

Figure 4-9: Proportion of $PM_{2.5}$ emissions by commercial activity type in the GMR

Table 4-5 shows total estimated annual emissions (for selected substances) from each commercial source type in the Sydney region.

Table 4-5: Total estimated annual emissions by commercial source type in the Sydney region

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Agricultural machinery manufacturing	0	0	0	0	0	0	0.00023
Aircraft manufacturing	2.35	2.8	0.213	0.213	0.213	0.0146	0.154
Automotive component manufacturing n.e.c.	0.208	0.247	1.21	0.25	0.0768	0.00129	12.7
Automotive fuel retailing	0	0	0	0	0	0	2,940
Basic iron and steel manufacturing	0.853	3.16	14.4	9.45	7.86	0.0053	12
Basic non-ferrous metal manufacturing n.e.c.	0.936	1.12	15.8	10	7.55	0.134	0.965
Beer and malt Manufacturing	4.77	5.68	3.39	3.39	3.39	8.91	21.9
Biscuit manufacturing	6.94	8.26	0.628	0.628	0.628	0.0432	0.454
Bread manufacturing	11.6	13.8	1.05	1.05	1.05	0.0721	132
Cake and pastry manufacturing	1.34	1.59	0.121	0.121	0.121	0.00832	12.2
Ceramic product manufacturing	15.7	2.57	41.6	23.3	21.3	47.5	0.153
Chemical product manufacturing n.e.c.	4.54	5.54	30.8	9.51	1.91	29.6	510
Chemical wholesaling	0	0	6.75	1.29	0.313	0	81.4
Concrete slurry manufacturing	0	0	13.2	4.52	0.716	0	0.00006
Confectionery manufacturing	0.353	1.41	0.0746	0.0708	0.0702	0.00481	1.35
Corrugated paperboard container manufacturing	4.82	5.74	0.436	0.436	0.436	0.03	0.316
Electrical and equipment manufacturing n.e.c.	0.0368	0.422	0.429	0.429	0.429	0.00023	4.18
Fabricated metal product manufacturing n.e.c.	0.87	2.08	11.9	4.54	3.21	0.00532	103
Food manufacturing n.e.c.	6.9	8.22	0.714	0.642	0.629	0.0429	5.72
Fruit and vegetable processing	2.49	1.48	0.225	0.225	0.225	0.0155	0.163
Funeral directors, crematoria and cemeteries	1.95	4.27	0.202	0.0605	0.0403	7.51	0.18
Furniture manufacturing n.e.c.	0	0	0.00086	0.00017	0.00004	0	2.84
Gas supply	3.09	3.68	0.28	0.28	0.28	0.0192	0.202
Glass and glass product manufacturing	3.71	3.88	8.57	8.4	8.25	0.174	2.86
Gravel and sand quarrying	0	0	2590	646	145	0	0.0477
Hospitals	38	45.6	3.44	3.44	3.44	0.256	2.62

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Ice cream manufacturing	0.294	2.08	0.11	0.0964	0.0938	0.00639	0.438
Industrial gas manufacturing	0.00188	0.0136	2.77	0.75	0.0868	0	5.82
Ink manufacturing	0	0	0.688	0.619	0.611	0	10.6
Laundries and dry-cleaners	3.87	4.68	0.356	0.356	0.356	0.0245	372
Lifting and material handling equipment manufacturing	0	0.124	0.0245	0.0245	0.0245	0	0.745
Medicinal and pharmaceutical product manufacturing	2.44	2.99	0.223	0.223	0.223	0.0151	1.35
Metal coating and finishing	2.7	3.83	11.3	9.85	9.28	0.0168	20.9
Milk and cream processing	1.03	1.22	0.093	0.093	0.093	0.0064	0.0673
Non-building construction n.e.c.	0.0165	0.119	2.46	0.476	0.118	0	0.00288
Non-metallic mineral product manufacturing n.e.c.	0.485	0.577	0.0439	0.0439	0.0439	0.00302	106
Oil and fat manufacturing	5.32	11.4	0.482	0.482	0.482	0.0331	0.349
Organic industrial chemical manufacturing n.e.c.	0.0251	0.0299	0.00227	0.00227	0.00227	0.00016	4.54
Paint manufacturing	0	0	34.3	29.3	28.3	0	124
Paper product manufacturing n.e.c.	1.14	1.35	0.103	0.103	0.103	0.00707	0.471
Petroleum product wholesaling	0	0	1.78	0.341	0.0825	0	53
Plaster product manufacturing	138	37.3	16.1	13.6	7.81	3.4	3.41
Plastic bag and film manufacturing	0	0	0.899	0.899	0.832	0	17.7
Plastic injection moulded product manufacturing	2.96	3.54	20.3	5.96	0.839	0.0218	0.441
Plastic product, rigid fibre reinforced, manufacturing	1.4	1.66	0.22	0.153	0.129	0.00869	20.4
Port operators	31.3	102	8.95	8.95	8.95	9.94	13.7
Poultry farming (eggs)	0	0	104	45.4	10.4	0	0
Poultry farming (meat)	1.16	1.38	147	64.1	14.8	0.00719	0.0757
Prepared animal and bird feed manufacturing	0.00144	0.00576	0.00032	0.00031	0.00031	0.00204	0.0001
Printing	14.9	26	1.46	1.46	1.46	0.0933	1,300
Railway equipment manufacturing	0	0	0	0	0	0	0.058
Road and bridge construction	0	0	12.6	3.44	0.394	0	0
Rubber product	0	0	0.00191	0.00578	0	0	0.006

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
manufacturing n.e.c.							
Scientific research	0.927	0.552	0.0839	0.0839	0.0839	0.00577	0.0607
Services to air transport	2.24	2.67	0.203	0.203	0.203	0.014	71.4
Smash repairing	0	0	0	0	0	0	308
Soap and other detergent manufacturing	0	0	2.35	0.665	0.0674	0	0.0289
Soft drink, cordial and syrup manufacturing	3.46	4.12	0.313	0.313	0.313	0.0215	2.24
Solid paperboard container manufacturing	0	0	0	0	0	0	15.3
Spirit manufacturing	0	0	0	0	0	0	66.8
Spring and wire product manufacturing	0.00452	0.00538	0.242	0.0468	0.0116	0.00003	0.00051
Steel pipe and tube manufacturing	0	0.744	1.91	1.27	1.05	0	0.00123
Structural metal product manufacturing n.e.c.	0	0	0.007	0.007	0.007	0	2.49
Structural steel fabricating	0	0	2.04	0.4	0.104	0	0
Synthetic resin manufacturing	0.9	1.07	212	191	189	0.0056	268
Waste disposal services	9.22	13	1.77	1.7	1.67	0.353	17.3
Wine manufacturing	0.00024	0.00175	0.00006	0.00005	0.00005	0	3.18
Wood product manufacturing n.e.c.	0.0005	0.0006	1.07	0.206	0.0499	0	0.00003
Wooden furniture and upholstered seat manufacturing	0	0	0	0	0	0	1.77
Grand Total	**335**	**344**	**3,330**	**1,110**	**485**	**108**	**6,650**

The proportion of total estimated annual emissions (for selected substances) from each commercial source type in the Sydney region are shown in Figure 4-10 to Figure 4-15.

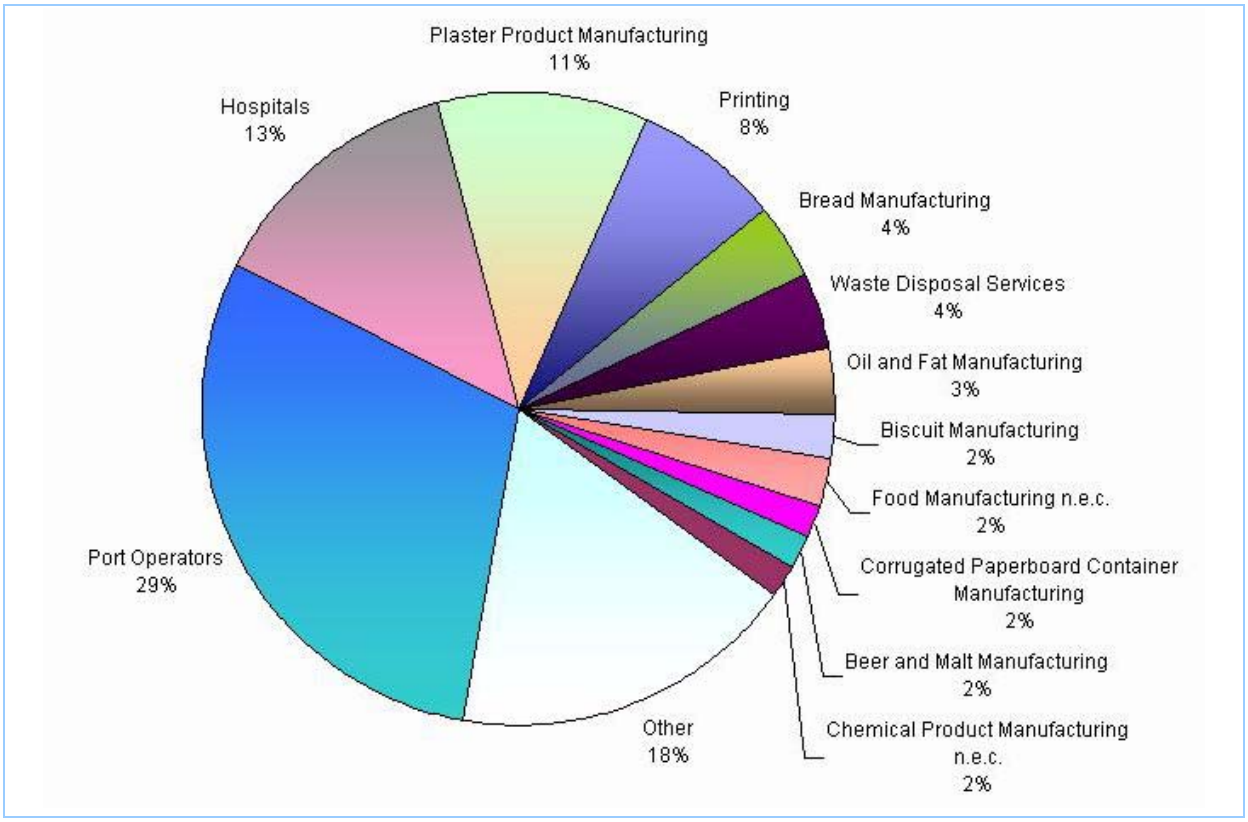

Figure 4-10: Proportion of NO_x emissions by commercial activity type in the Sydney region

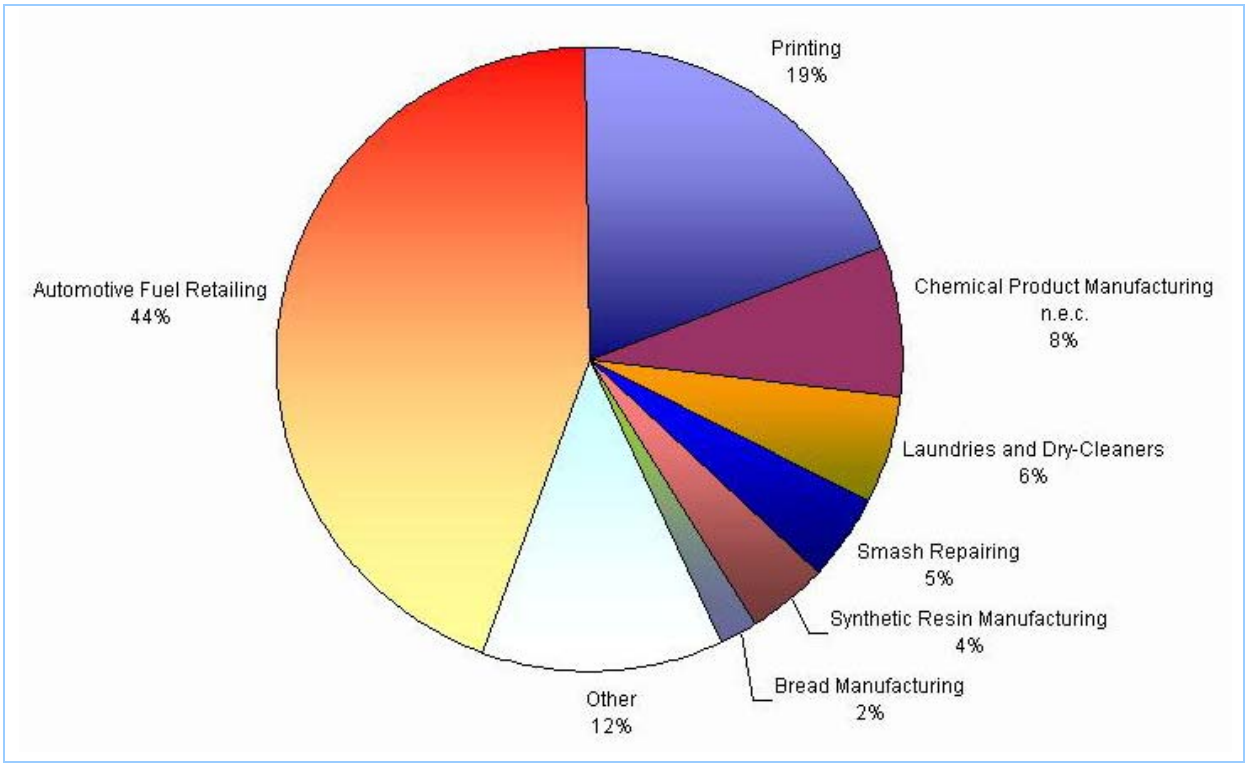

Figure 4-11: Proportion of VOC emissions by commercial activity type in the Sydney region

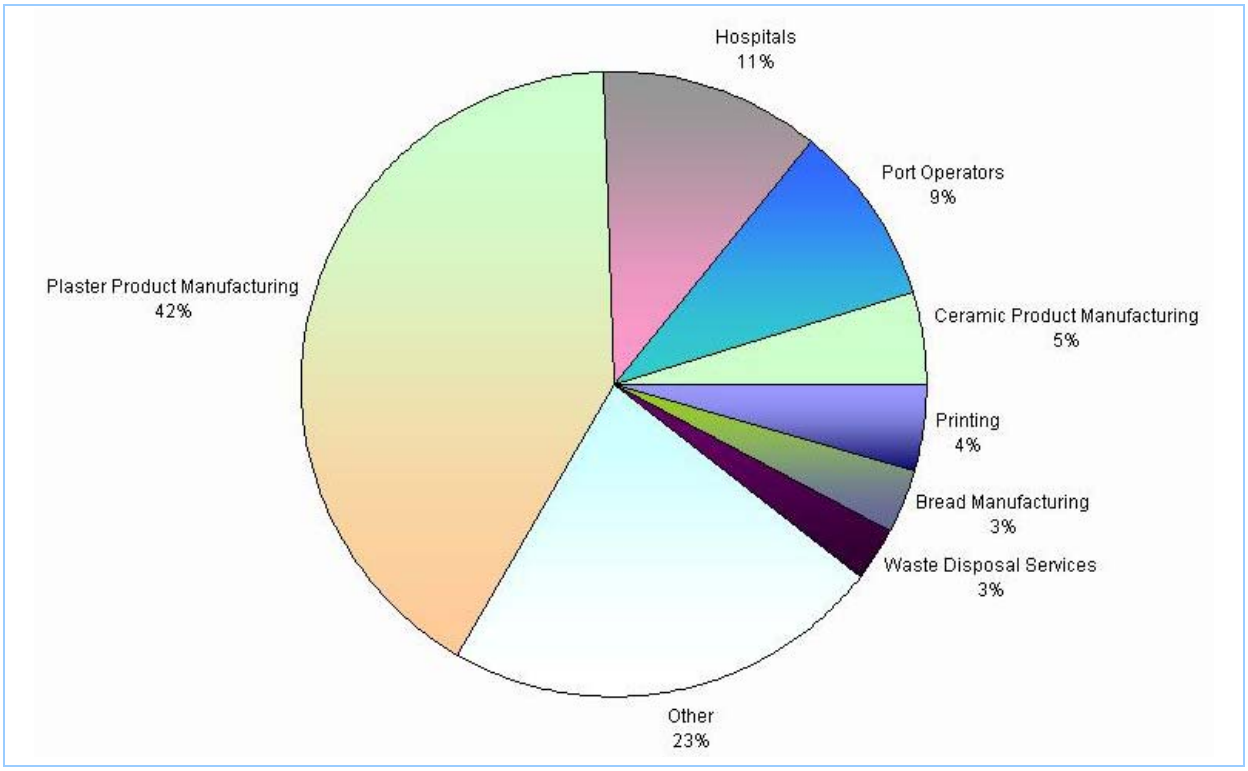

Figure 4-12: Proportion of CO emissions by commercial activity type in the Sydney region

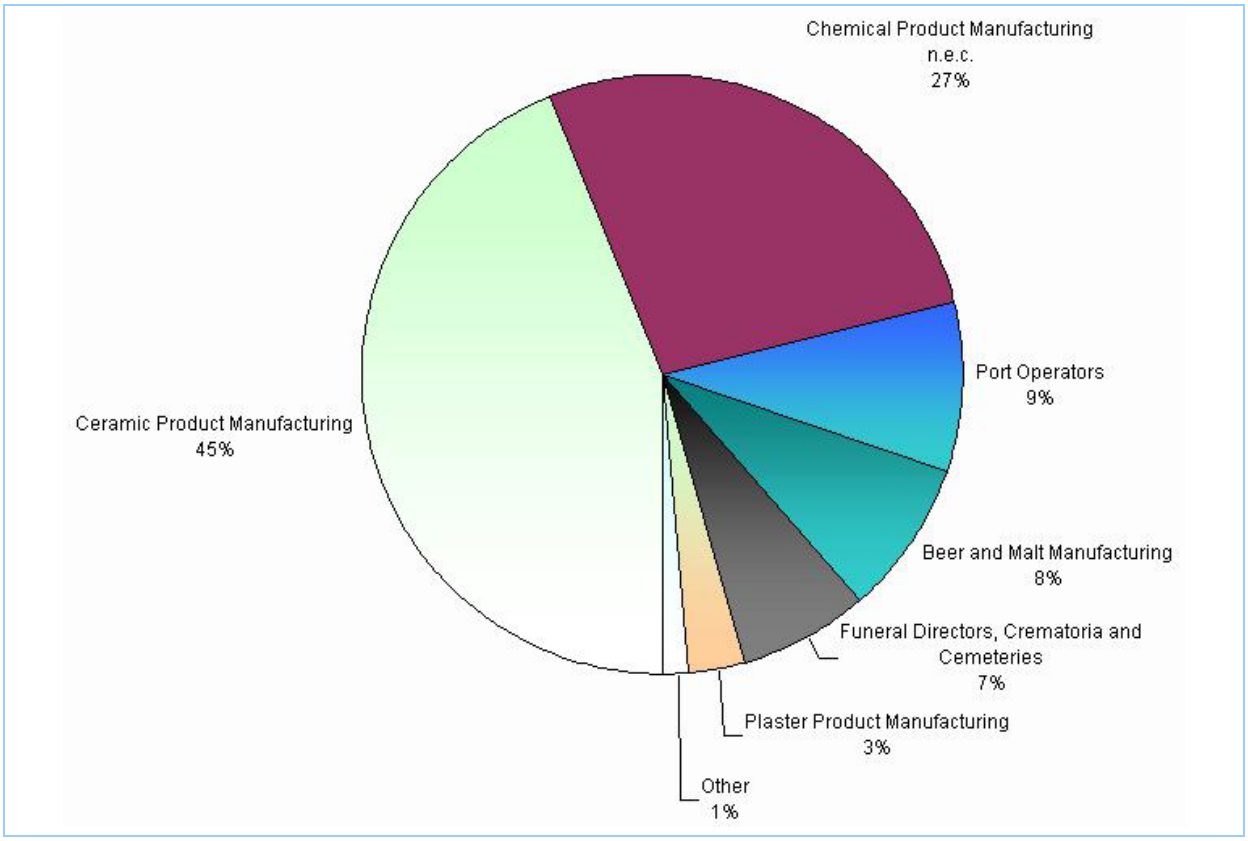

Figure 4-13: Proportion of SO_2 emissions by commercial activity type in the Sydney region

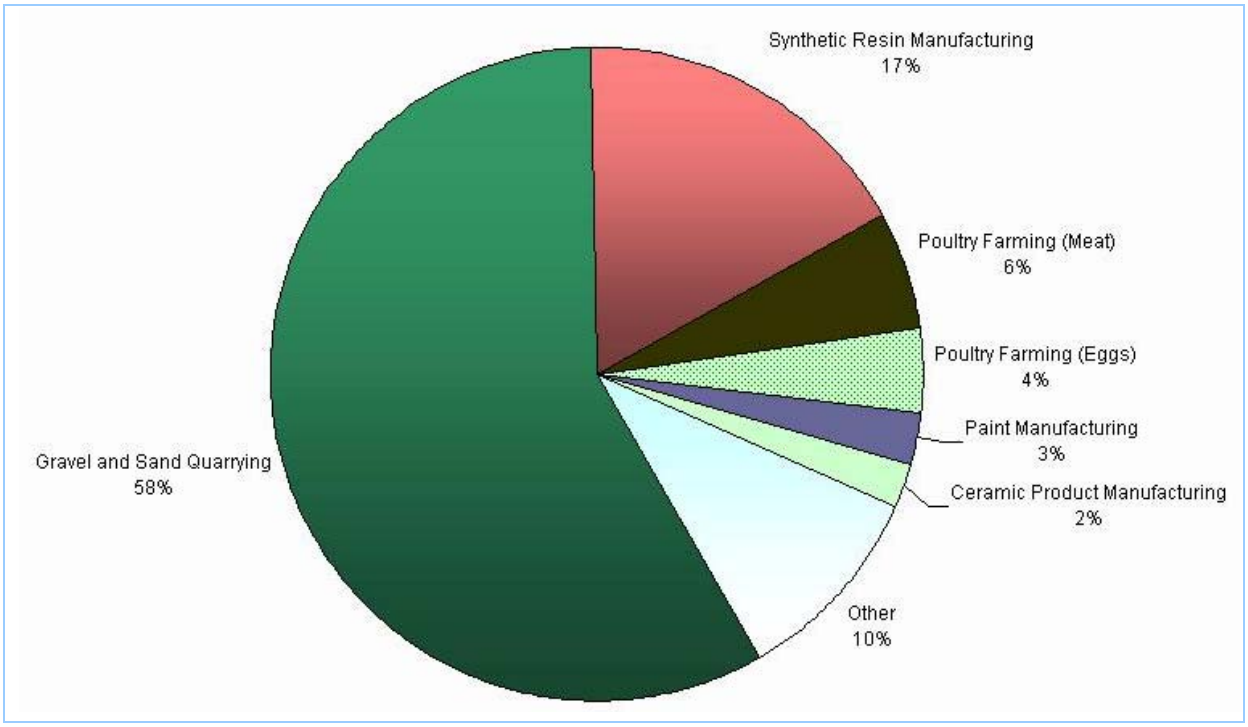

Figure 4-14: Proportion of PM_{10} emissions by commercial activity type in the Sydney region

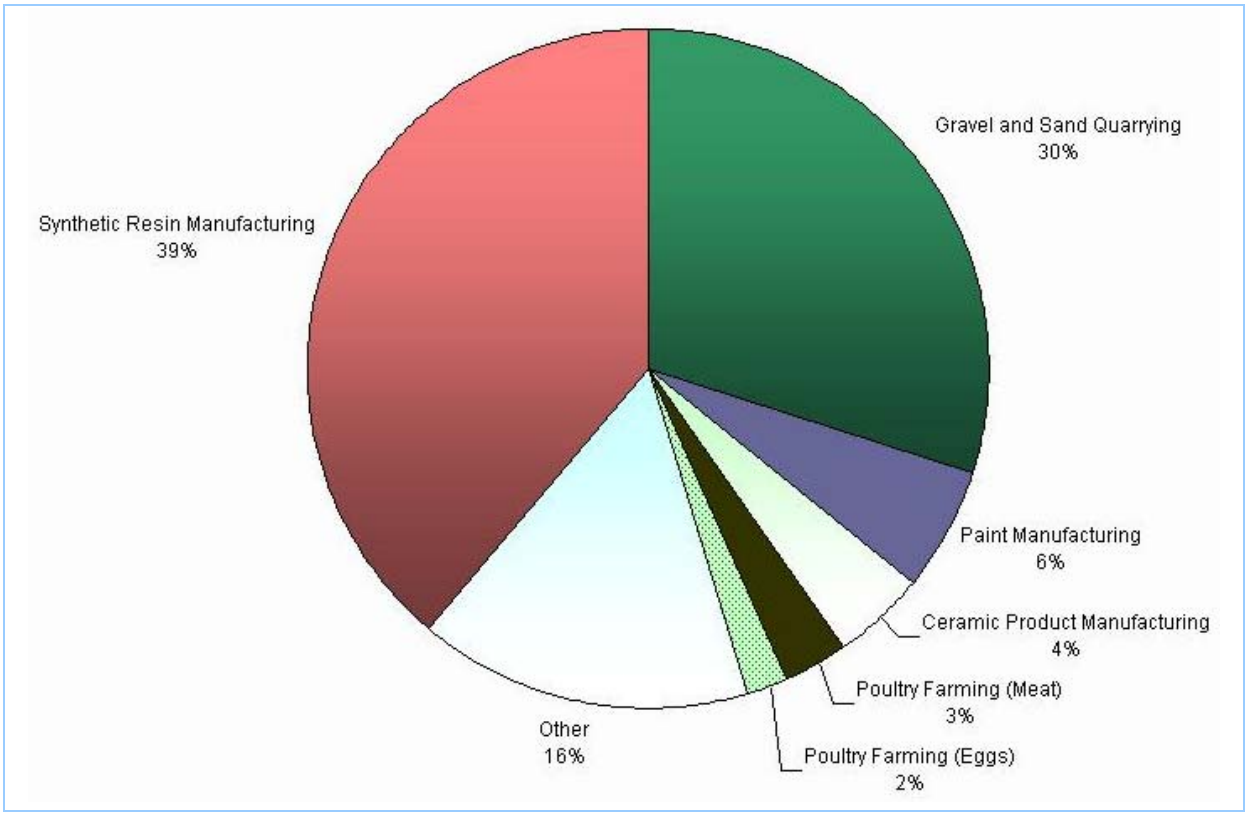

Figure 4-15: Proportion of $PM_{2.5}$ emissions by commercial activity type in the Sydney region

Table 4-6 shows total estimated annual emissions (for selected substances) from each commercial source type in the Newcastle region.

Table 4-6: Total estimated annual emissions by commercial source type in the Newcastle region

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Aluminium rolling, drawing, extruding	0	0	0.0012	0.0012	0.0012	0	0
Automotive fuel retailing	0	0	0	0	0	0	389
Bread manufacturing	1.68	2	1.2	0.477	0.346	0.0105	10.3
Ceramic product manufacturing n.e.c.	0.0048	0.0348	0.00111	0.00108	0.00107	0	0.00084
Chemical product manufacturing n.e.c.	0	0	0	0	0	0	6.34
Chemical wholesaling	0	0	1.15	0.221	0.0534	0	0
Concrete slurry manufacturing	0	0	2.81	1.03	0.161	0	0
Construction material mining n.e.c.	0	0	57	33.9	6.58	0	0.00423
Fabricated metal product manufacturing n.e.c.	0	0.413	0.427	0.237	0.203	0	0.0247
Funeral directors, crematoria and cemeteries	0.381	0.835	0.0394	0.0118	0.00789	1.47	0.0351
Furniture manufacturing n.e.c.	0	0	0	0	0	0	4.29
Gravel and sand quarrying	0	0	245	85.5	18.4	0	0.009
Hospitals	4.66	6.63	0.498	0.496	0.495	0.122	0.391
Laundries and dry-cleaners	0	0	0	0	0	0	22.3
Metal coating and finishing	2.46	28.6	13.7	4.79	3.19	0.0153	0.59
Mining and construction machinery manufacturing	0	0	0.0002	0.0002	0.0002	0	0.475
Petroleum product wholesaling	0	0	0	0	0	0	0.0895
Plastic product, rigid fibre reinforced, manufacturing	0	0	0	0	0	0	5.31
Poultry farming (meat)	0	0	5.39	2.35	0.539	0	0
Road and bridge construction	0	0	0.0652	0.0326	0.00656	0	0.00702
Smash repairing	0	0	0	0	0	0	20.8
Spring and wire product manufacturing	0	0	0.005	0.005	0.005	0	0
Waste disposal services	0.00613	0.0073	0.00055	0.00055	0.00055	0.00004	16
Wine manufacturing	0	0	0	0	0	0	0.034
Grand Total	**9.2**	**38.5**	**327**	**129**	**30**	**1.62**	**476**

The proportion of total estimated annual emissions (for selected substances) from each commercial source type in the Newcastle region are shown in Figure 4-16 to Figure 4-21.

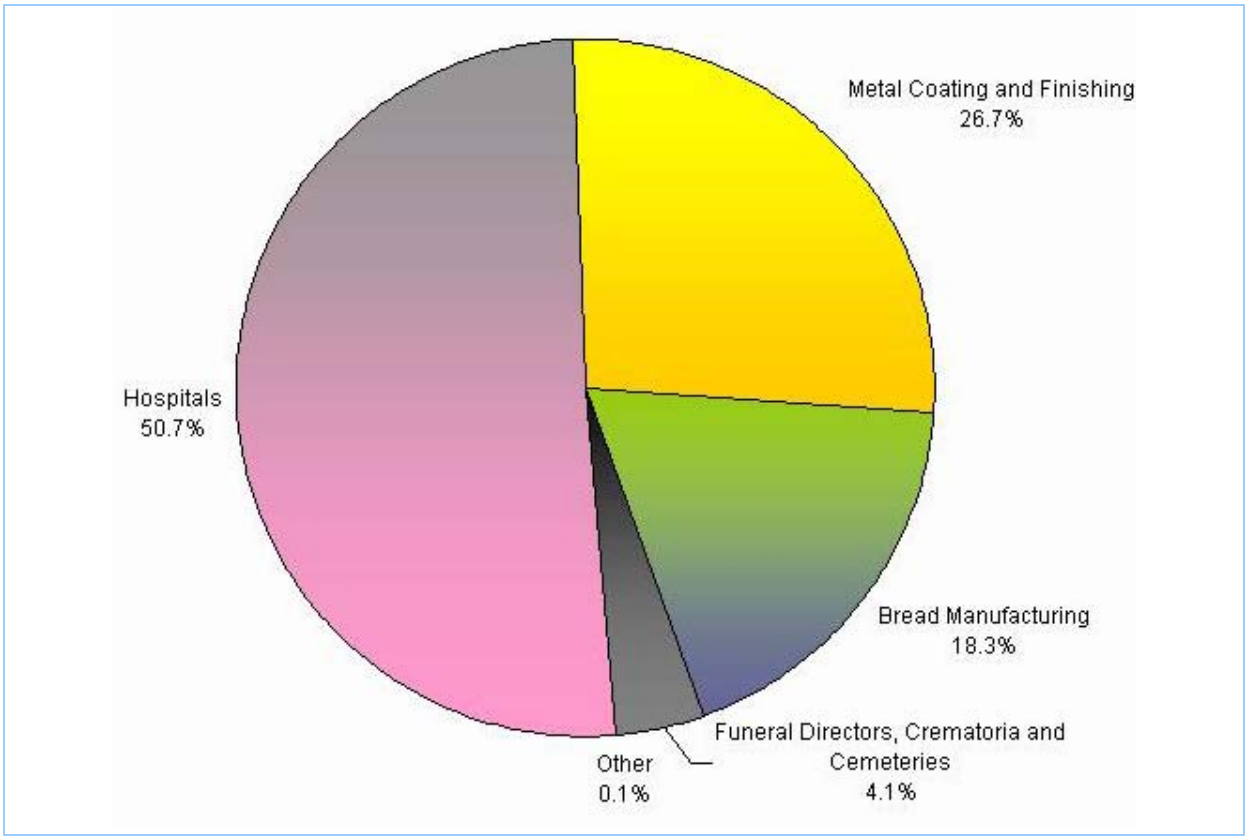

Figure 4-16: Proportion of NO_x emissions by commercial activity type in the Newcastle region

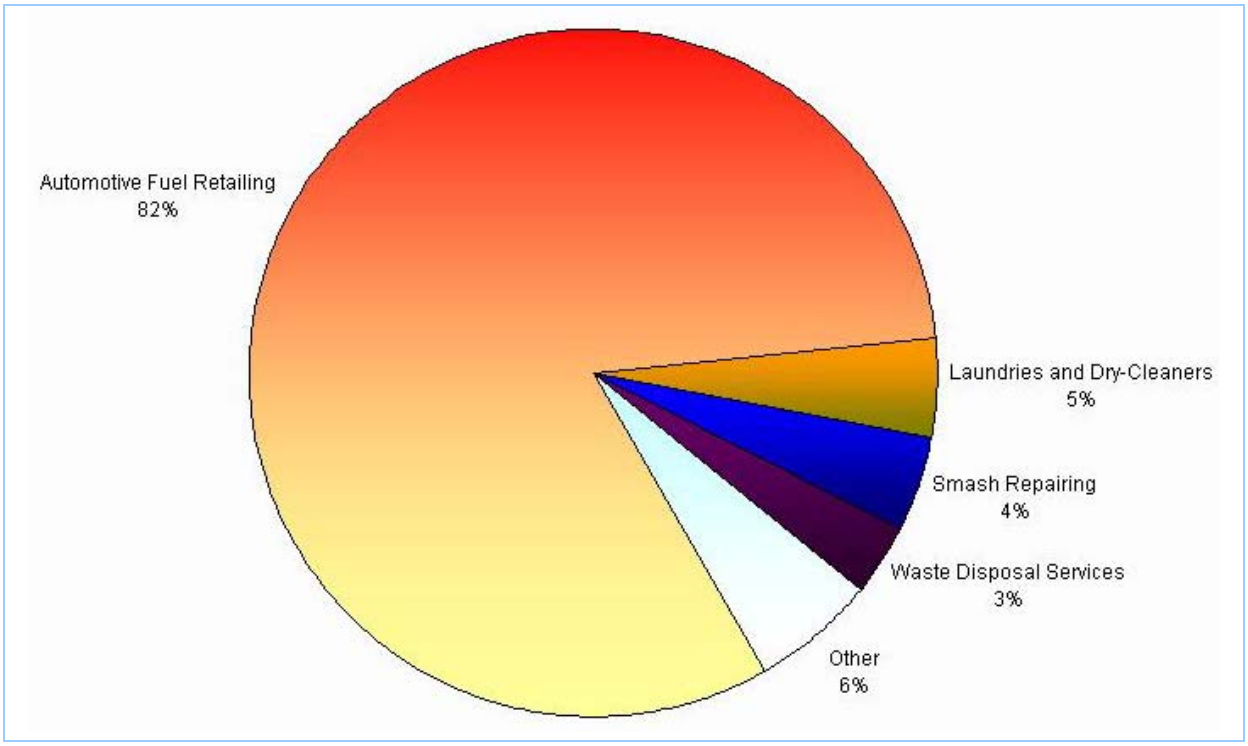

Figure 4-17: Proportion of VOC emissions by commercial activity type in the Newcastle region

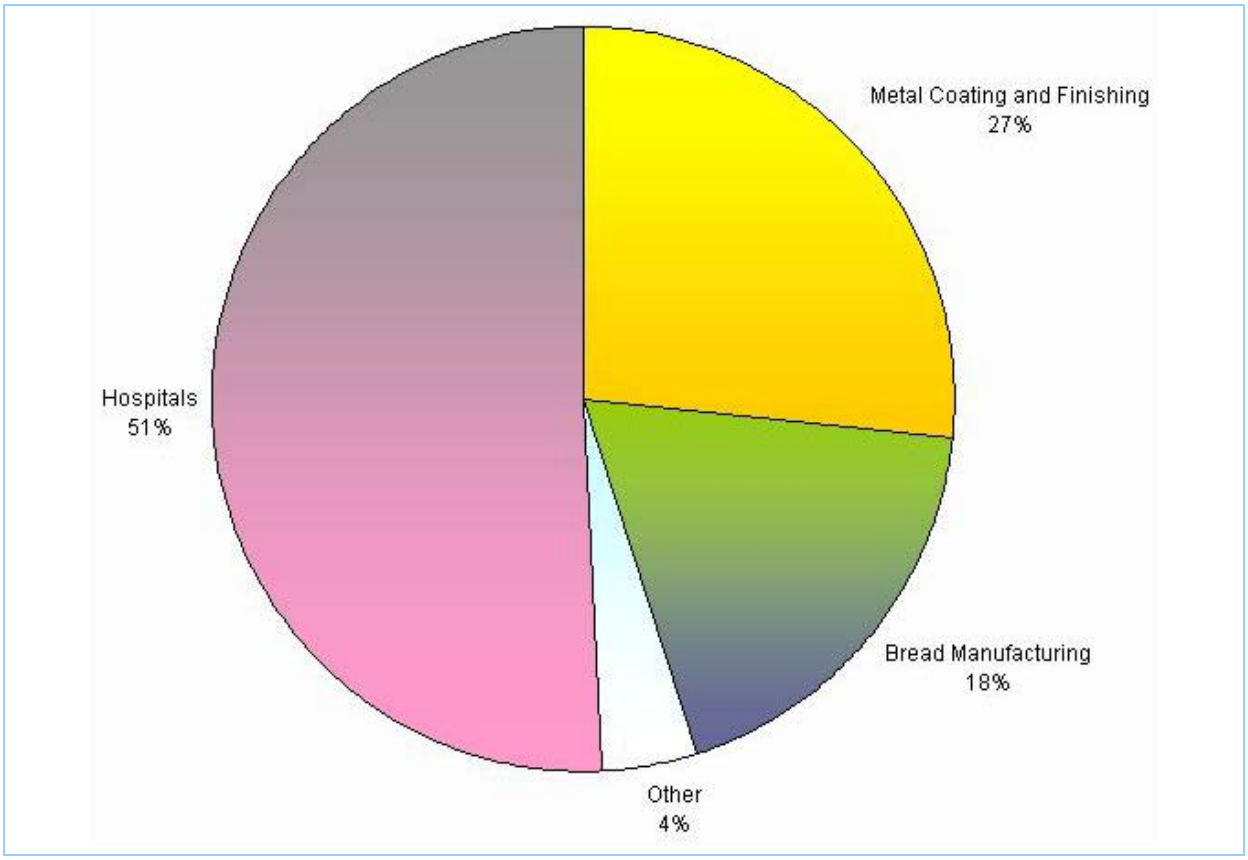

Figure 4-18: Proportion of CO emissions by commercial activity type in the Newcastle region

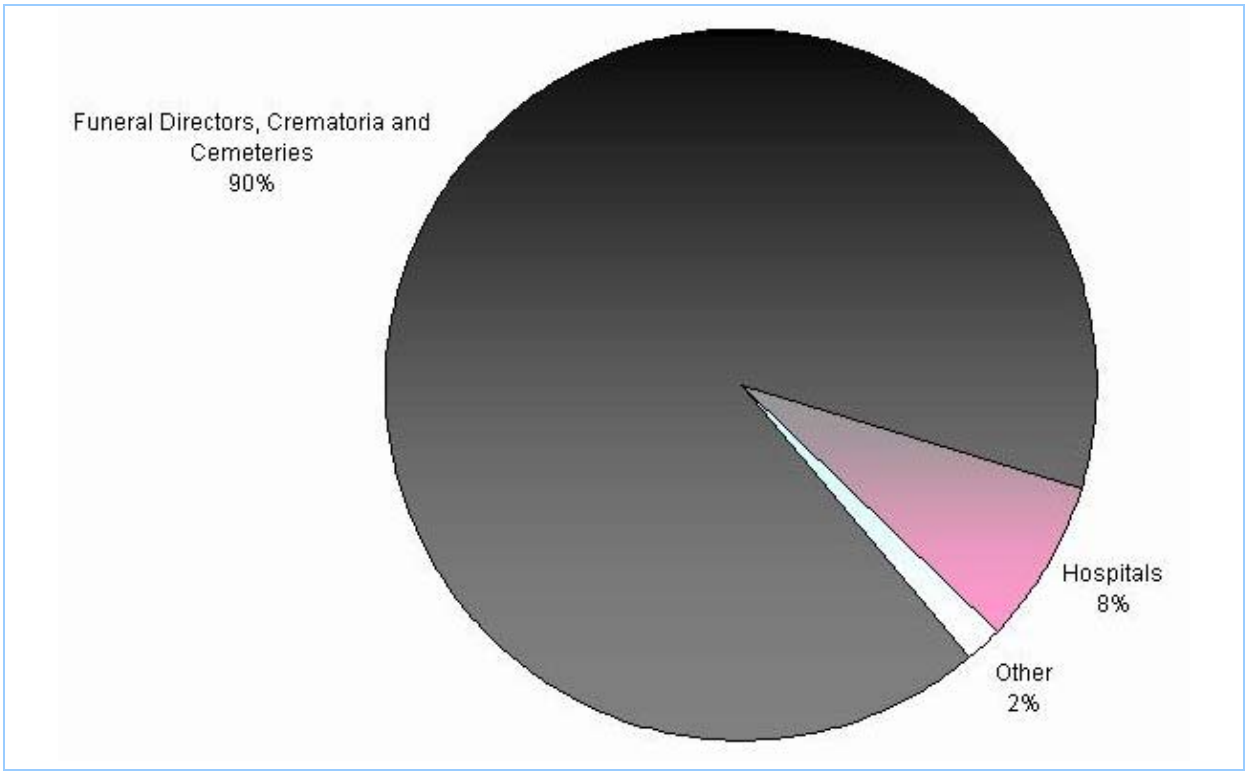

Figure 4-19: Proportion of SO_2 emissions by commercial activity type in the Newcastle region

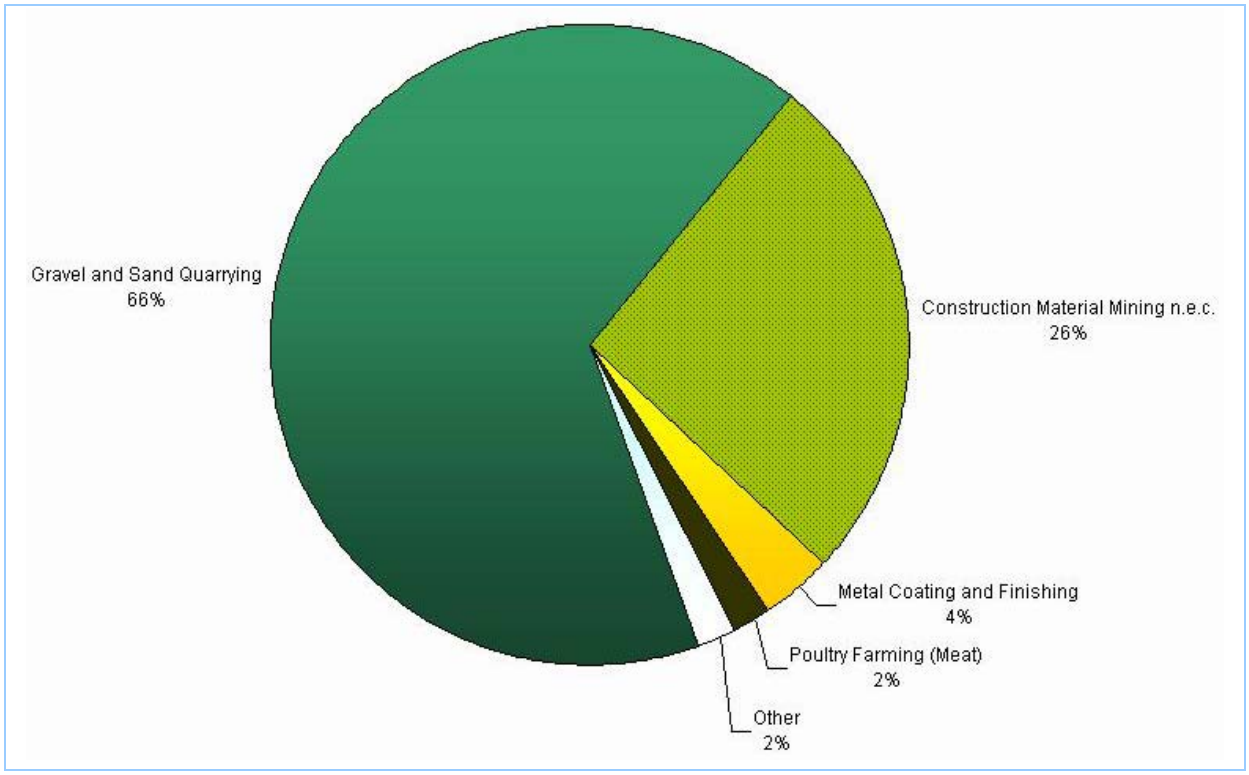

Figure 4-20: Proportion of PM_{10} emissions by commercial activity type in the Newcastle region

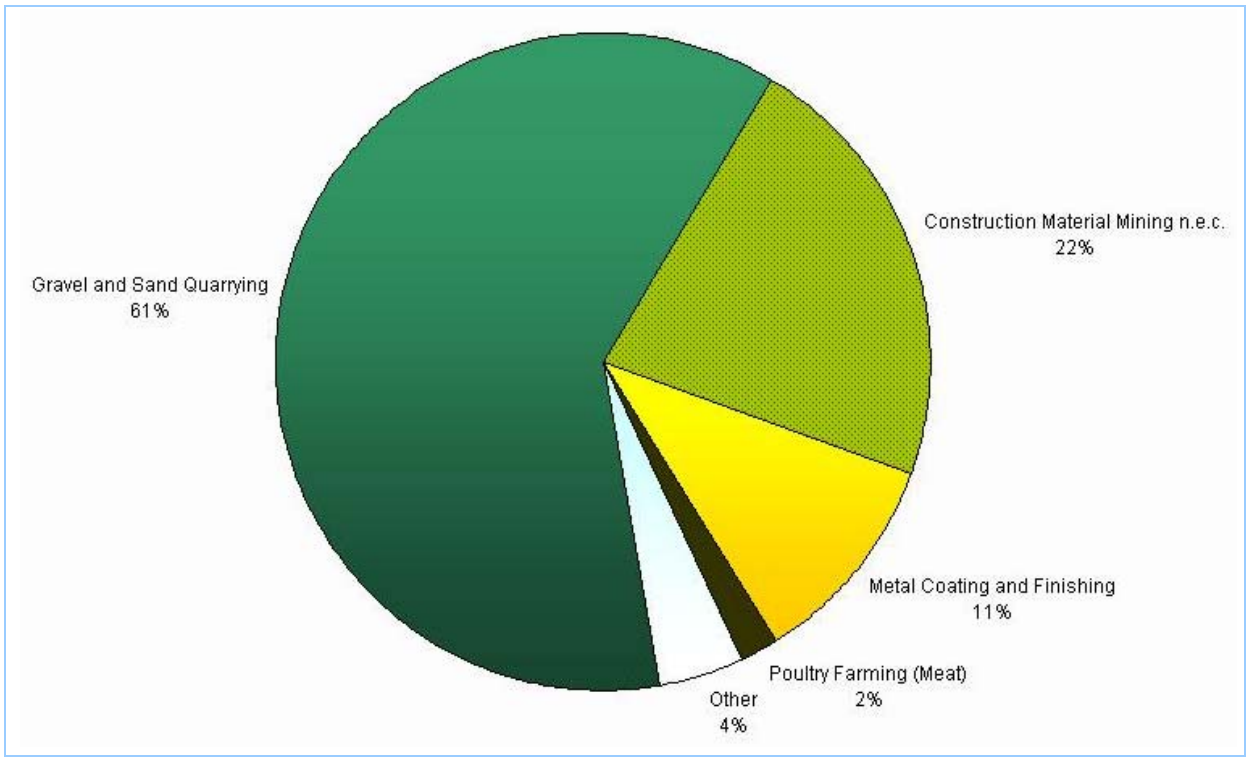

Figure 4-21: Proportion of $PM_{2.5}$ emissions by commercial activity type in the Newcastle region

Table 4-7 shows total estimated annual emissions (for selected substances) from each commercial source type in the Wollongong region.

Table 4-7: Total estimated annual emissions by commercial source type in the Wollongong region

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Aluminium rolling, drawing, extruding	0	0	0.0693	0.0693	0.0693	0	0
Automotive component manufacturing n.e.c.	0.00269	0.0032	0.00024	0.00024	0.00024	0.00002	0.807
Automotive fuel retailing	0	0	0	0	0	0	292
Basic iron and steel manufacturing	4.57	5.44	0.457	0.457	0.457	0.0284	0.334
Ceramic product manufacturing	12.9	3.87	7.96	7.54	1.9	0.22	0.477
Concrete slurry manufacturing	0	0	0.236	0.084	0.0134	0	0
Fabricated metal product manufacturing n.e.c.	0	0	0	0	0	0	1.39
Funeral directors, crematoria and cemeteries	0.118	0.258	0.0122	0.00366	0.00244	0.454	0.0109
Gravel and sand quarrying	0	0	106	35.1	7.62	0	0.0036
Hospitals	2.1	2.5	0.19	0.19	0.19	0.013	0.137
Laundries and dry-cleaners	0	0	0	0	0	0	17.7
Petroleum product wholesaling	0	0	0	0	0	0	10.6
Plastic product, rigid fibre reinforced, manufacturing	0	0	0	0	0	0	13.4
Poultry farming (meat)	0	0	1.36	0.593	0.136	0	0
Printing	0	0	0	0	0	0	6.19
Rubber product manufacturing n.e.c.	0.0072	0.0288	0.278	0.0711	0.0111	0.0102	0.00087
Smash repairing	0	0	0	0	0	0	15.1
Spring and wire product manufacturing	0.0006	0.00435	0.00014	0.00014	0.00013	0	0.00011
Steel pipe and tube manufacturing	0	0	3.9	3.51	3.51	0	0
Synthetic resin manufacturing	0.00148	0.00176	0.00013	0.00013	0.00013	0.00001	0.0001
Grand Total	**19.7**	**12.1**	**121**	**47.7**	**13.9**	**0.726**	**358**

The proportion of total estimated annual emissions (for selected substances) from each commercial source type in the Wollongong region are shown in Figure 4-22 to Figure 4-27.

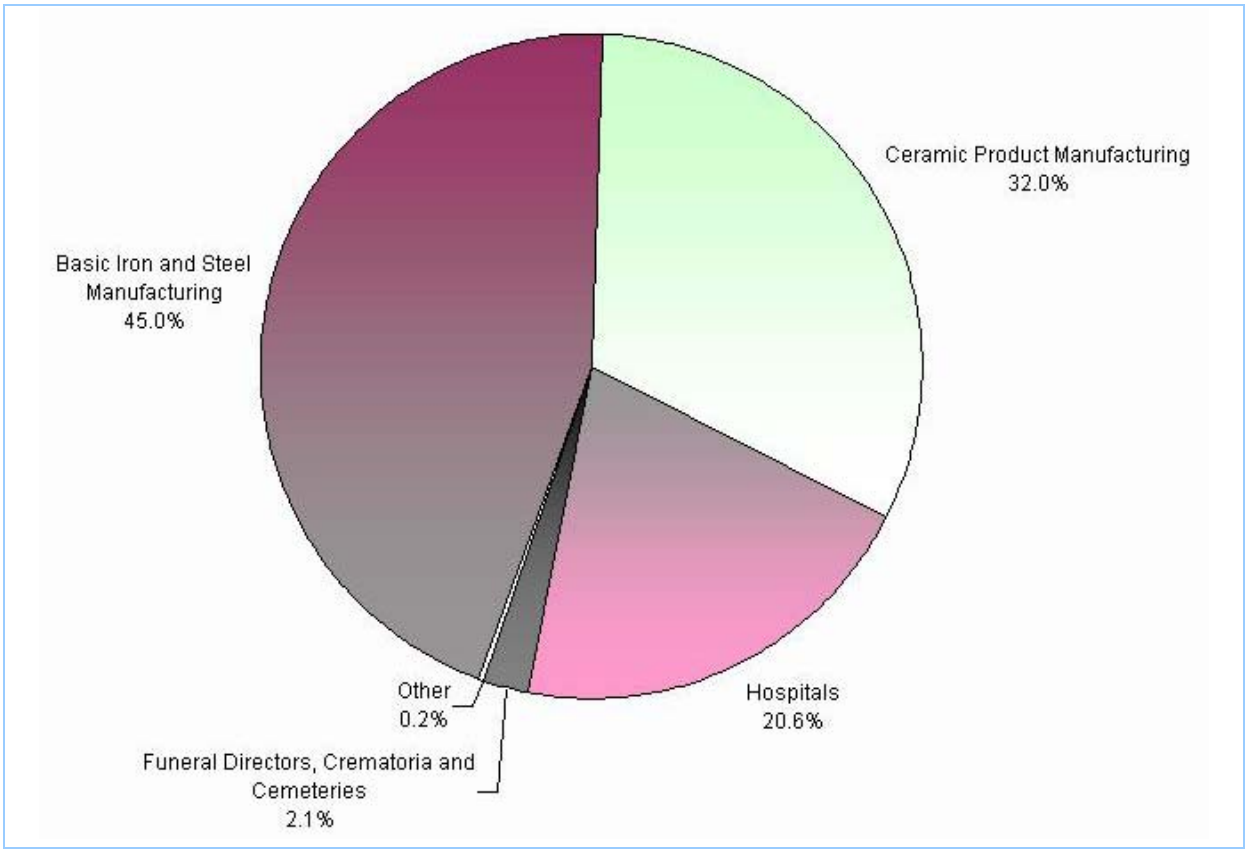

Figure 4-22: Proportion of NO_x emissions by commercial activity type in the Wollongong region

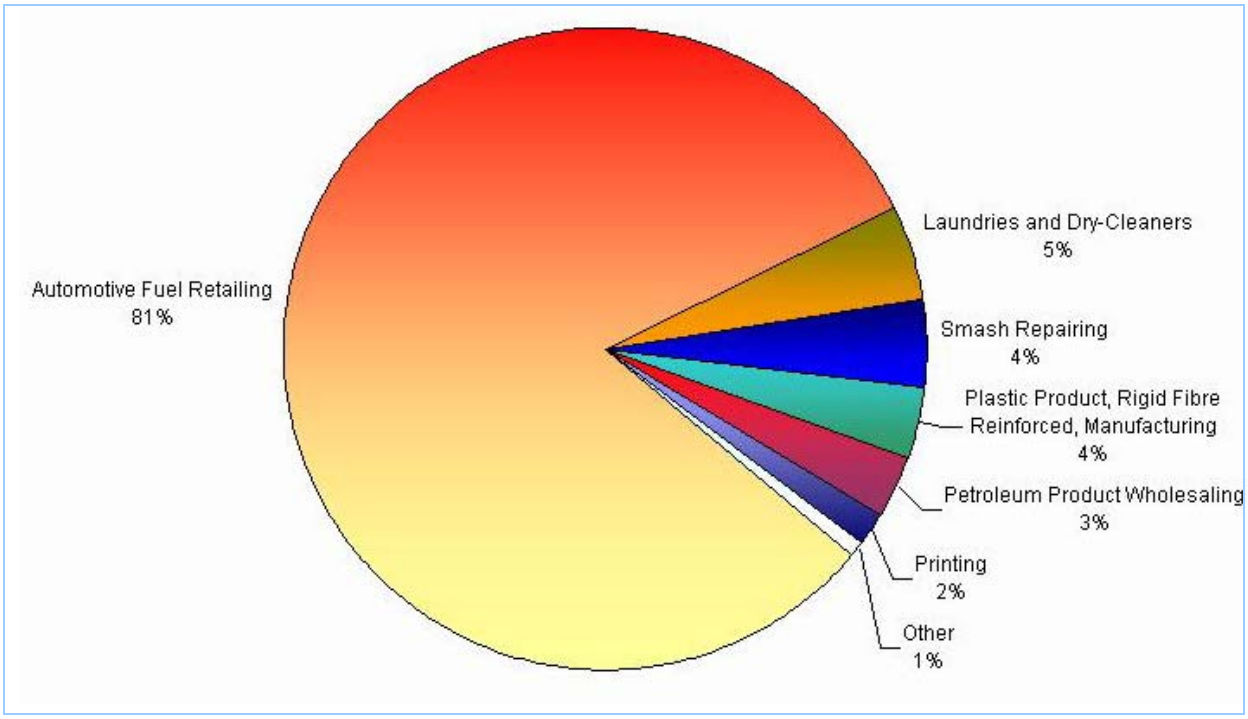

Figure 4-23: Proportion of VOC emissions by commercial activity type in the Wollongong region

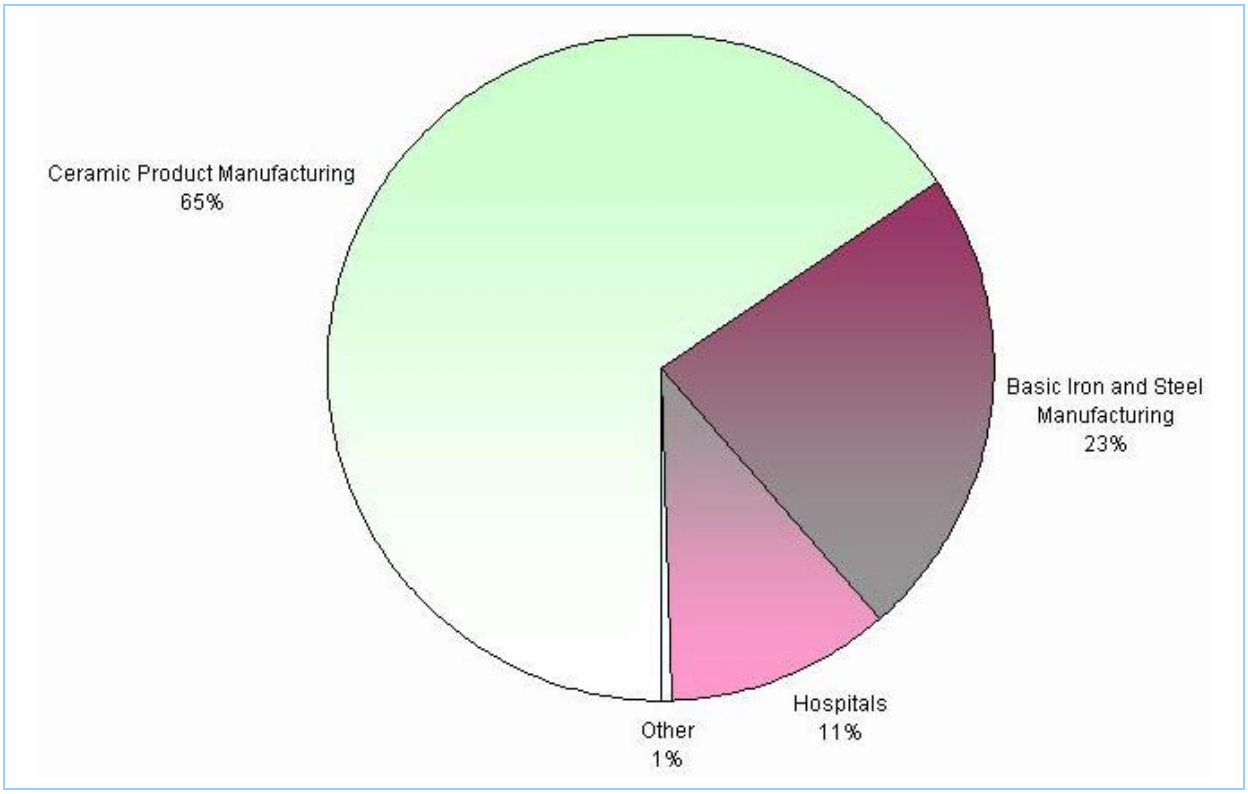

Figure 4-24: Proportion of CO emissions by commercial activity type in the Wollongong region

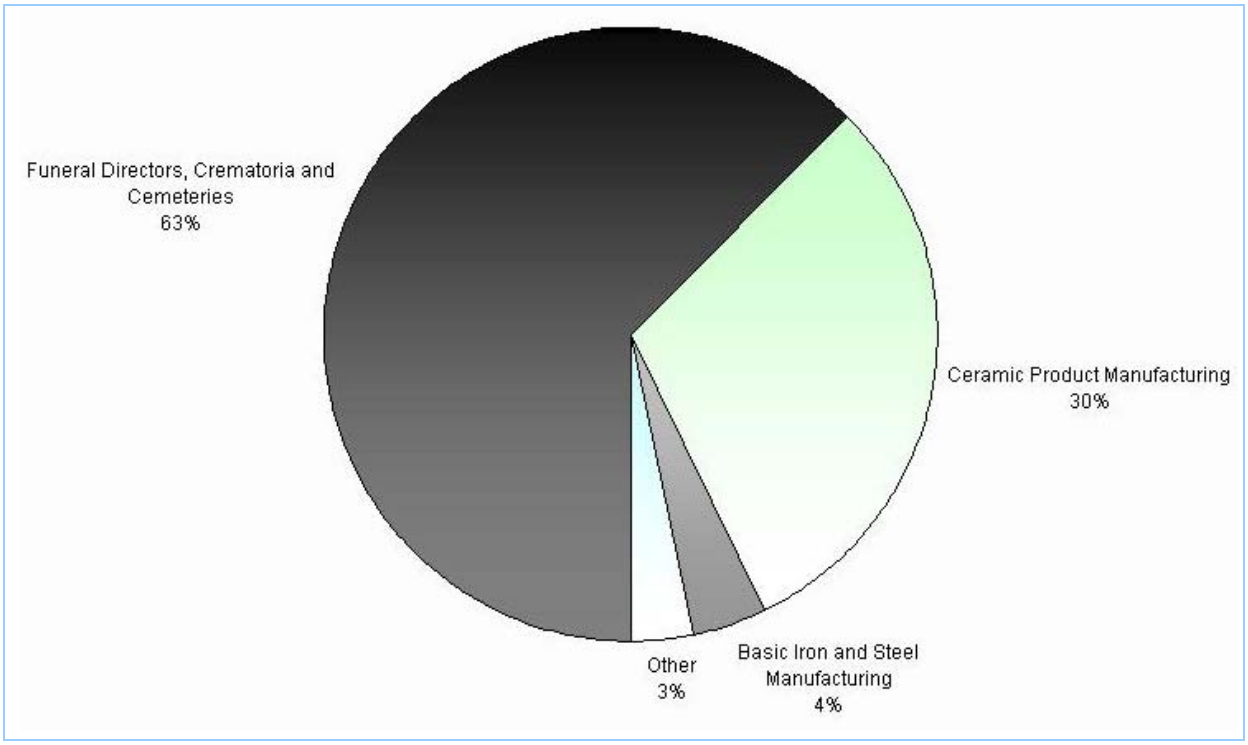

Figure 4-25: Proportion of SO_2 emissions by commercial activity type in the Wollongong region

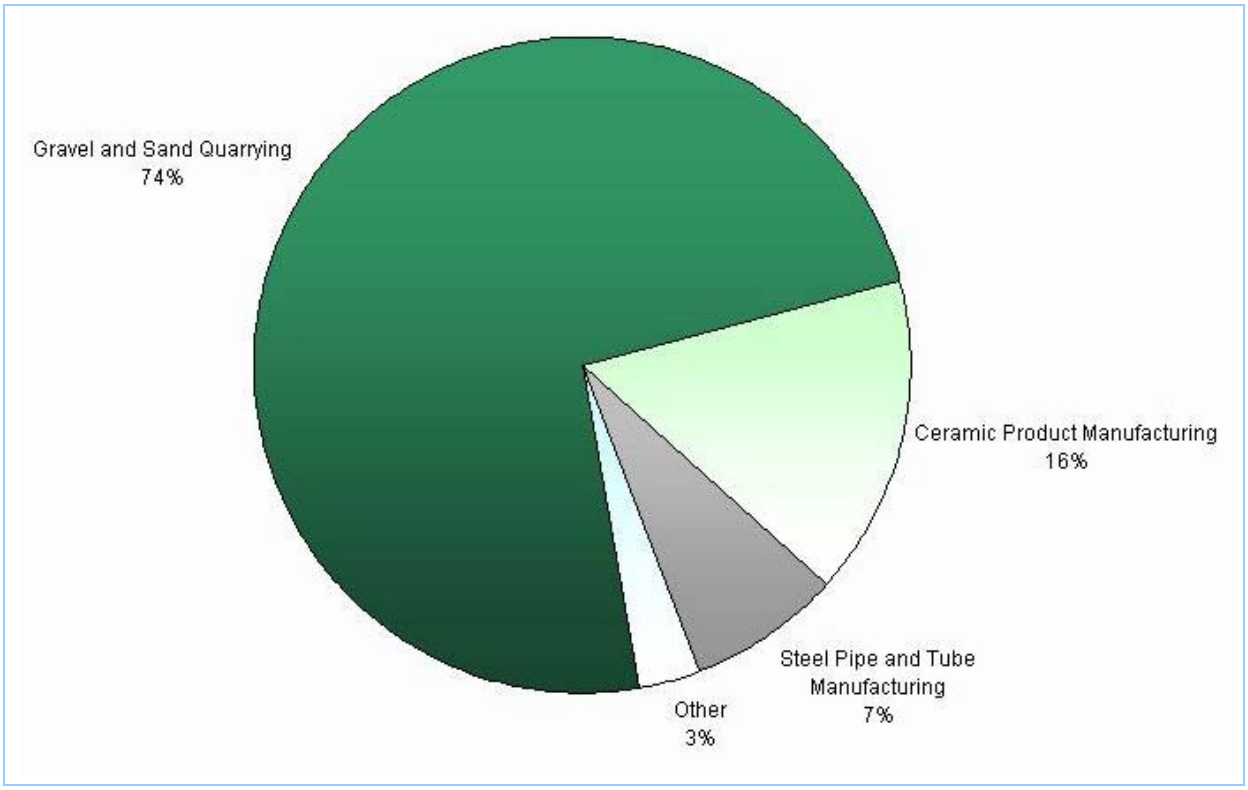

Figure 4-26: Proportion of PM_{10} emissions by commercial activity type in the Wollongong region

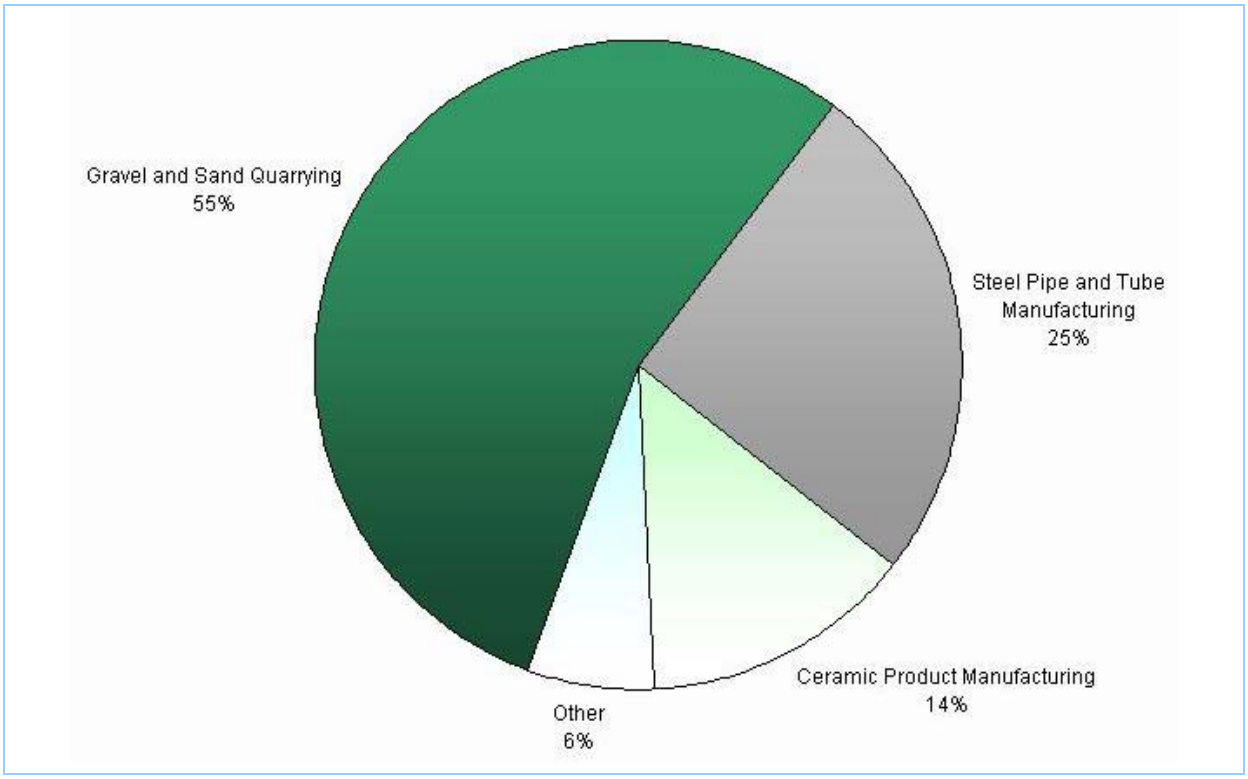

Figure 4-27: Proportion of $PM_{2.5}$ emissions by commercial activity type in the Wollongong region

Table 4-8 shows total estimated annual emissions (for selected substances) from each commercial source type in the Non Urban region.

Table 4-8: Total estimated annual emissions by commercial source type in the Non Urban region

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
Automotive component manufacturing n.e.c.	0	0	0	0	0	0	0.429
Automotive fuel retailing	0	0	0	0	0	0	1,290
Chemical product manufacturing n.e.c.	0	0	0.0199	0.00786	0.00569	0	4.06
Concrete slurry manufacturing	0	0	4.01	1.43	0.228	0	0
Construction material mining n.e.c.	0	0	48.9	16.4	3.69	0	0.0018
Electric cable and wire manufacturing	0	0	3.33	1.22	0.722	0	84
Explosive manufacturing	0	0	0	0	0	0	0.0213
Fabricated metal product manufacturing n.e.c.	0.766	0.912	0.0693	0.0693	0.0693	0.00477	0.0586
Food manufacturing n.e.c.	6.05	21	1.65	1.01	0.738	17.8	0.489
Funeral directors, crematoria and cemeteries	0.627	1.37	0.0649	0.0195	0.013	2.42	0.0578
Furniture manufacturing n.e.c.	1.59	1.9	0.149	0.145	0.144	0.00991	0.105
Glass and glass product manufacturing	0.00442	0.0356	0.00914	0.00895	0.00196	0.0028	0.00096
Gravel and sand quarrying	0	0	2,140	621	136	0	0.0445
Hospitals	9.51	11.8	0.881	0.88	0.88	0.0776	0.644
Laundries and dry-cleaners	0	0	0	0	0	0	62.4
Log sawmilling	3.29	64.8	45.2	18.4	7.42	49.5	90
Medicinal and pharmaceutical product manufacturing	0.52	0.619	0.0477	0.0471	0.047	0.00323	0.693
Mining and construction machinery manufacturing	0	0	0.00488	0.00094	0.00023	0	0.806
Non-building construction n.e.c.	0.00709	0.0514	0.00163	0.00159	0.00158	0	0.00124
Non-ferrous metal casting	0.0072	0.0288	0.384	0.244	0.183	0.0217	0.00064
Paper product manufacturing n.e.c.	0.0811	0.377	0.0272	0.0265	0.0263	0.0248	0.0276
Petroleum product wholesaling	0	0	0.572	0.163	0.0163	0	61.3
Plastic product, rigid fibre reinforced, manufacturing	0	0	0.213	0.0409	0.0099	0	4.35
Poultry farming (eggs)	0	0	11.7	5.12	1.17	0	0
Poultry farming (meat)	0	0	149	64.9	14.9	0	0
Prepared animal and bird	1.3	1.55	0.118	0.118	0.118	0.00809	0.0852

Activity	Emissions (tonne/year)						
	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$	SO_2	VOC
feed manufacturing							
Printing	0.00003	0.00004	0	0	0	0	13
Rail transport	0	0	0	0	0	0	0.00126
Road and bridge construction	0	0	0.065	0.0325	0.00651	0	0.00784
Smash repairing	0	0	0	0	0	0	48.8
Spring and wire product manufacturing	0	0.772	5.23	1.11	0.366	0	0.38
Synthetic resin manufacturing	0.554	0.66	0.0538	0.0538	0.0538	0.00345	1.29
Wine manufacturing	0	0	0	0	0	0	20.9
Wood product manufacturing n.e.c.	0	0	0.132	0.0254	0.00614	0	5.42
Grand Total	**24.3**	**106**	**2,420**	**732**	**167**	**69.8**	**1,690**

The proportion of total estimated annual emissions (for selected substances) from each commercial source type in the Non Urban region are shown in Figure 4-28 to Figure 4-33.

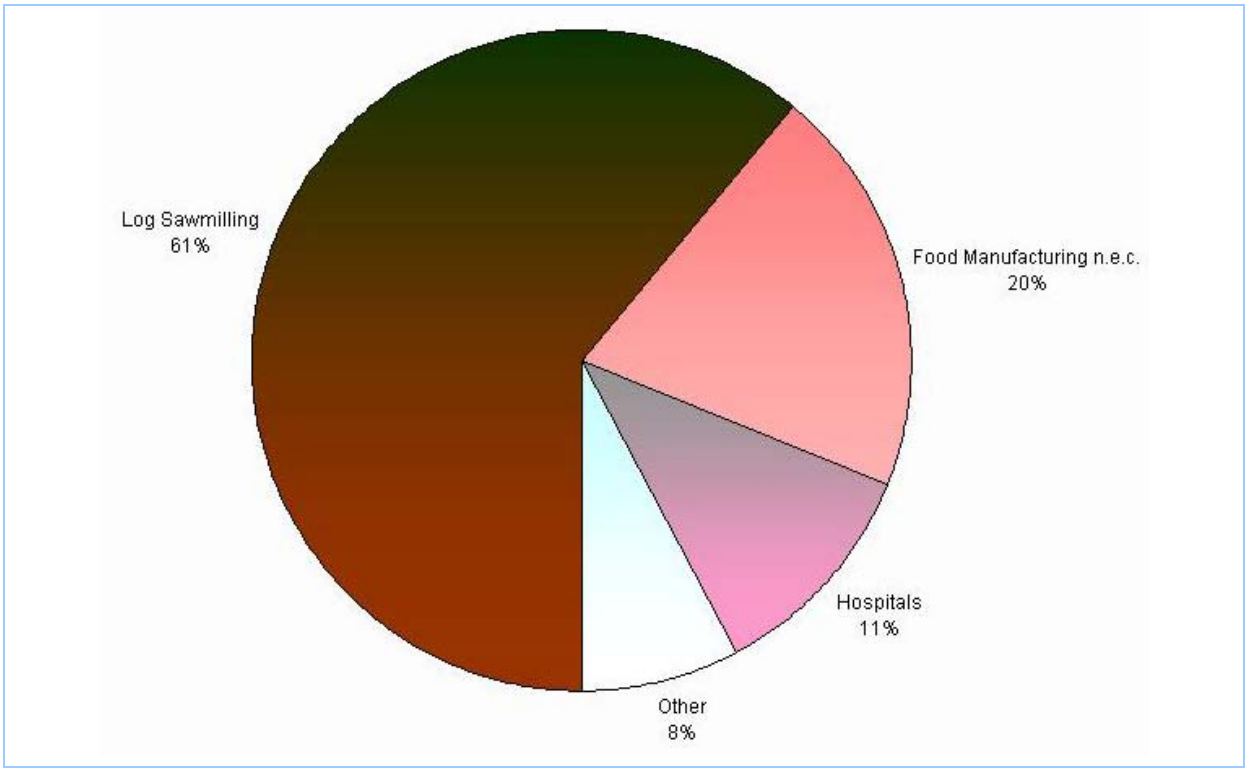

Figure 4-28: Proportion of NO_x emissions by commercial activity type in the Non Urban region

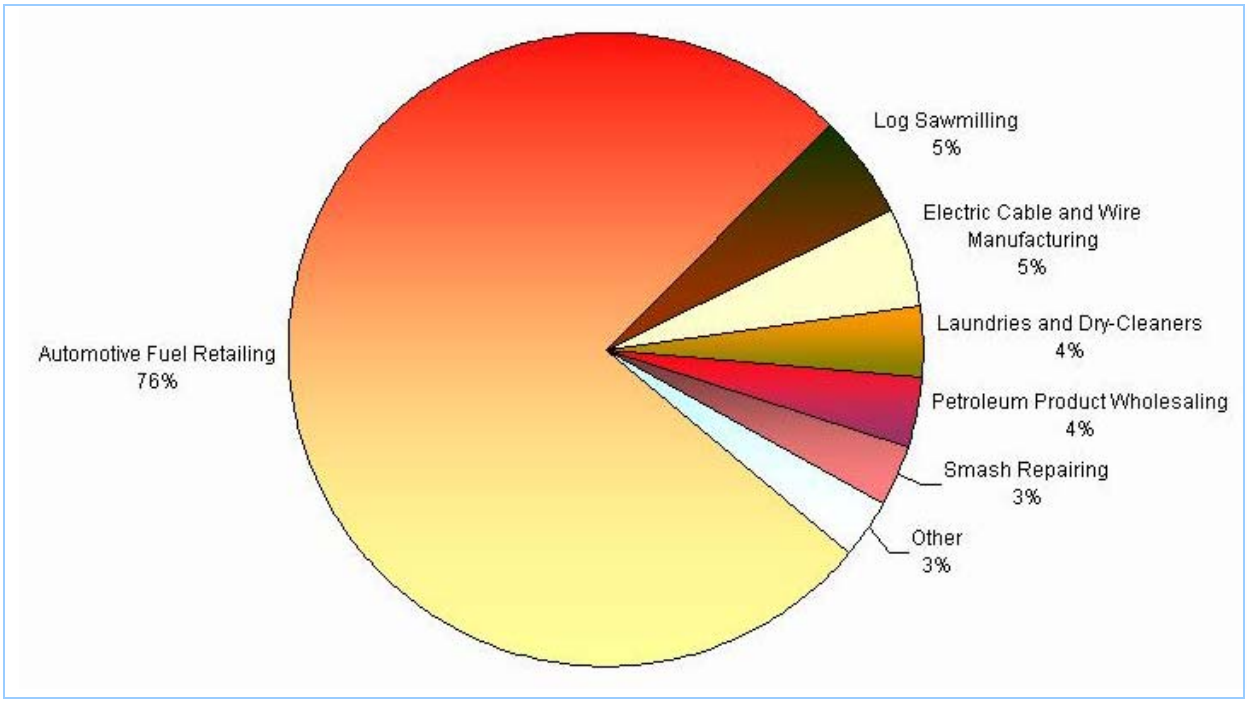

Figure 4-29: Proportion of VOC emissions by commercial activity type in the Non Urban region

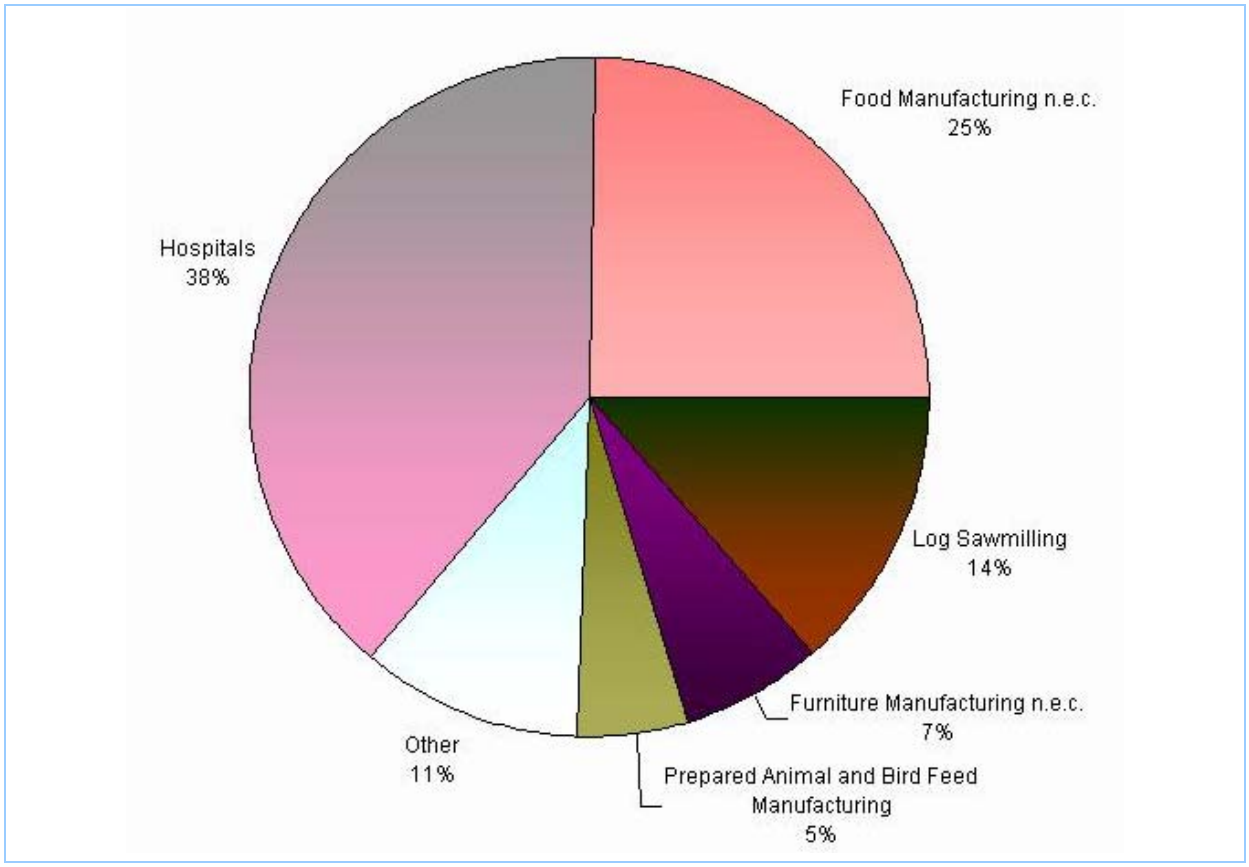

Figure 4-30: Proportion of CO emissions by commercial activity type in the Non Urban region

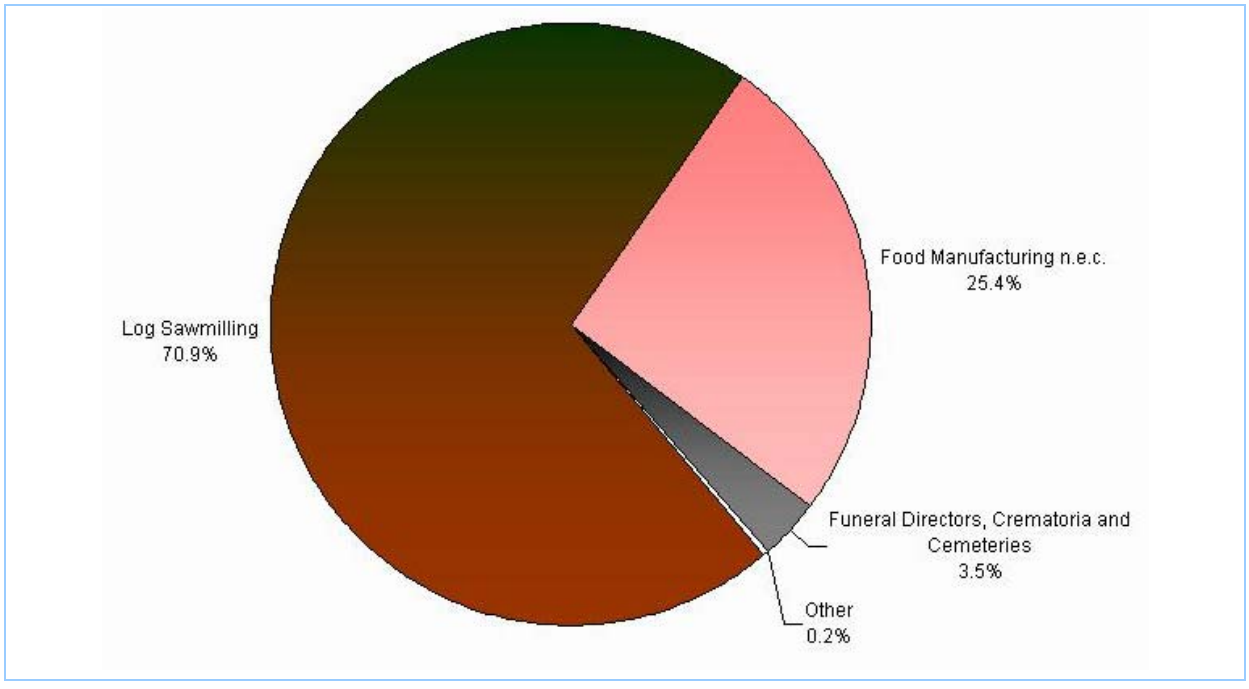

Figure 4-31: Proportion of SO_2 emissions by commercial activity type in the Non Urban region

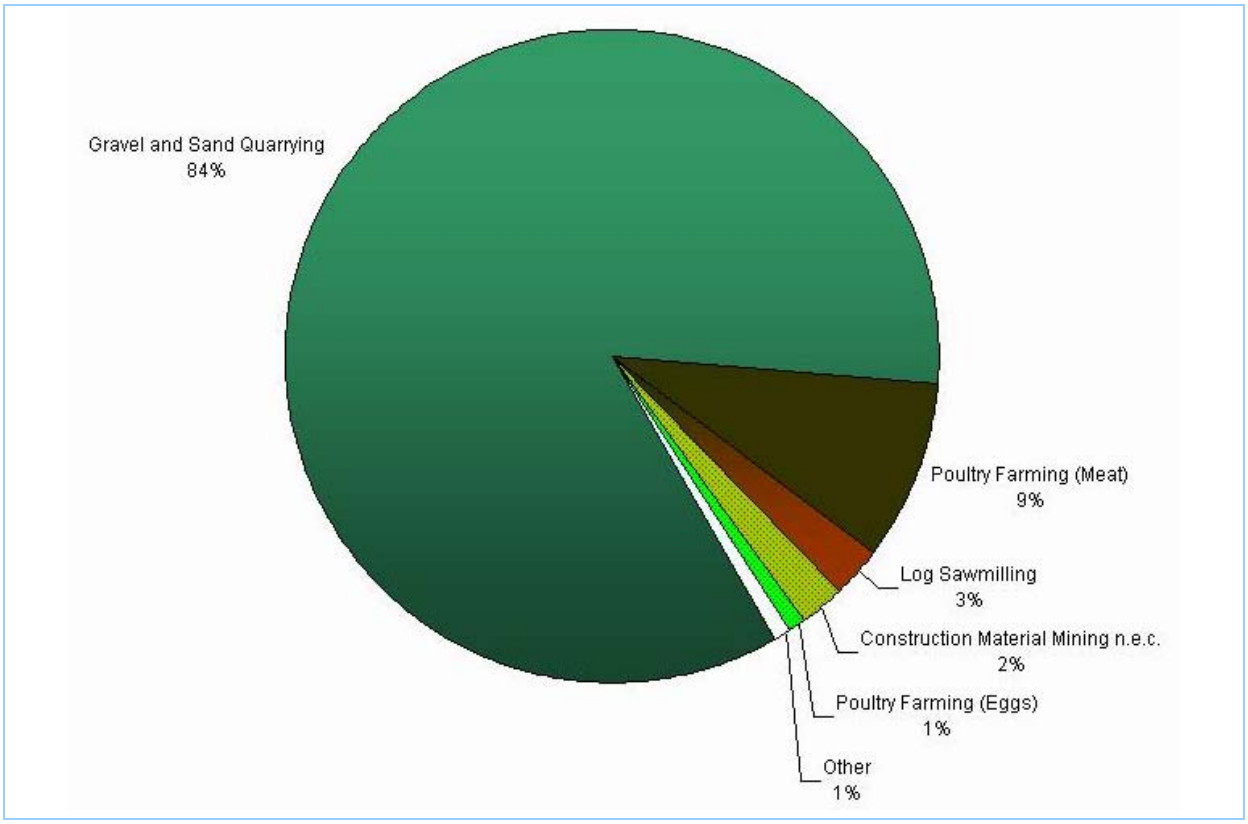

Figure 4-32: Proportion of PM_{10} emissions by commercial activity type in the Non Urban region

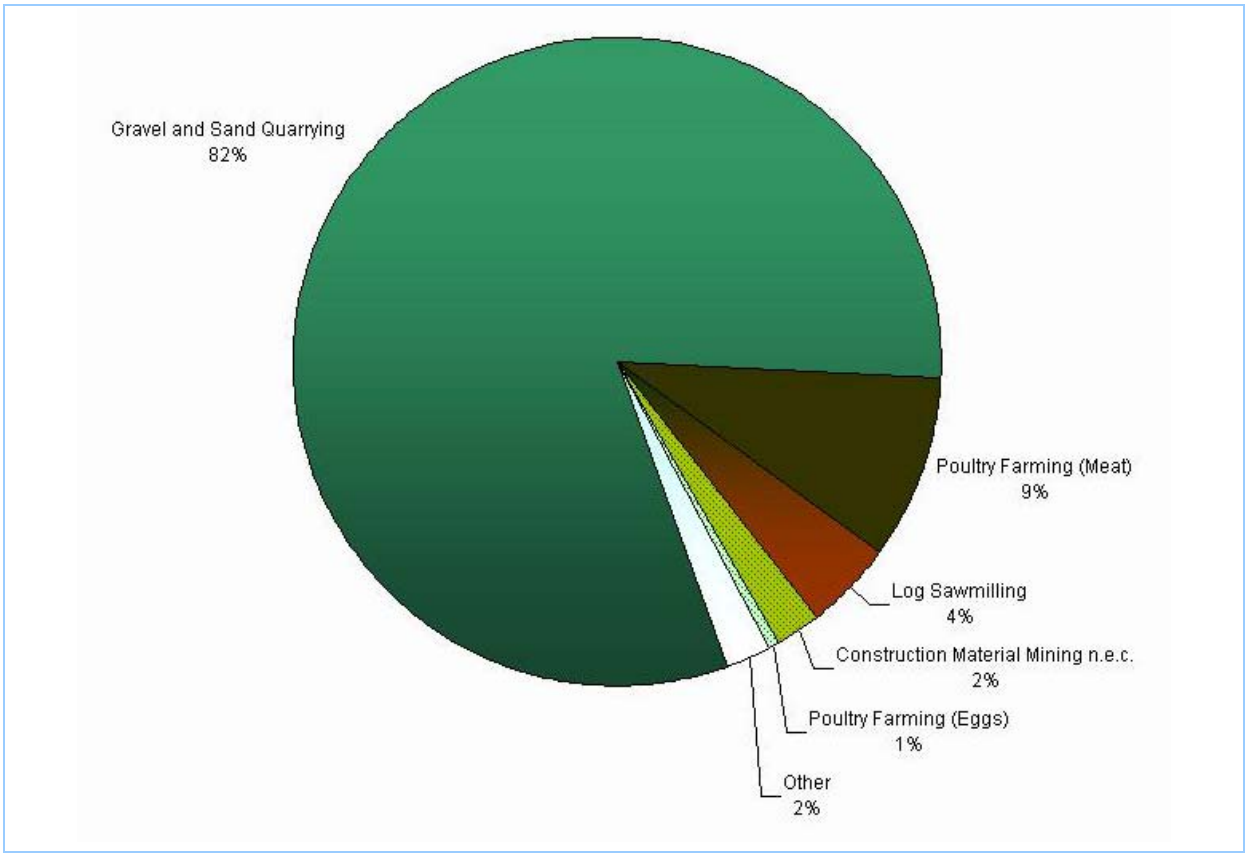

Figure 4-33: Proportion of $PM_{2.5}$ emissions by commercial activity type in the Non Urban region

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