Updated Air Quality Assessment

Attachment B

Updated Air Quality Assessment
Munmorah Rehabilitation
Delta Electricity

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aurecon

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1. Introduction and Context

1.1 Background

Delta Electricity's Munmorah Power Station was constructed as a 1,400MW, four unit coal fired power station in 1967. Units one and two ceased operating in the early 1990s, while units three and four have continued to generate electricity for sale in the National Electricity Market (NEM).

Some years ago, the operational generating units at Munmorah Power Station (Units 3 and 4) were down rated to 290 MW due to their age. Delta Electricity (the Proponent) now proposes to rehabilitate these units by replacing worn and obsolete components with current technology. It is also proposed to provide options for substitution of gas for coal as the fuel source.

The rehabilitation will return the output of each unit to the original 350MW with improved reliability and efficiency, such that they are able to continue to generate electricity for the NEM in the short to medium term. Following rehabilitation, each unit will generate additional electricity for effectively the same fuel consumption currently required to run the down rated station. Consistent with the requirements of the Director of Planning, the rehabilitation of this operating power station is being assessed as a new facility in the region.

A previous air quality assessment was been undertaken for Delta Electricity to support the application for project approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The project proposal and supporting environmental assessment were placed on public display from 21 October 2009 to 20 November 2009. This updated Air quality assessment has been prepared to clarify issues raised through the review process.

The objective of the air quality assessment is to investigate how the emissions from the rehabilitated Munmorah Power Station will affect ambient air quality and to provide guidance for the setting of emission standards for the facility to ensure the protection of air quality in the local and regional environment.

The assessment has included consideration of meteorology taking into account dispersion conditions relevant to the region, fuel and emission characteristics, sensitive receptors that surround the facility, local topography and land use characteristics in accordance with the 'Approved Methods for the Modelling and Assessment of air pollutants in NSW' (DEC, 2005) document. The assessment has been based on the 100% coal fired scenario, representing the potential worst case option in terms of air quality impacts, as any substitution of gas for coal in the boiler(s)would result in equivalent or lower emission rates for all relevant substances.

Emissions to the air from units 3 and 4 are a point source emission from a single 155m tall stack. As the emissions from Munmorah (for the 100% coal fired option) remain essentially unchanged from those at present, the assessment has considered both the extensive existing information from monitoring, and specialist studies, that are available in relation to the effect of Munmorah's operations on local and regional air quality along with the additional modelling undertaken for this assessment. The air quality assessment undertaken to support the project application for the Colongra Gas Turbine Facility < Munmorah EA Reference>are of particular relevance as this facility is adjacent to Munmorah Power Station and the assessment included consideration of Munmorah Power Station operating at full load.

1.2 Project requirements and previous studies

On the basis of the Department of Planning Director Generals Requirements the following scope was adopted for the assessment:

- Assess existing air quality monitoring records for the region ;
- Review air emission concentrations predicted for the rehabilitated Munmorah Power Station and compare them against the relevant emission standards in the Protection of the Environment Operations (Clean Air) Regulation 2002 (POEO);
- Assess the potential local, regional and inter-regional impacts from the proposed facility using :
  - desktop meteorological and air dispersion modelling in accordance with the Approved methods for the modelling and assessment of air pollutants in NSW document (DEC, 2005) (the Approved Methods)
  - A literature review incorporating, but not limited to, the following:
    - the Colongra gas turbine proposal air quality assessment for (Holmes Air Sciences, Cope et. al., 2005),
    - a study of the inter regional transport of air pollutants associated with the Colongra gas turbine proposal (Nelson et. al., 2002)
    - Central coast air quality data (Wyee, Lake Munmorah Primary School)
    - Munmorah power station – An evaluation of factors relevant to an application for the revision of the Environment Protection Licence (Malfroy, c.2007)
  - review of the Delta Electricity Central Coast air quality data relevant to Munmorah Power Station operations (Wyee, Lake Munmorah Primary School)
- Review of air pollution control technologies appropriate to the facility
- Consideration of practicable monitoring and mitigation programs that may be appropriate for the facility.

The modelling assessment considers a range of air pollutants based on a consideration of the Clean Air Regulation, the Approved Methods and an understanding of relevant pollutants emitted form Munmorah Power Station.

1.2.1 Structure of This Report

Section 2 of the report examines the regulations and guidelines that govern the emissions from Munmorah Power Station and the relevant air quality goals.

Section 3 provides a description of the existing environment including an examination of sensitive receivers, ambient air quality and examines the development of reference background conditions. This includes development of the methodology used to account for emissions from the approved upgrade of Eraring Power Station and the recently constructed Colongra Gas Turbine Facility, which are currently not reflected in the background air quality data.

Section 4 describes the process by which the power station atmospheric emission characteristics were developed and following an examination of information available used to develop the range of emission concentrations for the substances of relevance to the investigation. The product of the emission characteristics power station and the emission concentrations provides the emission inputs used for the investigation.

Section 5 examines the development of the meteorological inputs used in the Air Quality Modelling assessment.

Section 6 presents the results of the modelling undertaken in accordance with the Approved Methods and examines the contribution of the rehabilitated Munmorah to local air quality and the cumulative impacts resulting from the operation of Munmorah within the existing air shed.

Section 7 considers the results from existing studies, including scientific research by CSIRO, within the region to assess the potential Regional and Inter-regional air quality impacts of the rehabilitation.

Section 8 examines air quality mitigation and control measures in the context of the rehabilitated power station.

Section 9 reviews the outcome of the preceding assessment.

Section 10 lists the references accessed for the assessment.

1.3 Plant description

The two operational generating units at Munmorah Power Station produce electricity using coal as fuel. The coal is pulverised to a fine powder in mills, then mixed with air and fed to the burners in the boiler where water is converted to superheated steam. The steam is then used to spin a turbine which, in turn, drives an electric generator to produce electricity. After passing through the turbine, the steam is condensed in a salt-water cooled condenser and returned to the boiler where the cycle is repeated.

The burning of coal to generate electricity at Munmorah produces hot water, ash and hot gases. The hot gases are exhausted to the atmosphere via a tall (155 metre) chimney stack. The finer ash particles (fly ash) are removed from the exhaust gas stream by bag filters and mixed with water for transport as a slurry. The heavier ash (bottom ash) is collected from the bottom of the boiler and transported as slurry. Delta Electricity has advised that the bag or fabric filters collect 99.9% of the ash in the discharge air stream.

The Munmorah Power station consumed 1.2 million tonnes of coal in 2008. When Munmorah operated as a 4 Unit power station it consumed up to 4 million tonnes per year. Following rehabilitation, it is estimated the power station will consume around 2 million tonnes of coal per year.

In the context of atmospheric emissions, the power station also includes a number of ancillary processes that can potentially lead to emissions to the atmosphere, as follows:

- Transport of coal to site via conveyor from the nearby Vales Point Power Station.
- Coal delivery to, and handling within, the coal storage area.
- Coal transfer from the storage area to the station bunkers.
- General activities within the site
- Evaporation from stored liquid fuels

The design and operation of the rehabilitated plant will incorporate the following measures to control atmospheric emissions.

- The retrofitting of "low-NO_x" burners to control the production of NO_x
- Limiting the sulfur content of the coal to control SO_2 emissions
- The use of fabric filters to collect fly ash from the stack gas stream
- The application of dust mitigation and control techniques to control the emission of "fugitive" dust

In addition to the above measures, the proposed rehabilitation works will make provision for partial gas firing of the boilers and the incorporation of post combustion carbon capture technology should it be required in the future. Future installation of a gas delivery system would be designed and constructed to comply with the applicable standards and regulations.

Fuel oil is used for the following purposes;

- Ignition oil during start ups.
- Fuel support during mill/unit load movements (ie I/S) to maintain flame stability in the boilers (to prevent hazardous condition developing).

The fuel used is standard distillate. The amount of fuel oil consumed during start ups is determined by the number of unit starts. The second condition is dependant on whether the plant is in or out of service and how much the unit load varies through the changeover provess.

Usage data for the period 2004 to 2009 inclusive is as follows;

- Total usage 11.3 million litres or an average of 1.9 million litres per year
- During this period there have been a total of 105 plant start-ups (average 17.5 per year) which consumed 7.4 million litres of fuel oil, or 1.2 million litres per year
- Oil used during mill changeover operations during the above period has been 3.9M litres which is an average of 0.8 million litre per year

The current EPA licence (No 759) for the facility includes the following requirements in relation to fuel oil useage:

"E1.1 The following fuels may be used in the power station for station start-up and combustion support provided that they comply with the specification set out in this licence:

- Distillate / heating oils
- Distillate / heating oils blended with refined oil additives

E1.1.1 The licensee must sample and analyse sufficient samples of fuel received on the premise to assess whether the fuel complies with the specifications in this licence"

It is expected that these licence conditions would continue.

Following rehabilitation, when the power station is operating as a baseload power station, the fuel oil consumption of during transient start-up conditions at the power station would be expected to significantly reduce due to a much reduced number of unit start-ups. The amount of fuel oil consumed during transient periods while the power station is in-service, that is to maintain boiler flame stability during mill change-over, would be expected to increase due to the extended in-service period, While this requirement is generally a function of the time the plant is in service, the consumption rate would be lower as less mill movements would be required per unit of energy generated when operating as a base load plant. .

The current EPA licence 759 for Munmorah also permits the use of biofuels at the site as described in the following extract from the current llicence.

"E1.4 Solid Alternative Fuel

E1.4.1 For the purpose of this licence, solid alternative fuel means timber products that are:

- In accordance with regulation 8 (special requirements – wood wastes) of division 2.2 (eligible renewable energy sources) in part 2 of the Renewable Energy (Electricity) Regulations 2001 and Renewable Energy (Electricity) Act 2000.
- Biomass that is sustainably harvested as defined in, Greenhouse Gas Emissions from Electricity Supplied in NSW; Emissions Workbook, October 2000. Ministry of Energy and Utilities.

Note: No condition of this licence authorises the intentional burning of treated, painted or otherwise modified timbers.

E1.4.2 Solid alternative fuel may only be co-fired with coal and at a rate not exceeding five

(5) percent by weight of the coal feed rate.

E1.4.3 The concentration of Type 1 & 2 elements and substances (as defined in the Clean Air Plant and Equipment Regulation 1997) in solid alternative fuel burnt in the power station must not exceed 350 milligrams per kilogram.

E1.4.4 The licensee must have a statistically valid quality control program for solid alternative fuel co-fired with coal at the premises. The quality control program must include the determination of the solid alternative fuel's calorific value (MJ/kg), the concentration of Type 1 & 2 elements and substances as described in the Clean Air Plant and Equipment Regulation 1997, and the concentration of chlorine (Cl), copper (Cu), fluorine (F) and sulphur (S).

The concentration of the elements and substances referred to above must be reported as milligrams per kilogram of solid alternative fuel."

The Proponent has advised that no solid alternative fuel has been consumed at Munmorah Power Station to date. Compliance with the above conditions maintains a very low of use of solid alternative fuel within the fuel mix (less than 5%) and limits the concentration of air pollutants in any fuel used. Due to these considerations the use of solid alternative fuel is not assessed in this report. However, it is proposed that this provision continue to apply to the facility.

1.4 Pollutant emissions

The characteristics of the releases from the power station (stack exit conditions) have been based on historical monitoring of plant performance and detailed technical investigations of the performance of the existing plant and modelling of the changes that will occur as a result of the rehabilitation. The air quality impacts associated with the emission of the following pollutants has been assessed:

- Sulfur dioxide (SO_2)
- Oxides of nitrogen (NO_x) as NO_2
- Solid Particles as PM_{10}
- Carbon Monoxide (CO)
- Lead (Pb)
- Fluoride [modelled as hydrogen fluoride (HF)]
- Cadmium (Cd);
- Mercury (Hg)
- Dioxins and furans (PCDD/F)
- Hydrogen Chloride (HCl)
- Chlorine (Cl_2)
- Sulfuric acid mist (H_2SO_4) and Sulfur trioxide (as SO_3)

The identification of air pollutants to be assessed has been based on the POEO Regulation, the Approved Methods and an understanding of relevant pollutants emitted as a product of electricity generation at Munmorah Power Station. The stack exit conditions and emission rates were calculated using the design flow rates and proponent guaranteed or assumed emission concentrations.

Fuel consumption was based on the PROATES modelling studies.

The emission characteristics of the pollutants assessed in the modelling of the rehabilitated power station have been developed with reference to the POEO Regulation, the output from the PROATES power station performance modelling package, available guaranteed emission limits along with consideration of emissions monitoring records and coal analysis data to provide worst case scenarios for some substances. Reference was made to coal properties, from existing and indicative future coal supplies, coal consumption rates predicted by the technical studies, and existing stack emission monitoring records.

1.5 Assessment Methodology

The report examines the outcomes of existing technical studies to describe the implications of the Munmorah rehabilitation project for local and regional air quality to enable the regulatory bodies to make an informed decision.

The local air quality impact assessment has been carried out in accordance with the DECCW Approved Methods (DEC 2005) with respect to the worst case conditions of plant operation, while making use of relevant local meteorological and ambient air quality data and meteorological and air dispersion modelling using the CSIRO developed model TAPM. On the basis of the availability of good ambient monitoring data, a Level 2 assessment has been undertaken in accordance with the Approved Methods The assessment has included the following:

- examination of the historical ambient air monitoring records at Wyee and Lake Munmorah Primary School from 1994-2008 for sulphur dioxide, oxides of nitrogen and hydrogen fluoride;
- assessment of relevant historical meteorological data both observed and predicted through the meteorological component of the CSIRO developed prognostic model TAPM;
- local scale pollutant air dispersion modelling based upon the three dimensional meteorological field developed within TAPM for a reference year representative of long term climatic conditions;

The year 2004 was selected the reference year to model the rehabilitated power station. The suitability of this reference year was assessed based on an analysis of long term average meteorological data.

The worst case assessment scenario is based on the unlikely coincidence of highest emission concentrations and maximum generation capacity with adverse atmospheric dispersion conditions.

The dispersion modelling predicted the worst case air quality impact from the rehabilitated Munmorah in isolation. The results were then used to assess the potential cumulative air quality impacts by including background concentrations which take into account the impacts of other sources in the region. The inclusion of background concentrations was undertaken in manner consistent with the Approved Methods.

The air emissions sources identified as influencing the background air quality included major industrial emission sources as well as fugitive air emission sources from motor vehicles on major carriageways. The major background air emission sources were identified as being:

- Vales Point Power Station (1320 MW), some 5.5 km to the north of Munmorah Power Station;
- Colongra Gas Turbine Facility (600 MW), adjacent to Munmorah which is currently being commissioned; the influence of this plant on local air quality as assessed in the Technical air quality report associated with the EA for this study was also taken into account in the presentation of cumulative impacts;
- Eraring Power Station (4 x 660MW) located some 17 km to the NNW of Munmorah PowerStation
- Future additional emissions from Eraring Power Station, which has recently obtained planning approval to increase its operations by 360 MW to become a 4 x 750 MW (3000 MW) station
- Motor vehicle emissions from Sydney-Newcastle Freeway and Pacific Highway.

The location of these sources and the ambient air monitoring stations used in the assessment are shown in Figure 1.1. Additional allowance was made in the modelling predictions to account for the contribution of Eraring upgrade and Colongra Gas Turbine Facility to local air quality as they not reflected in the existing background monitoring.

The impact assessment criteria listed in the Approved Methods were used in assessing the acceptability or otherwise of impacts of the refurbished power station. In addition the following are addressed in a semi quantitative manner:

- potential impacts on regional and inter regional impacts of photochemical pollution (ozone and nitrogen dioxide); and
- dust deposition (fall-out) associated local impacts.

The assessment of impacts on regional and inter-regional air quality has largely been based on a literature review of work carried out by CSIRO, Malfroy, Holmes Air Sciences and other relevant peer-reviewed scientific literature as identified above.

The assessment is thus summarised as incorporating a discussion of the following key issues:

- Processes and infrastructure following rehabilitation relevant to air emissions
- Air quality emission and assessment guidelines
- Existing air quality and meteorology
- Changes to emission characteristics following rehabilitation works
- The suitability of 2004 as a reference year in terms of meteorology and power station operating conditions
- Establishment of ambient background conditions
- Methodology used for the impact assessment
- Comparison of predicted ground level concentrations at sensitive receptors with the air quality assessment criteria for the modelled pollutants
- Mitigation measures and safeguards, including monitoring.

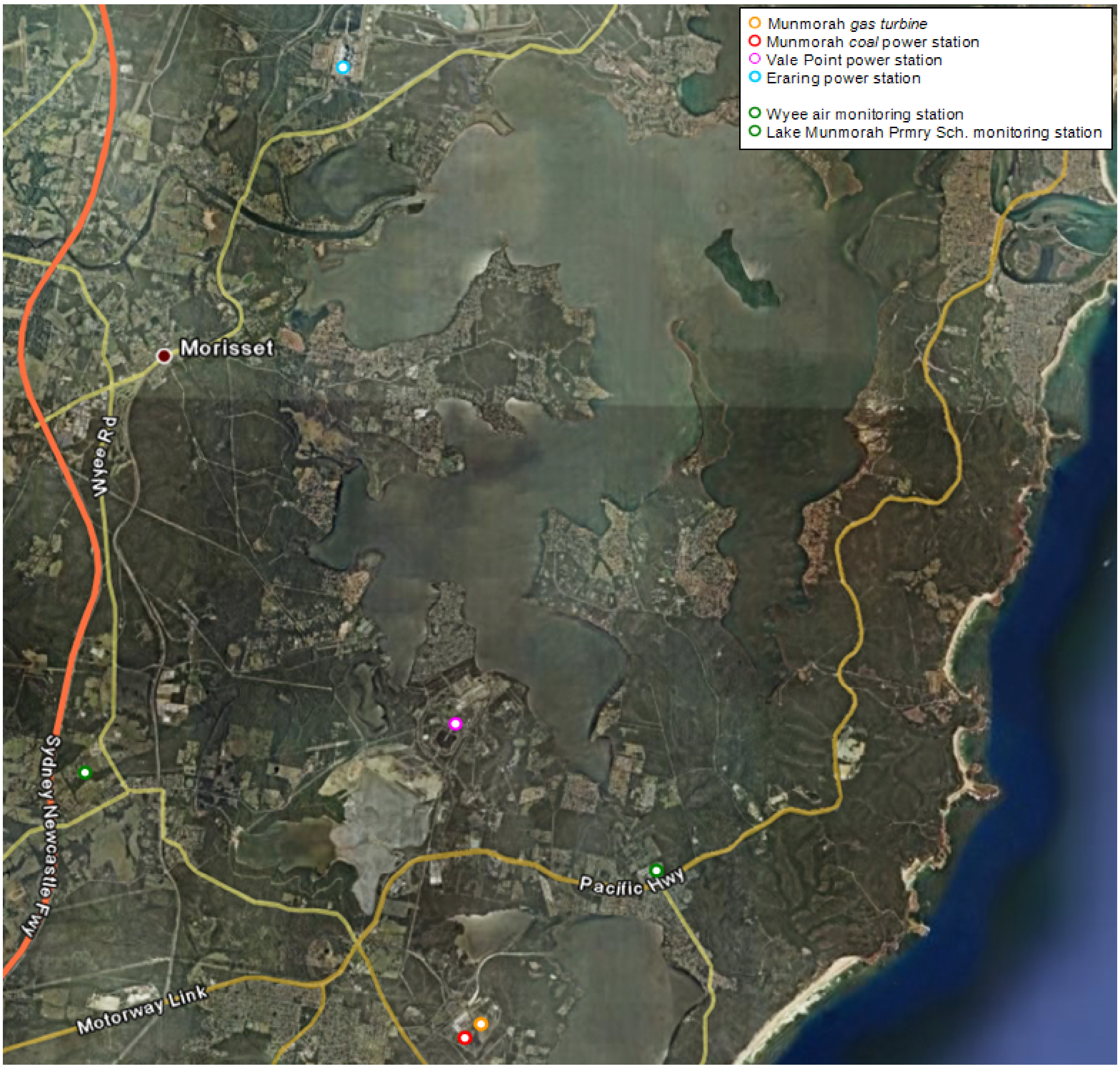

Figure 1.1 Munmorah power station in relation to other major industrial and diffuse (traffic) air emission sources on the NSW Central Coast

2. Regulations and Guidelines

In NSW, the regulation of emissions to the atmosphere and the protection of ambient air quality are managed in an integrated manner by several pieces of legislation and guidance documents administered by the Department of Environment, Climate Change and Water:

2.1 The Protection of the Environment Operations Act 1997 (POEO)

In relation to air quality POEO, amongst other things, requires plant and facility owners to:

- to maintain the plant in an efficient condition, and
- to operate the plant in a proper and efficient manner.

POEO makes it an offence for air emissions to be emitted to the atmosphere at a rate and or concentration which exceeds limits specified in the subordinate Clean Air Regulation.

Environment Protection Licenses administered under POEO, amongst other things, require plant and facility owners to meet operating, reporting and monitoring conditions.

Protection of the Environment Operations (Clean Air) Regulation 2002 (Clean Air Regulation)

This section lists, and briefly discusses, a number of clauses in the Clean Air Regulation which are relevant to the assessment.

Clause 21: General grouping of activities and plant
This clause assigns activities and plant to one of six groups subject to the commencement (and possibly approval) date of the activity or plant.

- Group 1: Prior to 1st January, 1972;
- Group 2: Between 1st January, 1972 and 1st July, 1979;
- Group 3: Between 1st July, 1979 and 1st July, 1986;
- Group 4: Between 1st July, 1986 and 1st August, 1997;
- Group 5: Between 1st August, 1997 and 1st September, 2005;
- Group 6: After 1st September, 2005[1].

An activity or plant belongs to Group 6 if it commenced operations, on or after 1 September 2005, as a result of an environment protection licence issued under the POEO Act.

Schedules 3 and 4 of the Regulation specify emission standards for a number of substances, with the standards becoming progressively more stringent for newer plant, and particularly for those in Group 6 (see Table 2.1)

Munmorah Power station commenced operation in 1969 and so *originally* belonged to Group 1.

However, Clause23: Phasing out of Group 1 required that from the beginning of 2008 Munmorah Power Station was required to meet the Group 2 emission standards.

Clause 24: Phasing out of Group 2
Unless other clauses, described below, come into effect, the impact of this clause is that from the beginning of 2012 Munmorah Power Station will be required to meet Group 5 emission standards, unless Delta Electricity makes an application to the Environment Protection Authority (EPA) to continue at Group 2 limits.

[1] Any activity or plant that would belong to Group 6 on the basis of a commencement date after 1 September 2005 is taken to belong to Group 5 if it is the subject of development consent before 1 September 2005.

Clause 22: Effect on grouping of alteration or replacement of emission units

In summary, this clause stipulates that if an emission unit[2] is altered as a result of a modification to a Development Consent (under the EP&A Act) or variation of the environmental protection licence and the effect of the alteration is that there is an increase in the emission of air impurities, or a change in the nature of the air impurities emitted or the intensity with which air impurities are emitted, from the plant of which the emission unit is part, or to which it is attached, the altered emission unit is taken to belong to Group 6.

If, in relation to plant operated in the Greater Metropolitan Area, which Munmorah is, an emission unit in Group 1, 2, 3, 4 or 5 is replaced, the replacement emission unit is taken to belong to Group 6.

The conditions of the environment protection licence may state that the an emission unit continues to belong to Group 2, 3, 4 or 5 subject to an application to the EPA being successful.

The question as to whether the (refurbished) Munmorah Power Station should belong to Group 6 is, arguably, open to interpretation, given that the development application addresses changes in plant operating conditions that will improve plant efficiency and reduce the intensity of air emissions. However, for the purpose of the assessment it has been assumed that the Group 6 emission limits, as shown in Table 2.1, will apply to the refurbished Munmorah Power Station.

Table 2.1: Emission Concentration Limits from latest version

Note that he EPL limit for SO_3 / SO_4 is anomalous in that it is the defunct Group1 limit

Pollutant	Units of Measure (1)	Munmorah Limits (2)	Group 2	Group 5 limits	Group 6 limits
Cadmium	mg/m^3	**1**	-	**1**	0.2
Chlorine (3)	mg/m^3	**200**	200	**200**	**200**
Mercury	mg/m^3	**1**	-	**1**	0.2
NO_2 or NO or both expressed as NO_2 equivalent	mg/m^3	2,500	2,500	800	500
Fluorine, as HF equivalent	mg/m^3	**50**	50	**50**	**50**
Hydrogen chloride (3)	mg/m^3	400	400	100	100
Total solid particles	mg/m^3	**100**	250	**100**	50
Smoke emissions	% opacity (Ringlemann)				
Approved circumstance (4)		-	60 (3)	60 (3)	60 (3)
Other circumstances		-	20 (1)	20 (1)	20 (1)
Sulfuric acid mist and sulfur trioxide (as SO_3)	mg/m^3	200	100	100	100
Type 1 and type 2 substances in aggregate (5)	mg/m^3	**5**	-	**5**	1
VOCs as n-propane equivalent	ng/m^3	-	-	-	0.1
Hydrogen sulphide (3)	mg/m^3	-	5	5	5

Source: POEO Regulation Schedule 3 Standards of concentration for scheduled premises: activities and plant used for specific purposes

NOTE: (1) 100 percentile concentration limit

(2) Munmorah Power Station EPL 759 – 24 August 2009

[2] "emission unit" means an item of plant that forms part of, or is attached to, some larger plant, being an item of plant that emits, treats or processes air impurities or controls the discharge of air impurities into the atmosphere.

(3) Source: POEO Regulation Schedule 4: Standards of concentration for scheduled premises: general activities and plant

(4) Approved circumstance (a) smoke is emitted as a result of blowing soot from a boiler, for a period of no more than 10 minutes per 8 hours, and (b) that all practicable means are employed to prevent or minimise the emission of smoke during that period.

(5) Type 1: antimony, arsenic, cadmium, lead or mercury. Type 2: Beryllium, chromium, cobalt, manganese, nickel, selenium, tin and vanadium. Type 1 included in Group 2 and Type 1 and Type 2 included in Group 5.

The Approved Methods

The Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC 2005) lists the statutory methods for modeling and assessing emissions of air pollutants from stationary sources in the state. It is referred to in the Clean Air Regulation.

Amongst other things, the Approved Methods cover:

- Preparation of emissions data;
- Preparation of meteorological data;
- Methods for accounting for background concentrations and dealing with elevated background concentrations;
- Dispersion modelling methodology, including use of approved models and interpreting results;
- Impact assessment criteria for a range of pollutants.

The assessment of the potential air quality impacts arising from the refurbished Munmorah Power Station have been undertaken in accordance with the requirements of the Approved Methods. Other sections of the assessment describe the development of emissions data (section **4.5**), meteorological data (5.2**)** and the dispersion modelling methodology, model used and results obtained (**Sections 1.5, 5-6**).

The remainder of this section describes the air pollutants considered in the assessment based on the assessment criteria in the Approved Methods and the relevant Group 6 emission limits in Table 2.1.

The section also describes the method used for accounting for background concentrations and the choice of the reference year.

Air pollutants assessed

Table 2.2 includes the substances assessed and the assessment criteria sourced from Tables 7.1, 7.2a and 7.2b in the Approved Methods. The substances assessed include all relevant Group 6 substances listed in Table 2.1, with the exception of the Hazardous Substances (Type 1 and Type 2 substances) and opacity for which assessment criteria do not exist. Two of the Type 1 substances (cadmium and mercury) are assessed individually, however.

In assessing particulate matter impacts (PM_{10} and total suspended particulates, TSP) a single emission rate for total solid particles has been modelled and the results compared with the impact assessment criteria for PM_{10}, which is a conservative approach as fine particles are a (majority) subset of the total solid particle emissions from fabric filter equipped power stations. This approach also provides estimation for the annual average ground level concentrations of TSP.

Two pollutants included in Table 7.1 of the Approved Methods have not been explicitly included in the modelling assessment:

Photochemical oxidants (as ozone): The potential for emissions of nitrogen oxides to contribute to photochemical pollution is addressed in Section 7 of the report under Regional and Inter regional impacts

Deposited dust: The potential for wind-blown emissions from the coal stock-pile to lead to increased levels of dust deposition in the immediate vicinity of the power station is addressed in Section 3.4.4.

Table 2.2 Impact Assessment Criteria for pollutants assessed (sourced from Tables 7.1, 7.2a and 7.2b of the Approved Methods).

Pollutant	Concentration		Averaging period	Reference: Approved Methods table number
	pphm	µg/m^3		
Sulfur dioxide (SO_2)	25	712	10 minutes	7.1
	20	570	1 hour	7.1
	8	228	24 hours	7.1
	2	60	Annual	7.1
Nitrogen dioxide (NO_2)	12	246	1 hour	7.1
	3	62	Annual	7.1
Photochemical oxidants (as ozone)	10	214	1 hour	7.1
	8	171	4 hours	7.1
Lead (Pb)	-	0.5	Annual	7.1
PM_{10}	-	50	24 hours	7.1
	-	30	Annual	7.1
Total suspended particulates (TSP)		90	Annual	7.1
		g/m^2/month (1)	**g/m^2/month (2)**	
Deposited dust		2	4	7.1
Carbon monoxide (CO)	**ppm**	**mg/m^3**		
	87	100	15 minutes	7.1
	25	30	1 hour	7.1
	9	10	8 hours	7.1
Hydrogen fluoride	**µg/m^3 (3)**	**µg/m^3 (4)**		
	0.5	0.25	90 days	7.1
	0.84	0.4	30 days	7.1
	1.7	0.8	7 days	7.1
	2.9	1.5	24 hours	7.1
	ppm	**mg/m^3**		
Cadmium (Cd)		0.000018	1 hour	7.2a
Mercury (Hg)	-	0.0018	1 hour	7.2b
Chlorine	0.018	0.05	1 hour	7.2b
Hydrogen chloride	0.09	0.14	1 hour	7.2b
Sulfuric acid **(5)**	-	0.018	1 hour	7.2b

1. Maximum increase in deposited duct level
2. Maximum total deposited dust level
3. General land use which includes all areas other than specialised land use
4. Specialised land use which includes all areas sensitive to fluoride, such as grape vines and stone fruits.
5. Interpreted to include sulfur trioxide / sulphuric acid mist, as per Table 2.1.

Background concentrations

The Approved Methods say that "*Including background concentrations of pollutants in the assessment enables the total impact of the proposal (i.e. impact of emissions on existing air quality) to be assessed. The background concentrations of air pollutants are ideally obtained from ambient monitoring data collected at the proposed site. As this is extremely rare, data is typically obtained from a monitoring site as close as possible to the proposed location where the sources of air pollution resemble the existing sources at the proposal site*. (p 21*).*

The current assessment benefits from the availability of high-quality, extensive ambient monitoring data obtained from 2 sites located so as to record power station impacts on air quality in the region of Munmorah and Vales Point Power Stations. The location of these sites and a summary of relevant data are presented in Section 3 of the assessment report.

The following is extracted from page 19 of the Approved Methods:

Accounting for background concentrations

For impact assessments of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), PM_{10}, total suspended particulates (TSP), deposited dust, lead (Pb), carbon monoxide (CO) and hydrogen fluoride (HF), the existing background concentrations of the pollutants in the vicinity of the proposal should be included in the assessment as follows:

Level 1 assessments

• Obtain ambient monitoring data that includes at least one year of continuous measurements.

• Determine the maximum background concentration of the pollutant being assessed for each relevant averaging period.

• At the maximum exposed off-site receptor, add the maximum background concentration and the 100th percentile dispersion model prediction to obtain the total impact for each averaging period.

Level 2 assessments

• Obtain ambient monitoring data that includes at least one year of continuous measurements and is contemporaneous with the meteorological data used in the dispersion modelling.

• At each receptor, add each individual dispersion model prediction to the corresponding measured background concentration (e.g. add the first hourly average dispersion model prediction to the first hourly average background concentration) to obtain hourly predictions of total impact.

• At each receptor, determine the 100th percentile total impact for the relevant averaging period.

The Munmorah assessment has been undertaken using a Level 2 assessment using 2004 as the reference year. Other sections of the report demonstrate that 2004 is a representative year when compared with conditions over a number of recent years, in terms of:

- Ambient concentrations (Section 3)
- Meteorology (Section 5)
- Operation of other major sources in the region (Section 5.3)

Unlike the case for the pollutants included in Table 7.1 of the Approved Methods, the impact assessment methodology for individual toxic air pollutants included in Tables 7.2a and 7.2 b of the Approved Methods does not include the requirement to account for background concentrations when comparing predicted concentrations with the relevant assessment criteria. In the current assessment, this applies to the assessment of cadmium, mercury, chlorine, hydrogen chloride and sulphuric acid, shown in Table 2.2.

3. Existing environment

3.1 General

Munmorah Power Station is located in flat to gently undulating terrain in the north of Wyong Shire on the NSW Central Coast adjacent to the Tuggerah lakes. The power station is surrounded by a vegetated buffer zone of some 900 hectares and is adjoined by urban areas, rural settlements, reserves and industrial developments.

The areas surrounding the power station include natural attractions such as Tuggerah Lakes, ocean beaches, scenic natural areas and other recreation areas as well as productive agricultural land, forest and mineral resources. It also includes manufacturing and a range of service industries and the region is a major tourist destination.

The estimated residential population in Wyong Shire has grown from 135,498 in 2001 to an estimated 146,589 in 2008 (source Wyong SC 2009).

3.2 Emission Sources in the Region

The air quality in this region is affected by major industrial sources (Munmorah, Vales Point and Eraring Power Stations) and fugitive emission sources (i.e. major roads), as highlighted in Figure 1.1. The emissions from the Colongra Gas Turbine facility (currently undergoing commissioning testing) and the approved Eraring Power Station upgrade works, which will its increase in capacity by 360 MW also require consideration in the assessment.

3.3 Sensitive receivers

The locations of the nearest sensitive residential receivers relative to the Munmorah Power Station (red) and Colongra Gas Turbine facility (orange) are listed in Table 3.1 and highlighted in Figure 3.1. A number of the sensitive receiver points highlighted on the plot correspond to the edges of the residential receiver zones which are the closest point to the power station. Other receivers correspond to locations within the residential receiver areas. These locations have been used in the estimation of air quality impacts.

In addition to identifying potentially sensitive residential receivers, the assessment has also examined the potential occurrence of sensitive plant species in the region, and in particular species which are known to be extremely sensitive to atmospheric concentrations of hydrogen fluoride, such as grape vines and stone fruit (1). As noted by ANZEC (1) fluoride can injure vegetation at one thousandth the level of concern to human health. The assessment criteria for fluoride in Table 2.2 are therefore designed to protect plants rather than human health.

Figure 3.1 Sensitive receiver regions (highlighted in orange) and assessment points (green markers) relative to Munmorah power station (red marker) and Colongra gas turbine (orange marker)

Table 3.1 Receiver locations identified in Figure 3.1

Receptor number
R1 – Kamilaroo Ave, Lake Munmorah
R2 – Halekulani *East*
R3 – Halekulani *West*
R4 – Barega Cl, Buff Point
R5 – San Remo / Camp Breakaway
R6 – Doyalson
R7 – Pacific Hwy, San Remo
R8 – Mootay Cl Buff Point
R9 – Noela Pl Oval, Budgewoi
R10 – Colongra Bay Rd, Lake Munmorah
R11 – Lake Munmorah Primary School
R12 – 'All Paws Pet Motel' Pacific Hwy
A – Flower greenhouse, Pacific Hwy
B – Pacific Hydroponics, Pacific Hwy

The assessment criteria for fluoride in Table 2.2 are based on the ANZEC goals (**1**), and include separate goals for:

- General Land Use (including residential) goals are designed to protect most of the sensitive species in the natural environment;
- Specialised Land Use Goals apply when commercially valuable plants, which are demonstrated to be sensitive to fluoride, are being considered, such as grape vines and stone fruit.

The Approved Methods Impact Assessment Criteria note that the General Land Use criteria apply in all areas other than Specialised Land Use.

The assessment has identified 2 commercial greenhouse operations with in the vicinity of Munmorah Power Station (marked “A” and “B” in Table 3.1 and on Figure 3.1). Neither grape vines nor stone fruit are grown at either facility. Flowers are grown at Site “A” and lettuce, herbs and baby-leaf vegetables at Site B.

The closest grape growing region to the Central Coast power stations is located in the Hunter Valley, in the vicinity of Cessnock some 44 km from the power stations.

Based on the above considerations the General Land Use criteria for hydrogen fluoride are applied in the assessment of potential impacts arising from emissions from Munmorah Power Station.

It is noted that Delta Electricity has undertaken routine monitoring of hydrogen fluoride at the Wyee monitoring site for many years. Recent hydrogen fluoride monitoring results are summarised Table 3.8 and show that concentrations in the ambient environment are well below levels of concern, even when referenced against the Specialised Land Use criteria.

3.4 Ambient air quality

This section examines the existing ambient air quality in the region based on data collected from the two compliance air monitoring stations for Munmorah Power Station located at Wyee and at Lake Munmorah Primary School (LMPS) over the period 1994 to 2008 and discusses how this information is used in the air quality assessment.

The background air quality in this region is affected by major industrial sources (Munmorah, Vales Point and Eraring Power Stations) and fugitive emission sources (i.e. major roads), as highlighted in Figure 3.2. The emissions from the Colongra Gas Turbine facility (currently undergoing commissioning testing) and the approved Eraring Power Station upgrade works, which will its increase in capacity by 360 MW, are not reflected in the historical air quality data. The method adopted to account for the effect of these new emission sources is discussed in Section 5.3.

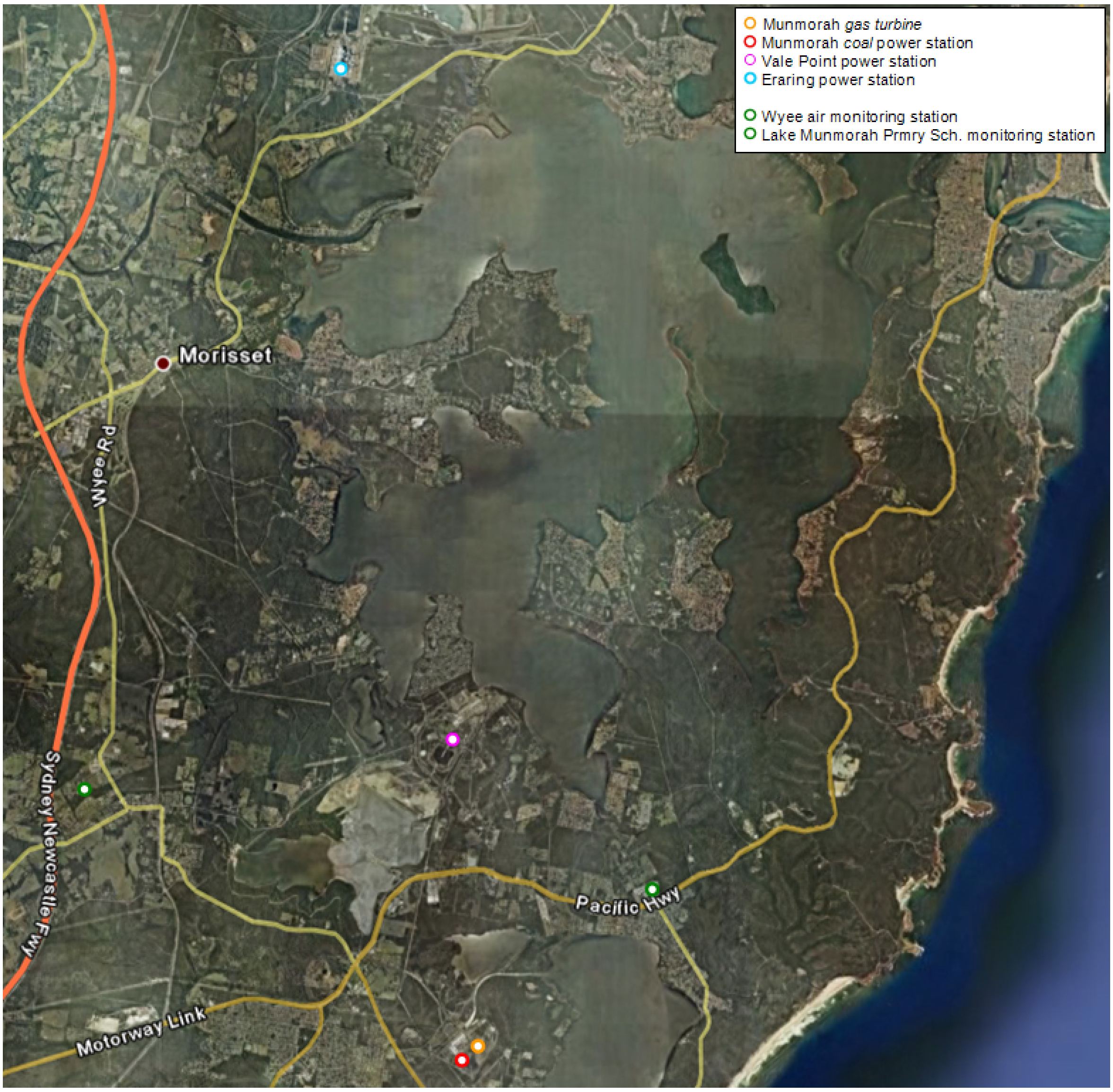

Figure 3.2 Major local industrial air emission sources proposed (approved) and existing and compliance air monitoring stations

It is noted that the annual output of Munmorah during this period varied between 288 GWh and 2645 GWh up to 2008. This has included periods with the equivalent output (based on fuel consumption) to the rehabilitated power station, as shown in the daily capacity factor plots provided in Figure 3.2.

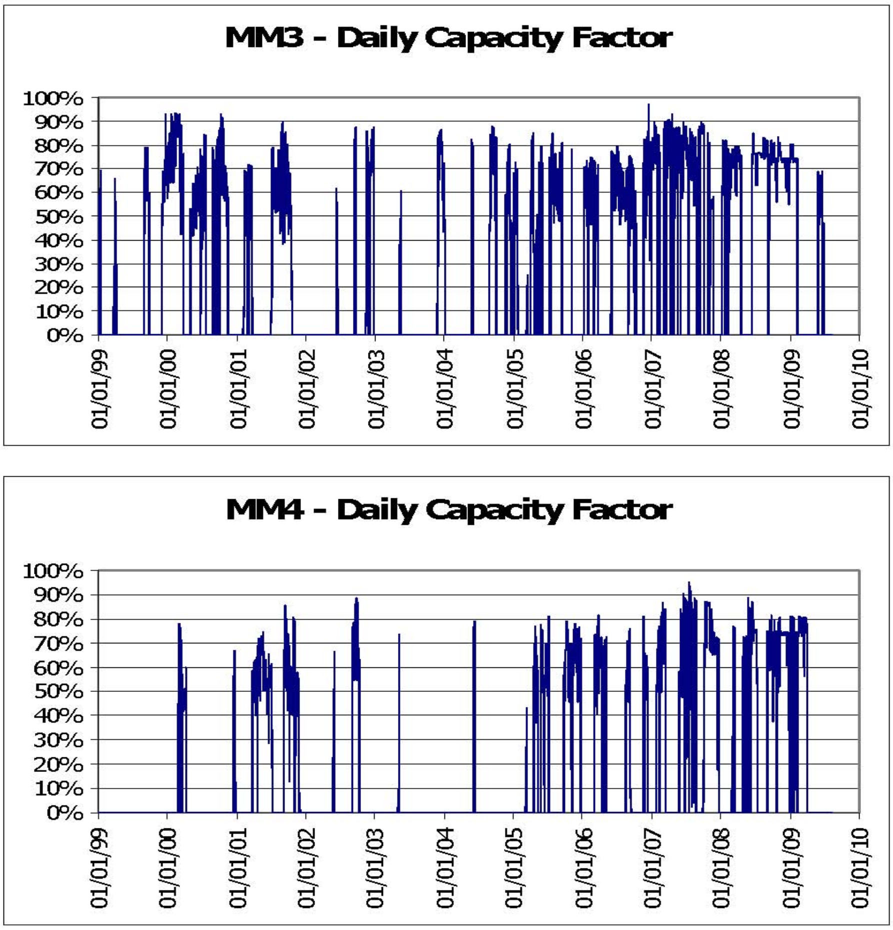

Figure 3.3 Munmorah Power Station Capacity Factor for 1999 – 2009

The following analysis of background data confirms that the adoption of 2004 for subsequent modelling allows for a reasonably conservative representation of the air quality through this region.

Lake Munmorah Primary School has been used as the input data to provide contemporaneous accounting for cumulative air quality impacts, which have been assessed in accordance with the Level II Approved methods methodology (DEC, 2005).

The LMPS dataset has been selected as the dispersion modelling impact assessment carried out for this project shows that the worst case hourly averaged impacts from Munmorah Power station occur at this location.

It is noted that Eraring Power Station has a significant influence on the observed ambient air quality at Wyee and LMPS monitoring stations. However the worst case impacts from the Eraring facility have been noted to occur to the North and North West of the facility (Rae et. al. (2007)).

While Eraring Power Station has been shown to have a more significant influence upon observations at Wyee than the LMPS monitoring site, the emissions from Munmorah have the converse range of influence. The worst case impacts for Munmorah are observed near or close to the Lake Munmorah region with much lower impacts through Wyee and surrounding regions.

3.4.1 Sulfur dioxide (SO_2)

Ambient SO_2 records from Wyee and LMPS air monitoring stations were examined for the period from 1994-2008. This included annual average, daily, one hour and ten minute ambient SO_2 air quality.

A summary of the historical maximum concentrations (1994 to 2008) for SO_2 across all the regulated averaging periods at LMPS and Wyee air monitoring stations is presented in Table 3.2.

The table shows the variably of the observed maximum levels over time and the relationship of the 2004 maxima, which was selected as the reference year for the dispersion modelling component of this impact assessment with maxima the other years in this dataset. The table shows that while the ambient SO_2 level observed through 2004 was exceeded across the various averaging periods for both sites through a number of the years, the exceedance difference for most of the cases is relatively small.

The following sections also examine the frequency distribution of recorded ambient SO_2 to confirm the acceptability of 2004 for modelling purposes.

Annual average

The profile of annual average ground level concentrations from 1994-2008 is presented in **Error! Reference source not found.**. This profile of statistics shows that the observed ambient SO_2 concentrations are low, close to an order of magnitude below the regulated NEPM and NSW DECCW (DEC) air quality goal of 60 µg/m^3 at both Wyee and Lake Munmorah Primary School air monitoring stations.

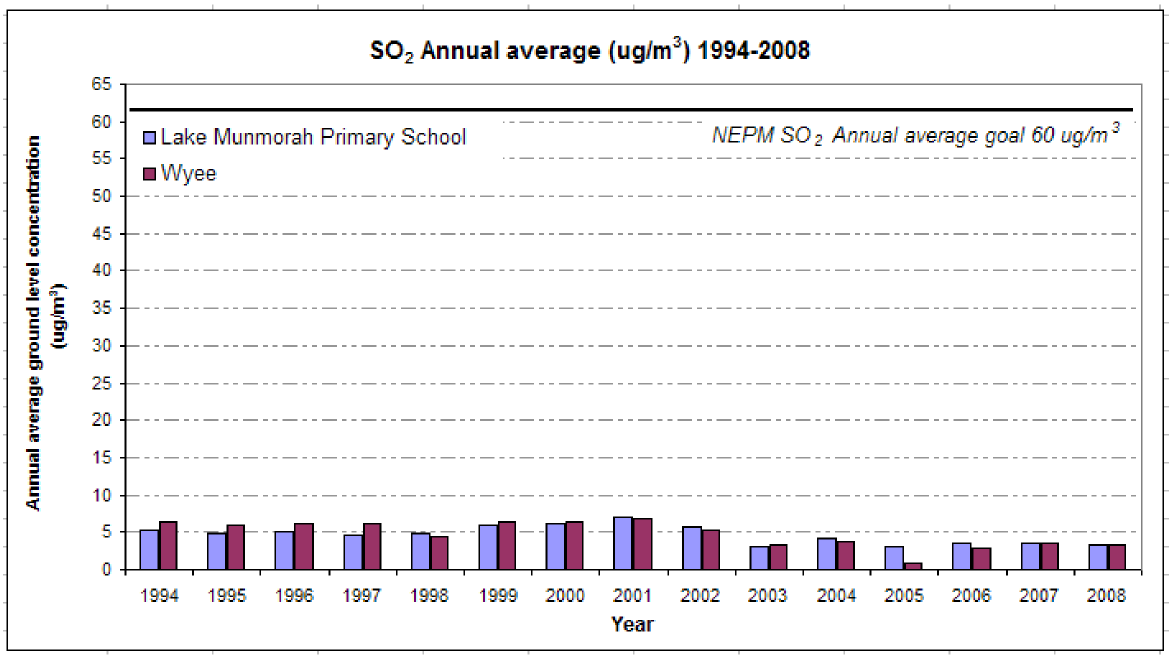

Figure 3.4 Observed annual averaged SO_2 concentrations, from 1994 to 2008 at the Wyee and Lake Munmorah Primary school air monitoring stations

Table 3.2 Maximum historical ground level concentrations for SO2 (µg/m3) for all stipulated air quality goals from 1994 – 2008 at LMPS and Wyee air monitoring stations

LMPS (µg/m³)		Air quality goal	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Mean
SO_2	10 min	712	686	572	400	629	686	257	343	172	200	257	372	200	372	229	458	389
	1 hr	570	286	164	184	139	226	112	192	120	164	141	188	124	167	122	178	179
	24 hr	228	41.2	24.9	36.0	25.2	47.8	28.6	38.9	23.2	45.8	23.2	41.5	28.6	30.6	24.9	36.9	36
	Annual	60	5.1	4.9	5.1	4.9	4.9	6.0	6.0	7.2	5.7	2.9	4.0	3.1	3.4	3.7	3.4	5
Wyee (µg/m³)		**Air quality goal**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**Mean**
SO_2	10 min	712	315	458	400	400	286	515	486	343	400	286	372	372	400	372	229	**376**
	1 hr	570	206	148	163	179	186	207	233	255	216	176	227	137	214	295	158	211
	24 hr	228	66.6	50.1	27.5	59.5	42.6	38.9	26.3	82.7	40.6	30.3	27.2	21.7	20.6	26.9	54.6	45
	Annual	60	6.3	6.0	6.0	6.3	4.6	6.6	6.3	6.9	5.1	3.1	3.7	0.9	2.9	3.4	3.1	5

Daily average

The profile of peak daily averaged ground level concentrations from 1994-2008 is presented in Figure 3.5 5. This profile of statistics shows that the observed ambient SO_2 concentrations are low, close to an order of magnitude below the NEPM and NSW DECCW (DEC) air quality goal of 228 µg/m^3 at both Wyee and Lake Munmorah Primary School air monitoring stations.

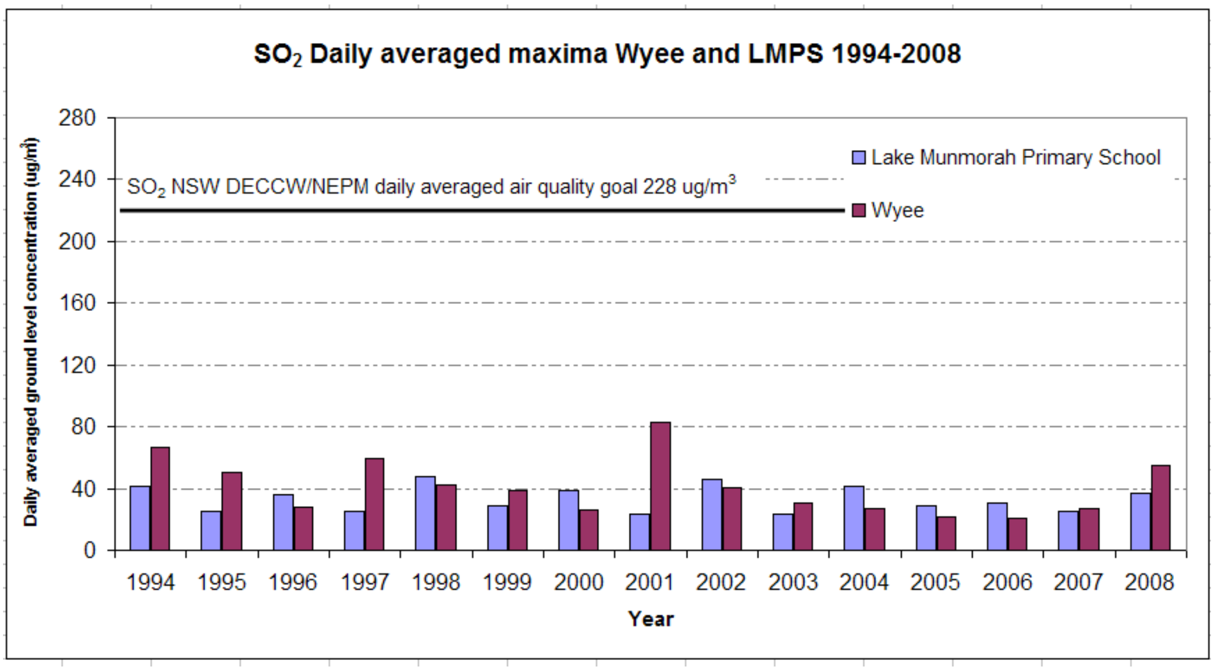

Figure 3.5 Observed daily averaged SO_2 concentrations, from 1994 to 2008 at the Wyee and Lake Munmorah Primary school air monitoring stations

Hourly average

Peak and percentile SO_2 ground level concentrations observed at Wyee (Figure 3.6) and LMPS (Figure 3.7) air monitoring stations from 1994 to 2008 are presented in this section. An examination of the percentiles data presented for Wyee and Lake Munmorah Primary School over this period shows that for more than 99% of the hours in any given year the observed data is below < 57 µg/m^3 (10% of the air quality goal).

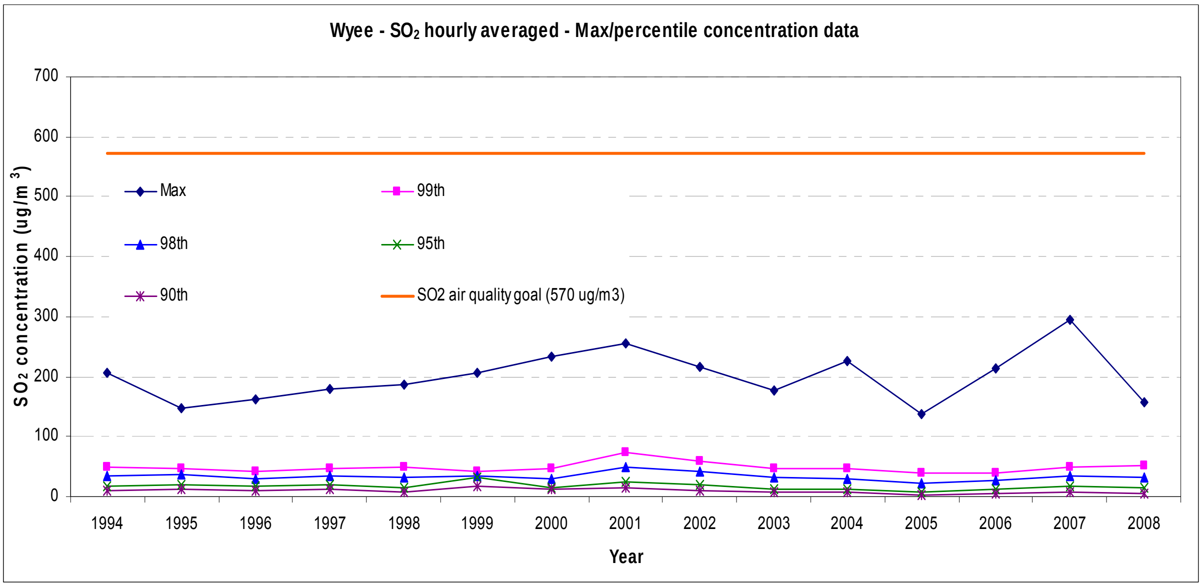

Figure 3.6 Observed hourly averaged SO_2 concentrations (µg/m^3), from 1994 to 2008 at Wyee air monitoring station

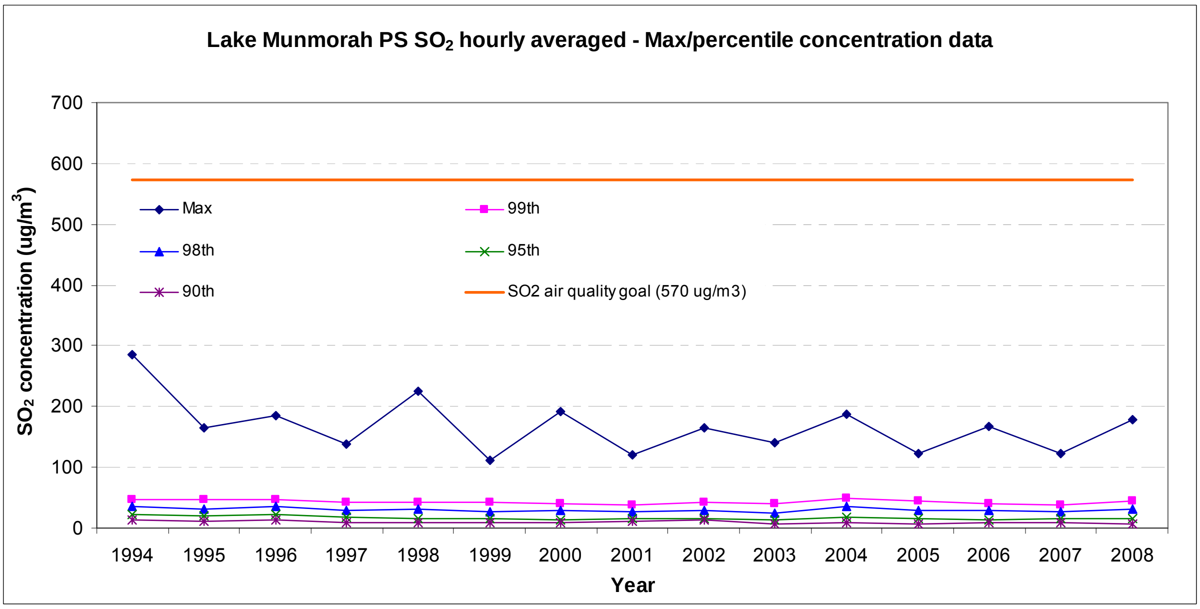

Figure 3.7 Observed hourly averaged SO_2 concentrations (µg/m^3), from 1994 to 2008 at Lake Munmorah Primary School air monitoring station

Ten minute average

An analysis of the 10 minute average data recorded between 1994 and 2008 shows that the maximum ambient records are generally significantly below the relevant air quality goals. The maximum recorded 10 minute average in the record is 686 µg/m^3, which is below the air quality goal of 712 µg/m^3. The average of the annual maxima for Wyee is 376 µg/m^3 and at LMPS it is 389 µg/m^3. The median values of the annual maxima over the same period are 343 µg/m^3 (Wyee) and 458 µg/m^3 (LMPS), which is 48% and 64% of the 10 minute goal.

It is noted that the high readings occurred when other significant sources of SO2, such as the Pasminco smelter, were operating in the region and when Munmorah was operating as a four unit power station. The maximum 10 minute average for 2004 is representative of records from more recent years.

Directionality of SO_2 data

The time series of the hourly averaged SO_2 ground level concentrations observed at Wyee and LMPS in 2004 (the reference year for subsequent modelling) are presented in Figure 3.8 and Figure 3.9 against contemporaneous observations of wind direction. Thus the wind directions (°N) (wind blowing from) that correspond to Munmorah, Vales Point and Eraring Power Stations being directly upwind of the corresponding air monitoring stations are also highlighted.

As these power stations are the only major source of SO_2 in the region, the peaks from certain wind directions are likely to represent the effect of emissions from the power station upwind.

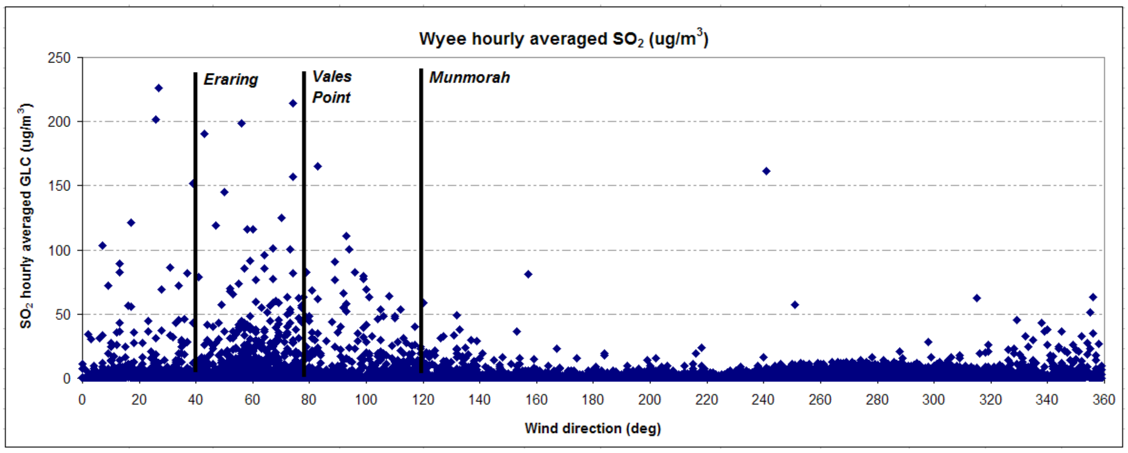

Figure 3.8 Observed hourly averaged SO_2 concentrations (µg/m^3) against contemporaneous wind directions at Wyee.

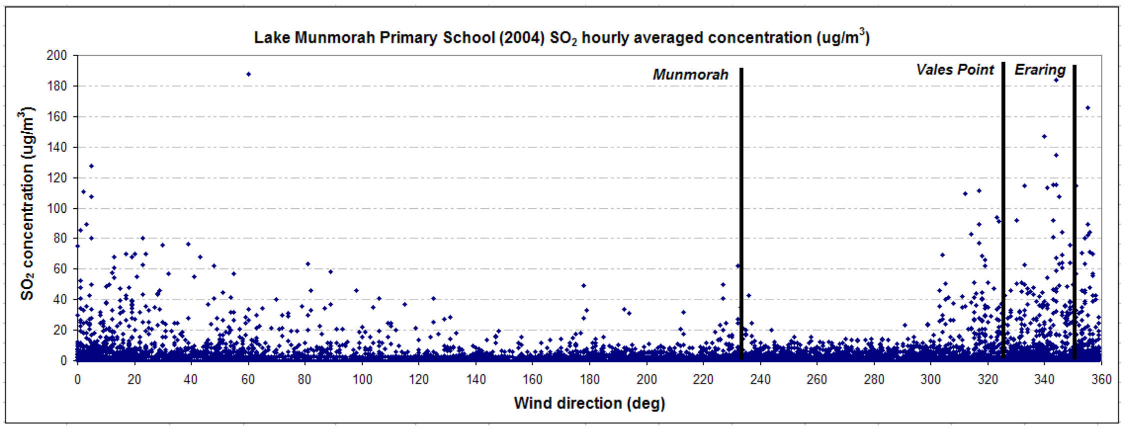

Figure 3.9 Observed hourly averaged SO_2 concentrations (µg/m^3) against contemporaneous wind directions at Lake Munmorah Primary School.

Discussion

The preceding analysis demonstrates that annual average, daily and one hour ambient concentrations have been significantly below the relevant air quality goals over the period assessed. This has also been the case for the 10 minute maximum in recent years.

This analysis shows that the adoption of the year 2004 for modelling purposes provides a reasonable representation of background concentrations over the longer period.

3.4.2 Nitrogen dioxide (NO_2)

An analysis of ambient NO_2 records from Wyee and LMPS air monitoring stations is provided for the period from 1994-2008 and examines annual average and one hour ambient NO_2 air quality.

A summary of the historical maximum concentrations (1994 to 2008) for SO_2 and NO_2 across all the regulated averaging periods at LMPS and Wyee air monitoring stations is presented in Table 3.3.The purpose of this table is to understand the range of maxima that have occurred through the monitoring period and the differences between the observed maximum levels through 2004, the reference year for the dispersion modelling, and the other years in this dataset.

The table shows that the level observed through 2004 was exceeded across the various averaging periods through a number of the years, however the difference through the various years is relatively small.

This analysis shows that the adoption of the year 2004 for modelling purposes provides a reasonable representation of background concentrations over the longer period.

The NO_2 background levels used to predict cumulative impacts were adopted by summing the predicted impact air quality impact with the contemporaneous observed impact at LMPS through the reference year. The 2004 dataset was considered in this case as this was the reference year for the meteorological and air dispersion modelling carried out for the local air quality impact assessment. The meteorological considerations associated with the selection of 2004 as an appropriate reference year is discussed further in Section 5.1.

Annual average

The profile of annual average ground level concentrations examines (Figure 3.10) the observed data from Wyee and LMPS air monitoring stations over the period from 1994-2008. This profile of annual average statistics demonstrates that the observations are less than a third of the regulated NEPM and DECCW air quality goals. A downward trend in annual average NO_2 concentrations is observed over the period.

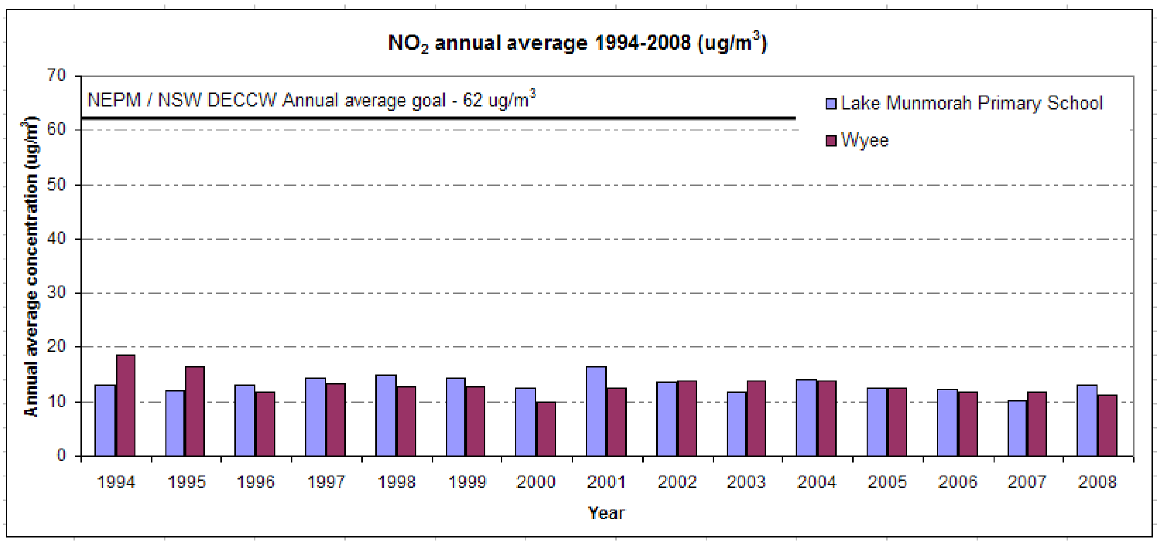

Figure 3.10 Summary of NO_2 annual averaged ground level concentrations (µg/m^3) 1994-2008 at Lake Munmorah Primary School (blue) Wyee (maroon) air monitoring stations

Table 3.3 Maximum historical NO_2 ground level concentrations (µg/m^3) for all stipulated air quality goals from 1994 – 2008 at LMPS and Wyee air monitoring stations

LMPS (µg/m^3)		Air quality goal	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Mean
NO_2	1hr	246	108	89.6	76.9	89.8	92.3	90.2	137	90.6	79.3	118	87.7	147	74.8	91.6	73.2	96.4
	Annual	62	13.1	11.9	13.1	14.4	15.0	14.4	12.5	16.4	13.5	11.7	14.1	12.5	12.3	10.3	13.1	13.2
Wyee (µg/m^3)		Air quality goal	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Mean
NO_2	1hr	246	148	105	117	144	75.0	65.8	103	74.2	87.7	98.4	140	109	72.8	74.8	143	103.9
	Annual	62	18.7	16.4	11.7	13.3	12.9	12.9	10.0	12.5	13.9	13.9	13.9	12.5	11.7	11.7	11.3	13.2

Hourly average

A summary of the hourly average records of NO_2 concentration from the Wyee and LMPS monitoring stations for the period from 1994 to 2005 is provided in Figure 3.11 and Figure 3.12 .

Wyee

The observed hourly averaged data illustrates that the maximum NO_2 concentrations observed over this period are largely less than half the hourly average goal of 246 µg/m^3. While the average concentrations have remained relatively steady over the 15 year period presented, the maximum concentrations recorded have been more variable.

Lake Munmorah Primary School (LMPS)

The observed hourly averaged data illustrates that the maximum NO_2 concentrations observed over this period are largely less than half the hourly average goal of 246 µg/m^3 and that there has not been a single exceedance of the air quality goal over the period examined.

The NO_2 concentration in 95% of the records examined are less than one fifth of the NEPM limit. The temporal differences in the observed 99th, 98th, 95th and 90th percentile levels are all largely negligible. A similar variability in the first highest (peak) concentrations recorded over the period at Wyee was also observed at LMPS. However there has not been any notable trend in maximum concentrations through any extended period of time in the LMPS dataset, the changes in maximum concentrations are seen to be largely sporadic.

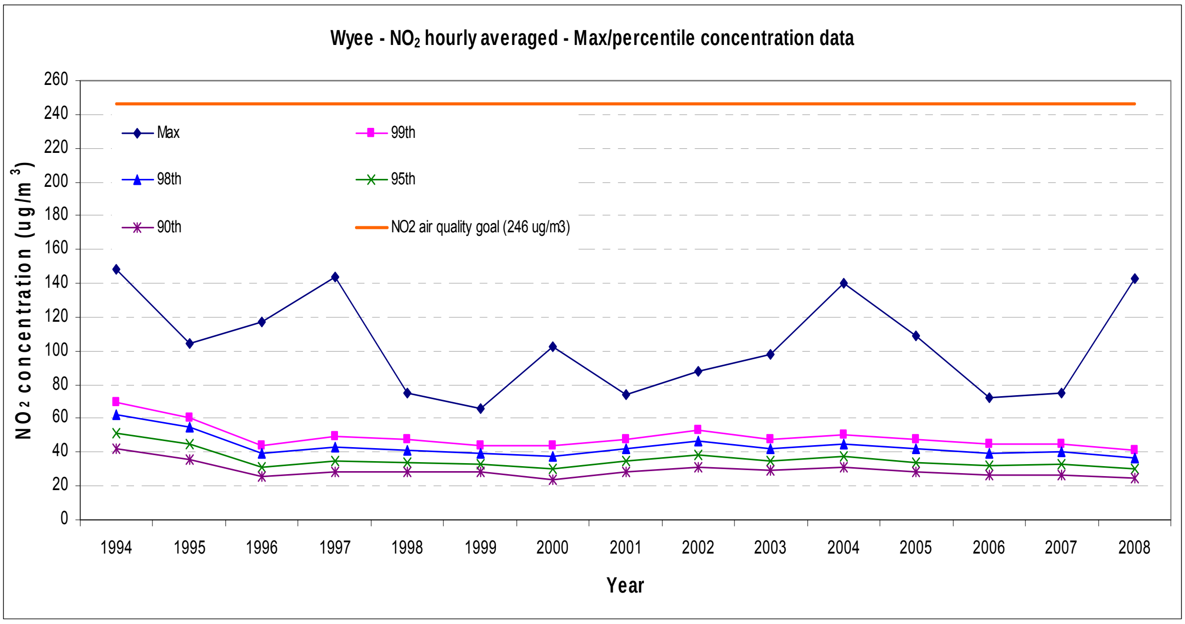

Figure 3.11 Summary of NO_2 percentile and peak hourly averaged ground level concentrations (µg/m^3) 1994-2008 at Wyee air monitoring station.

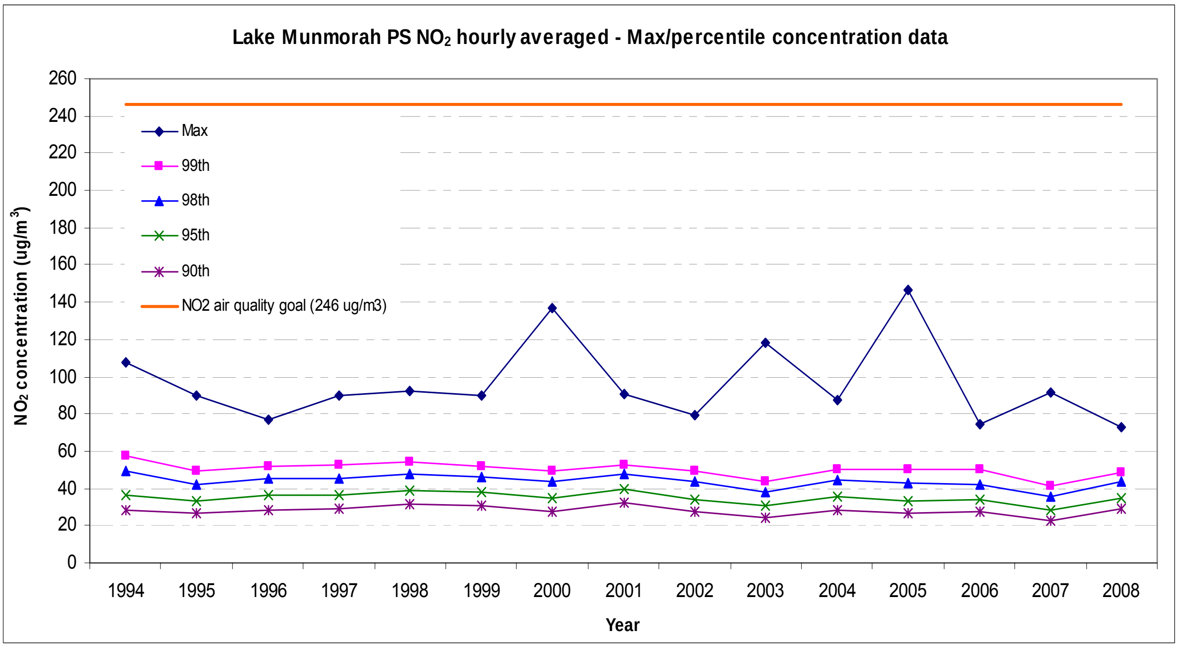

Figure 3.12 Summary of NO_2 percentile and peak hourly averaged ground level concentrations (µg/m^3) 1994-2008 at Lake Munmorah Primary School air monitoring station

Discussion of NO_2 ambient data

The observed NO_2 data indicates that the air quality in the region is generally good. The 99th percentile hourly averaged NO_2 concentration recorded at Wyee and LMPS indicates that the highest concentrations are well below the NEPM and corresponding NSW DECCW (DEC) hourly averaged air quality goal. The difference between the 99th percentile and first highest concentrations observed through the year indicates that the peak events are largely isolated. The 95th percentile of the hourly averaged NO_2 concentrations observed each year over the last 15 years is less than one fifth of the commensurate air quality goal.

The following discussion is provided to understand the relationship between periods through which the power station plume is likely to be brought to ground level and the observed level through those periods.

Both the Wyee and Lake Munmorah Primary School air monitoring stations are located near carriageways that have heavy daily traffic flows. The Wyee air monitoring station is sited approximately 500 m from the Sydney-Newcastle Freeway (> 40,000 veh/day) and the LMPS monitoring station is located approximately 100 m from the edge of Pacific Highway (20-40,000 veh/day) (RTA, 2006). The hourly averaged ground level concentration observed through 2004 at both Wyee and LMPS monitoring stations largely correspond to periods through which peak AM and PM traffic flows occur.

An analysis of the ten highest NO_2 concentrations observed at Wyee air monitoring station through the dispersion modelling reference year, 2004 (refer Table 3.4) shows that, the peak concentrations correspond to weekday periods when traffic flow on the carriageway would be most significant (i.e. between 6 and 7 pm). The ten highest NO_2 concentrations also coincide with periods of relatively low SO_2 concentrations (< 20 µg/m^3). This supports the suggestion that emissions from power stations are not likely to be the primary cause of the peak observed NO_2 air quality impacts.

Although the first highest NO_2 ground level concentration observed at Wyee does not correspond with a period when peak hourly traffic volume would be expected, it corresponds with a wind direction that indicates emissions from Munmorah Power Station to be immediately upwind of the monitoring station. However it is believed that emissions from Munmorah Power Station could not have been responsible for this event, as low levels of SO_2 were observed, through the hours and days either side of this statistic (no coincident SO_2 data was recorded at the time). The low levels of SO_2 observed through these periods suggest that emissions from motor vehicles as opposed to those from a power station plume are likely to be the primary contributor to the peak events presented.

A similar analysis of the ten highest hourly averaged NO_2 concentrations observed at LMPS monitoring station (refer Table 3.5) illustrates that emissions from motor vehicles as opposed to emissions from any of the power stations were the primary contributor to peak NO_2 events. Seven of the ten highest observations occur through periods that correspond to the AM and PM traffic flow peaks. Two of the three remaining events coincide with high SO_2 levels; through these hours the corresponding wind directions do not place Munmorah down wind of the monitoring station.

Table 3.4 Ten highest NO_2 ground level concentrations (µg/m^3) observed at Wyee through reference year 2004.

Date/time	NO_2	SO_2	Wind direction
2/03/2004 11:00	140	ND	131
26/03/2004 19:00	71.8	2.1	282
1/04/2004 18:00	76.5	2.1	311
27/08/2004 4:00	66.2	2.7	291
17/09/2004 19:00	65.2	3.7	348
27/09/2004 20:00	67.2	2.1	305
12/10/2004 18:00	67.2	2.7	300
13/10/2004 18:00	73.4	1.4	339
14/10/2004 0:00	69.1	19.9	354
30/11/2004 19:00	66.0	1.4	313

Table 3.5 Ten highest NO_2 ground level concentrations (µg/m^3) observed at Lake Munmorah Primary School through reference year 2004.

Date/time	NO_2	SO_2	Wind direction
7/05/2004 17:00	87.7	6.6	132
9/03/2004 13:00	77.3	105	340
1/04/2004 19:00	76.5	5.7	253
7/05/2004 16:00	76.3	5.7	130
16/05/2004 17:00	75.2	3.5	122
20/12/2004 1:00	73.2	0.0	192
9/03/2004 12:00	72.8	96.8	344
7/05/2004 18:00	72.2	5.5	55
8/05/2004 18:00	70.3	6.8	92
11/05/2004 17:00	68.7	11.3	31

3.4.3 Fine particulate matter (PM_{10})

The observed levels of fine particulate matter (PM_{10}) are documented based on the DECC Ambient Air Monitoring Reports for 2004. The levels observed by the TEOM particulate monitor at the air monitoring stations in the Lower Hunter being Beresfield, and Wallsend, are used to represent the background level of PM_{10} at this facility, to enable a reasonable representation of cumulative air quality impacts.

As Wallsend is approximately 35 km from Munmorah Power Station and Beresfield is approximately 47 km from Munmorah the Wallsend data has been used in the assessment.

The Wallsend monitoring station is located in the Newcastle City Council Swimming Pool, off Frances Street. A consideration of the region surrounding the air monitoring station through Wallsend illustrates that it is similar to Munmorah given the absence of any large fugitive sources of dust near the monitoring station. The major sources of PM_{10} through this region are considered to be that from mobile sources (i.e. traffic) and natural sources such as windblown dust and bushfires. This is similar to the nature of the PM_{10} sources found around Munmorah, notwithstanding the fact that the Vales Point and Eraring Power Stations do contribute to observed levels of PM_{10} to some extent.

Exceedances in the daily averaged NEPM ambient air quality guideline for PM_{10} were observed at both of these stations through the month of December through the reference year (2004). The majority of the exceedances in PM_{10} air quality goals through this region through the summer months (as shown in Table 3.6) can be attributed to local dust events, and/or bushfires which lead to the transport of large amounts of particulate matter over large distances. In this instance the relatively minor exceedance in the guideline through December is indicative of a local dust event.

Table 3.6 Monthly PM_{10} maxima at DECCW air monitoring station at Wallsend.

PM_{10} daily averaged (μg/m^3)	Wallsend
Jan	19
Feb	43
Mar	34
Apr	34
May	38
Jun	20
Jul	25
Aug	29
Sept	29
Oct	43
Nov	36
Dec	52*

* Single exceedance in the NEPM PM_{10} daily averaged guideline limit of 50 μg/m^3 through the month of December occurred at both DECC Air monitoring sites.

3.4.4 Fugitive dust

Delta Electricity operates a network of dust gauges to monitor dust deposition in the locality. The location of the Munmorah Power Station dust gauges is shown in Figure 3.13.

Figure 3.13 Munmorah Dust Gauge Locations

The time series profile of dust deposited (assessed as insoluble solids) on a monthly basis at each of the six dust gauges surrounding Munmorah power station is provided in Figure 3.13 This figure illustrates that although there have been occasional events above the DECCW cumulative impact assessment criterion of 4g/m^2/month over the 16 year period analysed ; these events have been very infrequent and in most cases the highest results are probably the result of external “interference” with the relevant gauge. This supported by the high degree of missing data caused by vandalism of the gauges which are more publicly accessible. Note that the level of deposited dust is presented on a logarithmic scale to illustrate the very infrequent occurrence of elevated dust deposition results.

Figure 3.14 illustrates that most of the observed levels have been below the level stipulated as the maximum allowable increase in the deposited dust level (2 g/m^2/month). A large proportion of the observed monthly figures since 2004 have been below 1 g/m^2/month. This is confirmed by the frequency distribution of events across the specified concentration ranges at each of the dust gauges in Figure 3.12. Further to this evidence supporting the likelihood of interference is represented by the high(er) frequency of deposited dust events concentrations greater than 10 g/m^2/month; as opposed to the frequency of deposition concentration in the range between 4-10 g/m^2/month.

A frequency distribution of the number of events above the NSW DECCW assessment criterion for deposited dust of 4 g/m^2/month is provided on a chronological basis in Figure 3.15. Although there were a number of events above the assessment criterion in 2006 as noted earlier, this can be discounted given notes in the monitoring reports that suggest a large degree of interference with the dust gauges. Furthermore it is important to note the power station has been operating regularly in recent years, but that there have not been any exceedances in the goal in 2009.

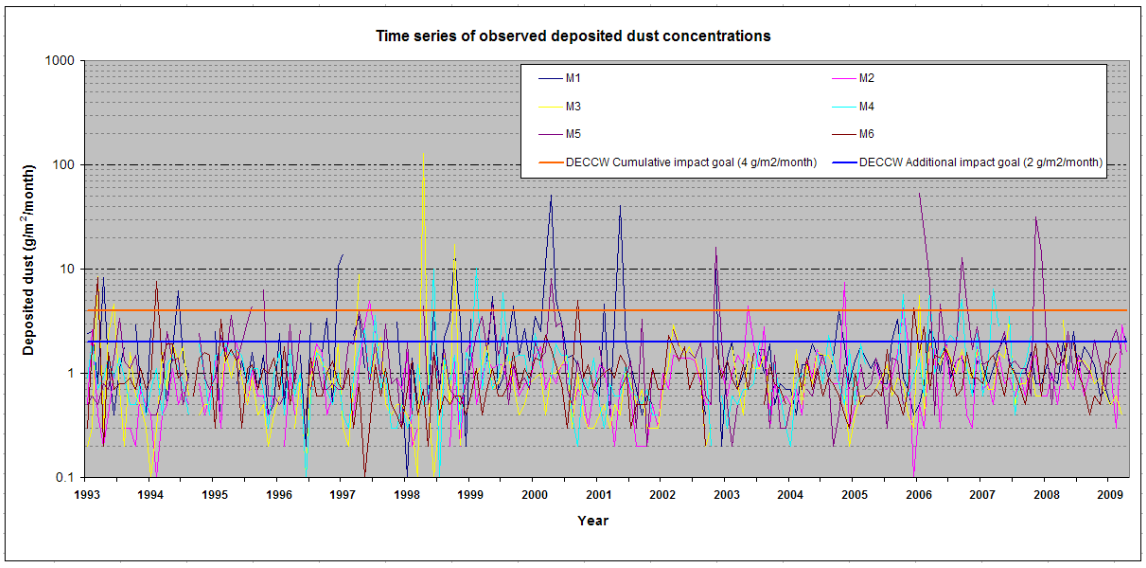

Figure 3.14 Time series profile of deposited dust concentrations from July 1993 to October 2009

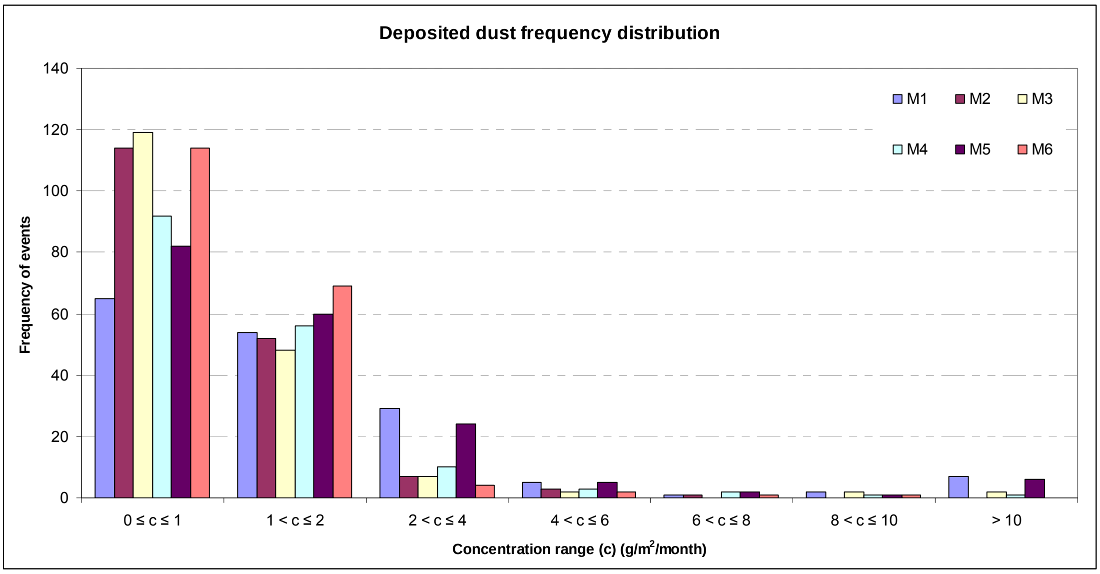

Figure 3.15 Frequency distribution across concentration ranges at each of the dust gauges (M1-M6)

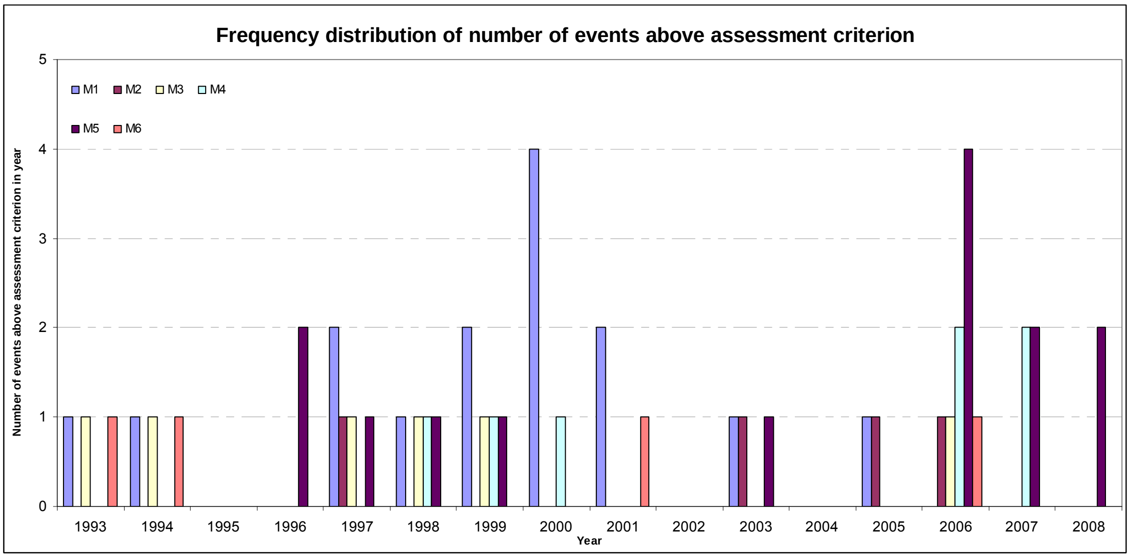

Figure 3.16 Frequency distribution of number of events above NSW DECCW assessment criterion for deposited dust (4 g/m^2/month) – at each of the six dust gauges from 1993 – 2008

3.4.5 Carbon monoxide (CO)

The carbon monoxide background level adopted to represent the background in this instance is based on the monitored pollutant levels through the reference year (2004) at the nearest NSW DECCW ambient air monitoring station in Newcastle.

The Newcastle monitoring station was selected for this purpose as it was thought to provide a reasonable representation of the region surrounding Munmorah power station. The primary emission sources around Newcastle would be emissions from motor vehicles; this would also be the case at Munmorah given the influence of motor vehicle emissions from Pacific Hwy and Sydney-Newcastle Fwy through this region.

The maximum 8 hour averaged ground level concentration through the reference year was converted into the 1 hour and 15 min averaging periods using the power law function described below:

$$C_2 = C_1 \left(\frac{t_1}{t_2} \right)^{0.2}$$

The adopted background concentrations for carbon monoxide are thus presented in Table 3.7 below.

Table 3.7 Adopted background concentrations for carbon monoxide (mg/m^3) – DECCW Newcastle air monitoring station 2004 figures

Averaging period	15 min	1 hour	8 hour
NSW DECCW air quality goal (mg/m^3)	100	30	10
Carbon monoxide (mg/m^3)	6.0	4.5	3.0

3.4.6 Hydrogen fluoride (HF)

Hydrogen fluoride was monitored at the Wyee air monitoring station over the period from 2004-2009. Summary data for this period corresponding with the DECCW air quality goals is presented in Table 3.8. This data illustrates from 2004-2009 the concentrations have been up to an order of magnitude below the relevant DEC (2005) air quality goals.

Table 3.8 First highest hydrogen fluoride (HF) concentrations across various averaging periods from 2004-2009; (analysis for 2009 incomplete year)

Concentration ($\mu g/m^3$)	Averaging period			
	24 hrs	**7day**	**30 day**	**90 day**
NSW DECCW (DEC) goal	**2.9**	**1.7**	**0.84**	**0.5**
2004	0.16	0.11	0.08	0.05
2005	0.26	0.18	0.10	0.07
2006	0.21	0.14	0.09	0.07
2007	0.39	0.26	0.12	0.07
2008	0.23	0.16	0.10	0.07
2009	0.23	0.16	0.10	0.07

While the observed maxima for the modelling reference year 2004 are low, the difference between values is between 4% and 9% of the goals.

3.5 Operation of Eraring and Vales Point Power Stations

As the consideration of the impact of Vales Point and Eraring Power Station (except for the upgrade) emissions is included in the background ambient air quality the following discussion is provided to provide an understanding of their level of operation through the period being assessed.

The following figure shoes the annual production of the power stations from 1994 to 2008.

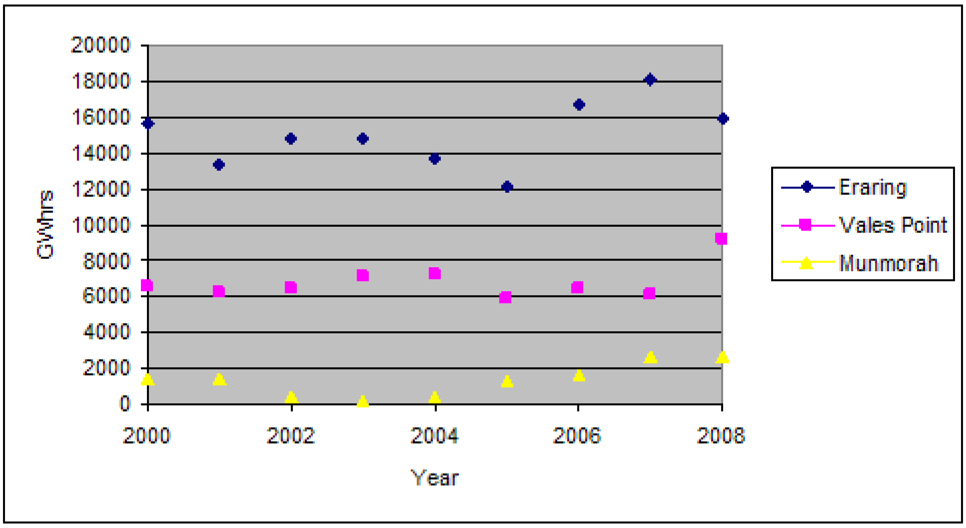

Figure 3.17 Central Coast Power stations Annual Operation 1994 to 2008

The seasonal operation of the plants is shown in the following figures.

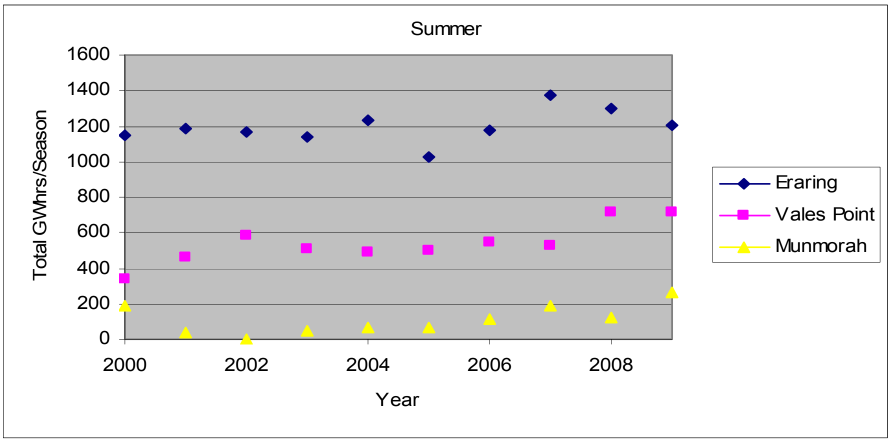

Figure 3.18 Central Coast Power Stations Summer Operation 1994 to 2008

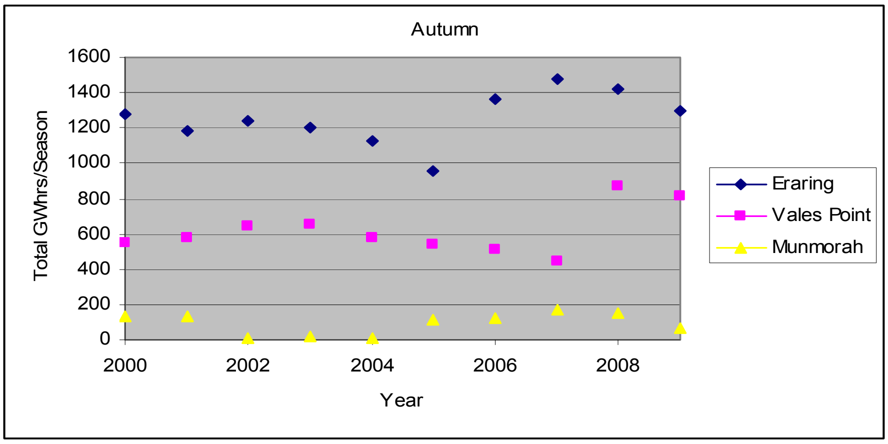

Figure 3.19 Central Coast Power Stations Autumn Operation 1994 to 2008

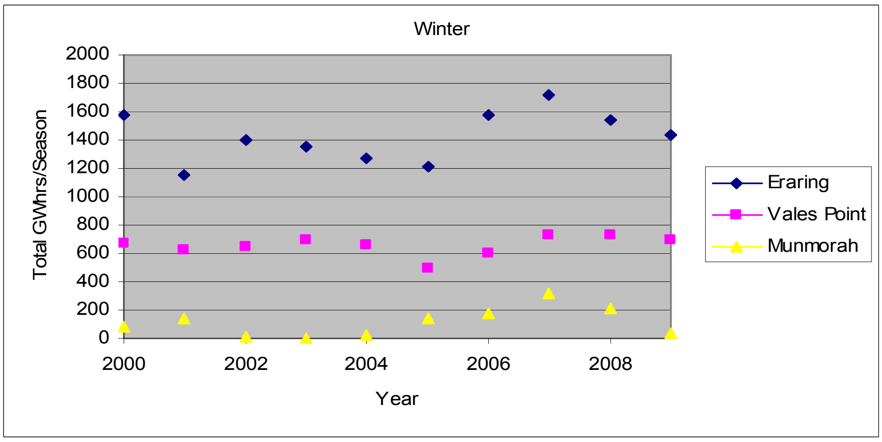

Figure 3.20 Central Coast Power Stations Winter Operation 1994 to 2008

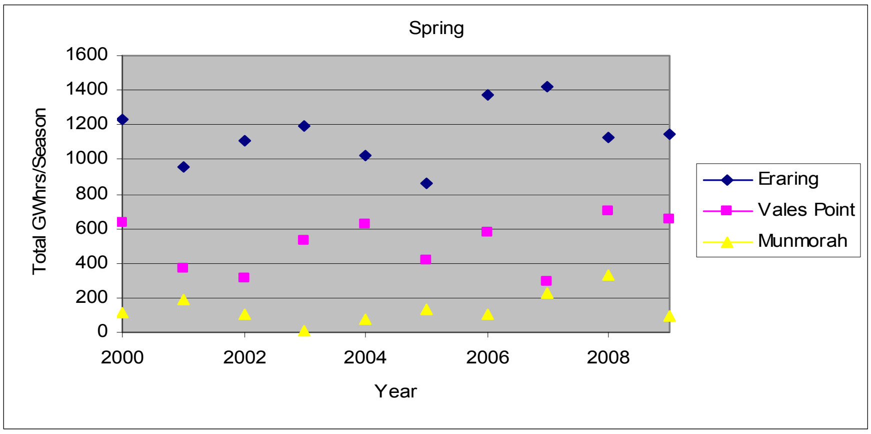

Figure 3.21 Central Coast Power Stations Spring Operation 1994 to 2008

Based on the above analysis it can be seen that the reference year (2004) is representative of emissions from Vales Point and Eraring power stations that are within the normal range of generation for those facilities.