R E P O R T

Air Quality Impact Assessment For Proposed Buronga Peaking Power Plant

Prepared for

International Power

Level 37, Rialto North Tower
525 Collins Street

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Project Manager:

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William Barrett
Associate

URS Australia Pty Ltd

Level 3, 116 Miller Street
North Sydney
NSW 2060
Australia
Tel: 61 2 8925 5500
Fax: 61 2 8925 5555

Project Director:

…………………………….
Matt Coetzee
Principal

Author:

…………………………….
Stephen Bowly
Senior Air Quality Scientist

…………………………….
James Grieve
Air Quality Engineer

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Executive Summary

International Power (Australia) Pty Ltd (IPRA) proposes to construct and operate a distillate-fired gas turbine peaking power plant near Buronga in the southwest of NSW. Subject to final plant selection, the peaking plant will comprise three gas turbines, each with a capacity of up to 50MW, each operating up to 10% of the year. URS has performed an air quality assessment of the proposed plant investigating local air quality impacts, impacts on human health and aviation safety. A greenhouse gas assessment has also been undertaken.

The impact of the proposed plant on local air quality has been assessed using the CSIRO's TAPM dispersion model, incorporating meteorological data from the Bureau of Meteorology Mildura Airport Weather Station. The modelled species included oxides of nitrogen (NO_x), particulate matter (PM_{10}), carbon monoxide (CO), sulphur dioxide (SO_2), lead and Hazardous Air Pollutants (HAPs).

In addition to this assessment, AUSPLUME modelling has been performed in order to screen against TAPM's worst case predicted impacts. This component of the assessment utilised both TAPM generated meteorology, and manually generated synthetic worst case meteorology, and demonstrated TAPM's predictions to be conservative against worst case AUSPLUME methodology.

The assessment has used a conservative approach applied in accordance with the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005a). Despite operations being limited to 10% of a year, it has been assumed that the peaking power plant would be running all three gas turbines continuously, at full load for every hour of the year, in order to assess impacts under a range of meteorological conditions.

The assessment of the cumulative impacts against regulatory criteria has used the aggregate of the worst case predicted plant impacts and peak background concentrations from DECC (NSW EPA) and Victorian EPA monitoring Stations.

The air dispersion modelling assessment has concluded that under worst case meteorological conditions, the predicted impacts on ground level concentrations of NO_2, CO, SO_2 and lead when added to peak background concentrations, are within the DECC regulatory criteria. Given the high background levels of naturally occurring background particulate matter in the region, PM_{10} was assessed in a contemporaneous manner, where the peak predicted plant impact was found to be minor relative to background levels, and no additional exceedances of PM_{10} regulatory criteria were found to be caused by the proposed plant.

As per the approved methods, HAPs were assessed for incremental impact and were below regulatory criteria.

Whilst this air quality assessment has shown the pollutants were below criteria, it is considered that this assessment is conservative and that actual impacts on local air quality from this development would be considerably lower.

A greenhouse gas assessment was also performed which estimated that based on a typical operating scenario, the Buronga Project is estimated to release 0.023Mt of CO_2-e per year, which when compared to the 2005 inventory, represents 0.04% of the emissions from electricity generation in NSW, or 0.004% of all sources of greenhouse gas in Australia.

A plume rise assessment / aviation safety study was performed which shows that the peaking power plant would produce exhaust plumes with vertical velocities that exceed 4.3m/s above the Obstacle Limitation Surface for approximately 2.5% of the year, based on a full year of three turbines operating. Whilst this assessment is considered conservative with respect to the modelled operating times and operating conditions, the Civil Aviation Safety Authority (CASA) at its discretion may opt to designate this to be a potential hazard to aircraft operators in the area.

Given the infrequent operating time of the peaking power plant and the conservative nature of the air quality assessment, it is considered that the potential for adverse air quality impacts of the proposed Buronga Peaking Power Plant will be negligible.

Section 1 Background

1.1 Proposed Development

International Power (Australia) Pty Ltd (IPRA) proposes to build an open cycle gas turbine power plant for peaking operation, with a total capacity up to 150MW (subject to final plant selection) to be located on Crown land immediately adjacent to the TransGrid 220kV switching station, approximately 10km northeast of Buronga in the far southwest of New South Wales. This location best facilitates regional connection into the national electricity grid.

The facility would comprise three distillate-fired gas turbines, each with an output capacity of up to 50MW. The operating regime for the power plant would be determined by market and transmission network requirements. However IPRA anticipates that, except for emergencies as allowed in its operating licence, the facility would operate on an as-required, intermittent basis for a total maximum period of up to 10% of any year for any one gas turbine.

1.2 Gas Turbine Operation

In each gas turbine generator, air is drawn in through filters to remove particulate matter and passed into the compressor section of the gas turbine. In each compressor, multiple rows of rotating blades raise the temperature and pressure of the air. Following compression of the air to pressures of 15 to 30 atmospheres, the air flows into the combustors, where fuel is injected and burnt, increasing the temperature to approximately 1,100°C to 1,200°C.

The combustion products enter the turbine section of the gas turbine and expand to toward atmospheric pressure, reducing in temperature to around 550°C. As the gas expands, the gases drive the turbine, which in turn, drives the compressor and an electrical generator. From the turbine section, the hot exhaust gases are discharged to the atmosphere via the exhaust stack.

1.3 Gas Turbine Emissions

The primary atmospheric emissions from gas turbines are typical for such combustion sources, namely: nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), water vapour (H_2O), oxides of nitrogen (NO_X) and carbon monoxide (CO).

Other gaseous emissions are likely to include oxides of sulphur (SO_X), low concentrations of particulates, Volatile Organic Compounds (VOCs) and Hazardous Air Pollutants (HAPs) in trace concentrations. Carbon dioxide is addressed as part of the greenhouse gas assessment contained in **Appendix A** and consequently is not discussed further in the body of this report. The various exhaust components of interest and their sources are listed in **Table 1-1**.

Table 1-1 Exhaust Components and their relevant sources

Species	Source/s
N_2, O_2,	Inlet Air
H_2O	Inlet Air, oxidation of hydrogen in fuel, water injection for NO_X control
NO_x	Oxidation of primarily atmospheric and also fuel-bound nitrogen
SO_x	Oxidation of fuel-bound sulphur
CO_2	Oxidation of carbon in fuel
CO	Incomplete oxidation of carbon in fuel
Lead	Impurities in fuel
Particulate Matter	Particulate matter in air, incomplete oxidation of fuel, impurities in fuel
Hazardous Air Pollutants / VOC	Impurities in fuel and incomplete oxidation of fuel

Section 1 Background

Gas turbines are extremely clean burning when compared with boilers and reciprocating internal combustion engines. The fuel is burnt at very high temperatures, with a large amount of excess air, which promotes more efficient combustion of the fuel, thus improving (reducing) the emissions of particulates, carbon monoxide and HAPs. However, the presence of excess air at high temperatures also promotes the formation of NO_X, where atmospheric nitrogen is oxidised into nitric oxide (NO) and nitrogen dioxide (NO_2).

Following is a discussion of the various pollutant species considered in this assessment.

1.3.1 Oxides of Nitrogen

Oxides of nitrogen (NO_X) are the sum of nitric oxide (NO) and nitrogen dioxide (NO_2). In gas turbines the primary mechanism for NO_X formation is termed "thermal NO_X". This occurs in the combustion chambers, where high temperatures allow the dissociation of atmospheric nitrogen (N_2), after which the nitrogen may combine with excess oxygen. Generally the NO_x emissions from a gas turbine exhaust stack comprise approximately 90% NO and 10% NO_2.

In the atmosphere NO and NO_2 are linked in a circular reaction with oxidants such as ozone, which generate NO_2 from NO and sunlight which breaks NO_2 down to NO. Due to this reaction sequence, the exact amount of NO and NO_2 within emissions is often unknown, and consequently the sum emission of both species (i.e. NO_x) is quoted. The ambient concentration of NO_2 near to a NO_X source is dependent on the amount of oxidant and sunlight at the time.

In ambient concentrations usually found within the atmosphere, NO has no impact on either human health or the environment. Conversely, it is known that short term concentrations of NO_2 greater than 200ppb (411µg/m^3) (NEPC, 1998), has the potential to cause irritation in certain individuals. To ensure that individuals are protected from potential health impacts of short term concentrations, maximum short term exposure is set within NSW at 246µg/m^3 (120ppb). The long term effects of NO_2 are less well known although some evidence suggests poor lung function of inhabitants of areas with high NO_2 concentrations. To address the potential long term effects of NO_2, an annual average limit of 62µg/m^3 has been set by the Department of Climate Change & Environment (DECC), now incorporating the New South Wales Environment Protection Authority (NSW EPA).

1.3.2 Particulate Matter

Emissions of particulate matter from distillate combustion are attributed to non-combustible components of the fuel, as well as incomplete combustion of the fuel. Smaller particles behave like gases in the atmosphere, and do not fall out of the plume in the manner of larger particles.

Major natural sources of background particulate levels include forest fires, pollen and wind-blown dust from exposed areas. Anthropogenic sources include stationary and mobile combustion sources, road dust, agriculture, mining, major fires and emissions from industrial processes. Background levels vary widely depending on location, meteorology and proximity of major point or area sources.

For this project, background particulate matter was found to be frequently elevated due to dust storms, however plant impact on ambient particulate matter was found to be low. **Appendix D** to this Air Quality Assessment presents a further discussion of PAH emissions from the proposed plant.

1.3.3 Sulphur dioxide

Emissions of sulphur dioxide are defined by the sulphur content of the fuel. Guidelines exist to limit sulphur content in the distillate fuel to be used at Buronga, such that sulphur dioxide emissions are likely to be negligible.

Under distillate operation, the plant will use low sulphur distillate to Australian Standard AS3570 which has been refined to standards specified in the Commonwealth *Fuel Quality Standards Act* (2000). Since 1 January 2006, this act has regulated the sulphur content of automotive diesel to 50mg/kg, with a further reduction to 10mg/kg as of January 1st 2009.

Sulphur dioxide emissions in this assessment have been conservatively based on the current specification for sulphur content of 50mg/kg, despite the forthcoming introduction of the lower limit.

1.3.4 Carbon monoxide

Carbon monoxide (CO) is produced due to the incomplete combustion of any fuel containing carbon. In the plant types intended to be used at Buronga, this occurs during the gas turbine start up and then reduces dramatically (by around 75%) by the time the plant commences generation output within 5 to 6 minutes of start up.

1.3.5 Lead

Lead had traditionally been incorporated into petrol, and it is not added to distillate fuels. Whilst lead is present in distillate, it is generally present in trace concentrations. Consequently lead emissions from the proposed distillate combustion are likely to be negligible.

Lead pollution related to the combustion of distillate fuels has declined significantly in recent years, due to the complete ban of lead in petrol. Since this time, the DECC has ceased all monitoring for ambient lead.

1.3.6 Hazardous Air Pollutants

Hazardous Air Pollutants (HAPs) emissions from gas turbines are lower than for other combustion sources e.g. internal combustion engines (USEPA, 2000). This is due to the combustion environment where high temperatures and high amounts of excess air promote more complete combustion of the fuel.

The HAPs under distillate-fired gas turbines include benzene and Polycyclic Aromatic Hydrocarbons (PAHs) as well as metallic HAPs such as manganese and chromium (US EPA 2000). Whilst HAP may be formed from combustion of fuel, they are generally present in trace concentrations.

Appendix D to this Air Quality Assessment presents a further discussion of PAH emissions from the proposed plant.

Section 2 Air Quality Criteria

2.1 General

There are three main types of air quality criteria relevant to industrial developments such as the power generation facility proposed by IPRA:

- ***Emission Standards*** – which are maximum allowable pollutant emission concentrations (exhaust stack concentrations) specified for particular types of equipment;
- ***Air Impact Assessment Criteria*** – which are designed for use in air dispersion modelling studies and air quality impact assessments for new or modified emission sources; and
- ***Ambient Air Quality Standards*** – which set standards against which ambient air quality monitoring results may be assessed.

In general, Emission Standards and Air Impact Assessment Criteria are used to evaluate the expected impact of air emissions on air quality and the effectiveness of plant design and any associated mitigation measures. The main objective of these criteria is to ensure that the resulting local and regional ambient air quality meets the relevant Ambient Air Quality Standards.

2.1.1 Emission Standards

The Protection of the Environment Operations (Clean Air) Regulation 2002 sets emission limits for air impurities from stationary plant and equipment. The current standards, taken from Schedule 3 (Electricity Generation) of the Regulation, relevant to the IPRA peaking power plant are presented in **Table 2-1**.

The proposed Buronga plant would be classified as a Group 6 source, as it will commence operation after 1 September 2005.

Table 2-1 Emission Standards for Electricity Generation (from Schedule 3, Protection of the Environment Operation (Clean Air) Regulation 2002)

Pollutant	Applicability	Limit
Solid Particulates (Total)	-	50 mg/m^3
NO_2 or NO or both as NO_2 equivalent	Any turbine operating on a fuel other than gas, being a turbine used in connection with an electricity generating system with a capacity of 30 MW or more	90 mg/m^3 as NO_2
Fluorine (F_2) and any compound containing fluorine, as total fluoride (HF) equivalent [A]	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel.	50 mg/m^3
Smoke	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel.	Ringelmann 1 or 20% opacity

Note: An activity is designated to "Group 6"if it commenced to be carried on, or to operate, on or after 1 September 2005, as a result of an environment protection licence granted under the Protection of the Environment Operations Act 1997 pursuant to an application made on or after 1 September 2005.

A: HF was excluded from the air quality assessment, as discussed in **Section 2.1.2**.

The emission rates used in this assessment have been based on conservative worst case emission rates. Specific emission concentrations will depend upon the type of gas turbines ultimately selected, however the proponent will ensure that turbine emissions will comply with the limits stipulated in the Development Approval.

2.1.2 Air Impact Assessment Criteria

In August 2005, the DEC (NSW EPA) released the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*. This document specifies a range of impact assessment criteria for toxic (hazardous) and odorous air pollutants. The impact assessment criteria for those pollutants associated with the proposed peaking power plant are shown in **Table 2-2** and **Table 2-3**.

It should be noted that hydrogen fluoride (HF) was excluded from **Table 2-2**, as no emission factors could be provided by US EPA (2000), DEH (2005) or IPRA. IPRA advises that its plant suppliers have cited negligible HF emission levels.

Consequently, it was considered that HF was not a pollutant of concern from this type of facility and did not warrant further assessment.

Table 2-2 DECC Impact Assessment Criteria for Criteria Pollutants[A]

Pollutant [A]	Concentration		Averaging Period
	(ppm)	(µg/m^3)	
NO_2	0.12 0.03	246 62	1 hour Annual
PM_{10}	- -	50 30	24 hour annual
SO_2	0.25 0.20 0.08 0.02	712 570 228 60	10 minutes 1 hour 24 hours Annual
CO	87 25 9	100,000 30,000 10,000	15 minutes 1 hour 8 hours
Lead	-	0.5	Annual

Notes

[A]: Primary pollutants are regional pollutants identified by the DEC(2005a) as pollutants that are known to adversely impact human health and the atmosphere.

Given that lead is classified as a criteria pollutant, lead has been presented in this report separately from other metallic air pollutants, which are classified as toxic or HAPs.

The HAPs required for assessment, as listed in **Table 2-3** have been taken from US EPA (2000) and DEH (2005). Where US EPA (2000) and DEH (2005) did not provide relevant and measurable emission rates, the pollutants were not included. Additionally emission rates from chromium are generally provided as total chromium, however, values for chromium (III) and chromium (VI) in **Table 2-3** are separated for comparison against relevant criteria.

Table 2-3 Impact Assessment Criteria for HAPs [A]

Pollutant [B]	Concentration (µg/m^3)	Averaging Period
HAPs		
Benzene	29	1 hour
Formaldehyde	20	1 hour
Total PAHs [C]	0.4	1 hour
Metallic HAPs		
Arsenic	0.09	1 hour
Beryllium	0.004	1 hour
Cadmium	0.018	1 hour
Chromium (III)	9	1 hour
Chromium (VI)	0.09	1 hour
Manganese	18	1 hour
Mercury [D]	0.18	1 hour
Nickel	0.18	1 hour

Notes

[A] HAPs/Air Toxics are pollutants identified by the DECC as pollutants that have the potential in the long term to adversely impact human health and the atmosphere. These pollutants are generally found at much lower concentrations compared with criteria pollutants.

[B] The air toxics relevant to this type of combustion emission have been sourced from US EPA (2000) and DEH (2005).

[C] PAH = Polycyclic Aromatic Hydrocarbons. For the purposes of this report, PAH includes naphthalene.

[D] For the purposes of this assessment, the more conservative organic mercury criteria of 0.18 ug/m^3 has been used in preference to the inorganic mercury criteria of 1.8 ug/m^3.

2.1.3 Ambient Air Quality Criteria

In February 1998 the NSW EPA issued ‘Action for Air’ - the NSW Government’s 25-year Air Quality Management Plan. In this plan the EPA adopted a number of regional ambient air quality goals for a range of air pollutants. This Plan was updated in August 2006 [1] and focuses on the Greater Metropolitan Region of NSW with emphasis on measures to reduce the adverse impact of photochemical smog and fine particle pollution.

The guidelines contained in NEPC (1998) and DEC (2006d) are designed for use in assessing regional air quality and are not intended for use as site boundary or atmospheric dispersion modelling criteria, hence the proposed peaking power plant emissions have not been assessed directly against these guidelines. However it should be noted that the maximum concentrations for NO_2, PM_{10}, SO_2, CO and lead are identical to the DEC (2005a) criteria.

[1] DEC 2006d *Action For Air 2006 Update*. NSW Government.

Section 3 Existing Environment

3.1 Climate

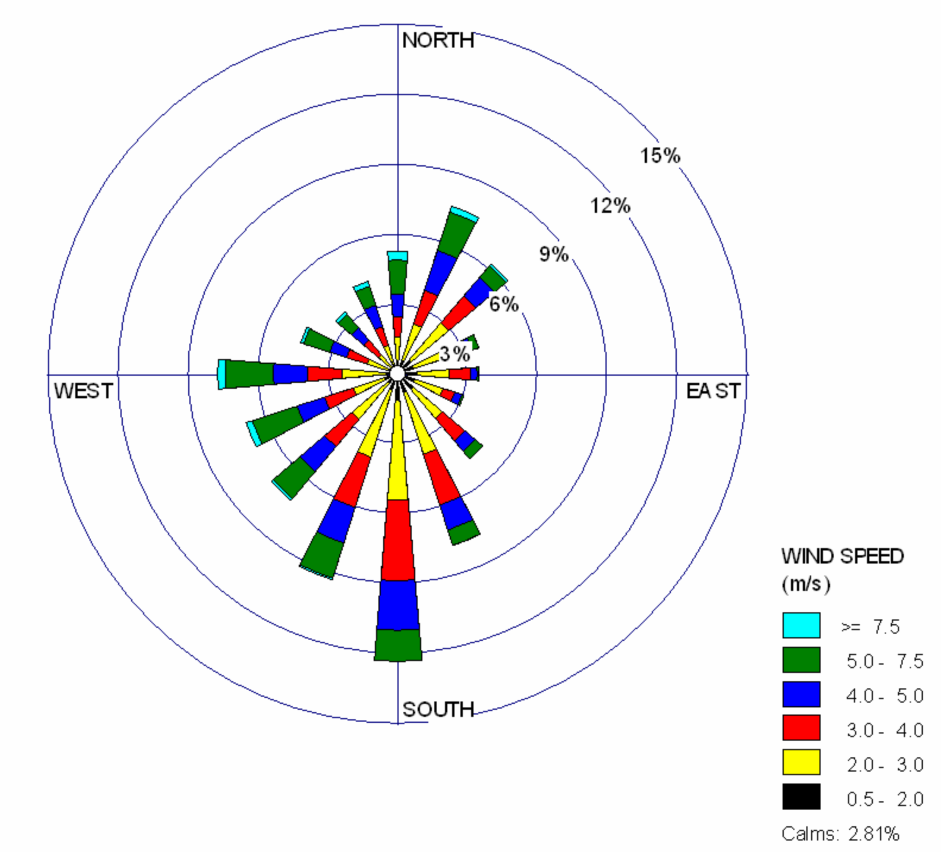
A summary of climatological data collected at the Mildura Bureau of Meteorology Station is provided in **Table 3-1**. This station is located at Mildura Airport, approximately 22km to the SW of the site, and is the closest meteorological monitoring station to the proposed Buronga facility. **Table 3-1** shows that the area experiences hot summers with temperatures up to 47^{0}C recorded since meteorological monitoring began. Conversely, the area has experienced sub zero temperatures during the winter months. Average annual rainfall is 284.8 mm with no significant monthly variation in rainfall patterns.

3.2 Meteorology

As site specific dispersion meteorology was not available, CSIRO's TAPM *(The Air Pollution Model* Hurley, 2005*)* meteorological model was used, with assimilation of wind data from Mildura Airport. The methodology for developing site specific meteorological data is provided in **Appendix B** of this report.

The TAPM derived meteorological data is presented as an annual wind rose in **Figure 3-1**. Wind in the region primarily blows from the south and southwest quadrant and to a lesser extent from the north north-easterly directions.

Figure 3-1 TAPM generated annual wind rose for proposed site (2005)



Section 3 Existing Environment

Table 3-1 Climate Data for Bureau of Mildura Airport - Bureau of Meteorology Station 076031 (Bureau of Meteorology, 2007)

Statistic Element	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Number of Years
Mean maximum temperature (Degrees C)	32.1	31.6	28.3	23.5	19	15.9	15.3	17.2	20.3	23.7	27.3	30.1	23.7	61
Highest temperature (Degrees C)	46.9	45.6	41.5	37.8	29.6	25.4	26.8	29.9	37.4	40.2	44.5	45.1	46.9	61
Lowest maximum temperature (Degrees C)	15.4	16.2	12	13.9	10.2	8.8	7.9	8.3	7.9	11.4	13.6	14.4	7.9	61
Mean minimum temperature (Degrees C)	16.6	16.4	13.8	10.1	7.4	5.2	4.3	5.2	7.4	9.7	12.4	14.8	10.3	61
Lowest temperature (Degrees C)	7.6	5.2	3.8	0.6	-2.1	-3.7	-4	-2.3	-1.1	1.1	3.3	5.3	-4	61
Highest minimum temperature (Degrees C)	30.9	30	27	22.4	18.3	16.6	14.3	18.8	22.1	23.7	27.6	28.9	30.9	61
Mean rainfall (mm)	21.1	20.3	18	18.5	25.6	22.9	26.4	26.7	27.4	30.6	24	23.4	284.8	61
Highest rainfall (mm)	92.2	100.9	128.2	120.4	86.3	82.2	59.4	74.8	88.3	120.6	129.9	181.2	536.4	61
Highest daily rainfall (mm)	37.6	65.2	91.2	58.8	46.4	33.3	29.2	44.7	41.1	43.2	65.5	68	91.2	61
Mean number of days of rain	3.6	3.1	3.4	4.2	6.8	7.9	9.3	9	7.5	7.1	5.5	4.3	71.7	61
Maximum wind gust speed (km/h)	111	115	117	80	80	91	97	91	102	100	139	145	145	50
Mean daily sunshine (hours)	10.8	10.5	9.9	8.4	6.6	5.5	5.9	7.5	8.1	9.4	10	10.6	8.6	18
Mean daily solar exposure (MJ/(m*m))	28.9	26.6	22.6	17.1	11.9	9.3	9.6	12.1	16.1	21	26.5	28.3	19.2	12
Mean number of clear days	15.5	14.6	15.7	12	7.9	7.3	7.4	7.8	9.6	10.2	10.8	13.1	131.9	61
Mean number of cloudy days	6.1	5.7	5.7	8.5	11.7	11.8	11.3	10	9.3	9.7	9.4	7.8	107	61
Mean daily evaporation (mm)	10.6	9.8	7.4	4.7	2.6	1.8	2	3	4.5	6.5	8.5	10.1	6	41
Mean 9am temperature (Degrees C)	21.7	20.8	18.5	14.8	10.8	7.7	7.1	9.1	12.7	16.1	18.3	20.5	14.8	61
Mean 9am wet bulb temperature (Degrees C)	15.7	15.6	14.1	11.8	9.3	6.8	6.1	7.4	9.7	11.6	13	14.4	11.3	61
Mean 9am dew point temperature (Degrees C)	10.6	11.1	10.2	8.6	7.6	5.7	4.8	5.2	6.4	6.9	7.8	8.9	7.8	61
Mean 9am relative humidity (%)	52	56	61	69	82	88	86	79	68	58	54	50	67	61
Mean 9am wind speed (km/h) for years 1946 to 2007	15.7	14.4	13.5	11.6	9.5	9.3	10.3	12.7	15.6	17.4	16.6	16	13.5	61
Mean 3pm temperature (Degrees C)	30.3	29.8	27	22.7	18.3	15.3	14.6	16.4	19.3	22.5	25.7	28.4	22.5	61
Mean 3pm wet bulb temperature (Degrees C)	18.2	18.4	17	14.8	12.7	11	10.2	10.7	12.3	13.7	15.4	16.8	14.3	61
Mean 3pm dew point temperature (Degrees C)	7.9	9	8.4	7.3	7.1	6.2	5	4.1	4.4	4.3	5	6	6.2	61
Mean 3pm relative humidity (%)	28	30	34	40	51	56	55	47	41	35	30	28	39	61
Mean 3pm wind speed (km/h) for years 1946 to 2007	16.9	16	15.6	15.3	15.1	15.5	17.3	19.3	19.7	19.8	18.4	18.2	17.3	61

Section 4 Background Air Quality

4.1 General

DEC (2005a) require that the highest background concentration of a pollutant, as measured by an appropriate monitoring station, is used to represent the background concentration of that pollutant for the region throughout the period assessed. It is necessary to incorporate the background concentrations of air pollutants as they provide a baseline level, to which the predicted impact of the development can be added, thus producing a cumulative air quality impact, suitable for comparison against regulatory criteria.

The area being assessed is a relatively sparsely populated rural area, and combustion source emissions such as NO_x, SO_2 and CO are low. The main air pollutant of concern is particulate matter (PM_{10}) which is generated primarily from the natural processes in the surrounding environment.

The availability of ambient monitoring data in the region of the proposed site is extremely sparse. In 2005, EPA Victoria undertook 7 months of ambient monitoring of PM_{10} in Mildura (13km SE of the proposed site), as part of its rural monitoring campaign (EPA Victoria, 2005). Under this campaign a series of locations each undergo a year of ambient monitoring. At Mildura this monitoring was only conducted for particulate matter, as it is the prime pollutant of concern for the region. Other pollutant species such as NO_2, CO and SO_2 were not monitored.

4.1.1 Nitrogen Dioxide, Carbon Monoxide and Sulphur Dioxide

Given that there is no appropriate background monitoring data available for species other than PM_{10}, background concentrations of NO_2, SO_2 and CO were adopted on a conservative basis from an area with greater pollution potential, as a function of population, industrial emissions, meteorology and topography. Whilst this is unsuitable for predicting the actual scale of cumulative peak impacts of the proposed plant, it is conservative, and appropriate for the purposes of this assessment in demonstrating compliance with regulatory criteria.

Hence, background NO_2, SO_2 and CO data for 2005 were sourced from Chullora in south western Sydney. This area lies in the Sydney basin, and is densely populated with residential, transport and industrial emissions greater than those the region of interest.

4.1.2 Particulate Matter

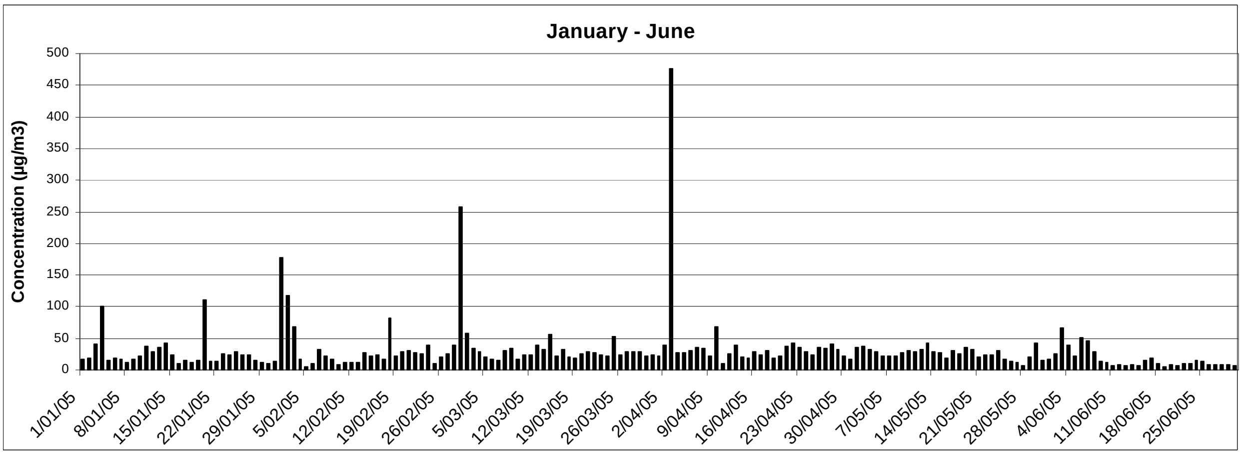
Particulate matter is the pollutant of greatest significance in the region. During dry periods, the region regularly experiences elevated levels of windblown dust, where fine exposed soil from agricultural areas and unsealed roads is mobilised by strong winds. Dust events have been found to occur most frequently during summer and autumn, and during times of drought (EPA Victoria, 2005).

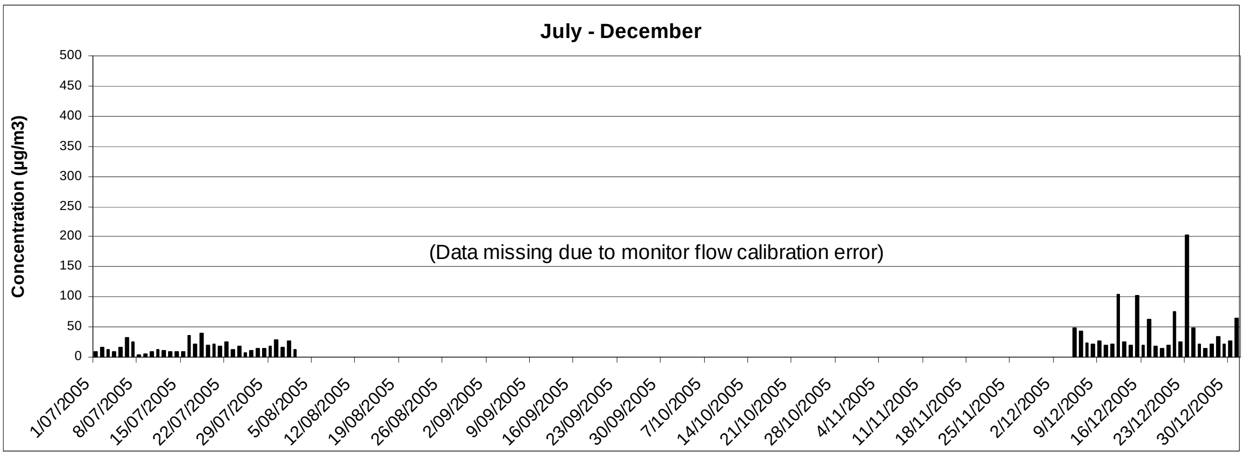
As part of a study investigating the effect of particles on human health, the EPA Victoria undertook ambient monitoring of PM_{10} in Mildura (13km SW of the proposed site) in 2005. During this period, exceedances of the NEPM ambient air quality standard occurred around one in ten days, with a peak background concentration of 476 $\mu g/m^3$ occurring on April 3, 2005. Further detail of this monitoring is contained in EPA Victoria (2005) *Airborne Particle Monitoring at Mildura – December 2004*.

A graphical representation of the monitoring is provided in **Figure 4-1**. EPA Victoria (2005) states that the high PM_{10} levels were generally associated with widespread dust storms and the increase in particulate matter was strongly related to wind speed. In the absence of dust storms, particulate monitoring results in Mildura were found to be similar to those in Bendigo and Melbourne. These data show that high concentrations of particulate matter, specifically PM_{10}, naturally occur around Mildura.

Section 4 Background Air Quality

Figure 4-1 Victorian EPA PM_{10} Monitoring in Mildura, 2005





4.1.3 Lead

Lead is classified by DECC as a criteria pollutant, with the primary source of lead pollution originating from combustion of leaded petrol. With a complete ban of leaded petrol, regional lead emissions have decreased significantly in recent years.

Ambient monitoring of Lead is no longer undertaken by the DECC, as a result of the elimination of the primary source of Lead emissions, and the corresponding reduction in ambient Lead levels.

To remain consistent with the DEC (2005) *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW,* this assessment has incorporated a background Lead concentration of 0.099 µg/m^3, which is the 24 hour averaged ambient value, taken from Table 11, NSW EPA (2002). This conservative value of 0.099 µg/m^3 is consistent with measurements taken between 2000 and 2003 in Sydney, Illawarra and the Hunter which showed a range in annual average concentrations between 0.02 to 0.09 µg/m^3 (DEC, 2004b).

4.2 Pollutant Concentrations less than 1 hour

Where pollutant concentrations were required to be assessed for averaging times less than one hour, namely for SO_2 and CO, **Equation 1** was used to convert the hourly averaged background data (EPA Victoria, 2005b).

$$C_t = C_{60}\left[\frac{60}{t}\right]^{0.2} \qquad \text{..........Equation 1}$$

Where:
C_t = concentration of pollutant at time t
C_{60} = concentration of pollutant based on averaging time of 60 minutes;
t = time (in minutes)

4.3 Summary of Background Concentrations

A summary of the background air quality concentrations used in this assessment is provided in **Table 4-1**.

Table 4-1 Summary of Background data for used in Air Quality Modelling

Species	Averaging Time	DECC Monitoring Station Data	Maximum Background Concentration (µg/m^3)	Air Quality Criteria (µg/m^3)
NO_2	1 hour	Chullora	131.2	246
	Annual average		28.7	62
CO	15 minute	Chullora	6930	100,000
	1 hour		5250	30,000
	8 hour		3500	10,000
SO_2	10 minute	Chullora	61.4	712
	1 hour		42.9	570
	24 hour		14.3	228
	Annual average		2.9	60
PM_{10} [A]	24 hour	Mildura	476	50
	Annual average		28.1	30
Lead [B]	Annual	Various	0.099	0.5

Notes:
Data obtained from DEC (2005b), DEC (2006a), DEC (2006b) and DEC (2006c).
[A] Both the peak 24 hour and annual average are both derived from 241 days of available monitoring data from Mildura.
[B] Background lead datum sourced from **Table 11**, NSW EPA (2002)

4.4 Assessment of Hazardous Air Pollutants (HAP)

In addition to the criteria air pollutants which are the primary air pollutants emitted from distillate combustion, other air toxics, otherwise known as Hazardous Air Pollutants (HAP) may be produced and can include (US EPA, 2000):

- Benzene;
- Formaldehyde;
- Polycyclic Aromatic Hydrocarbons (PAHs);
- Arsenic;
- Beryllium;
- Cadmium;
- Chromium III;
- Chromium VI;
- Manganese;
- Mercury; and
- Nickel.

DEC (2005a) methodology specifies that HAPs be assessed against regulatory criteria, without the incorporation of a background concentration.

Section 5 Assessment Methodology

5.1 Construction Impacts

The estimated duration of construction through to commissioning is 6-8 months, although construction activities may only be evident for around 5 months. The construction phase will include mobilisation, bulk earthworks, establishing and preparing foundations, construction of buildings and plant and demobilisation.

During the construction phase, there is the potential for dust to be generated due to the excavation and handling of soils, site grading activities and vehicle movements. The minimisation and control of dust emissions during the construction period will be implemented using procedures contained in the Construction Environmental Management Plan (CEMP).

Construction activities on previously occupied industrial sites have been known to give rise to odours or dust containing contaminants. Given the agricultural nature of the site, there is considered to be no significant potential for any dust emissions from construction activities to contain contaminants, or for the works to give rise to odorous emissions, consequently a comprehensive assessment of emissions during construction has not been quantified. The distance to the nearest residential dwelling (approximately 3.5 km) and the main work area provides a sufficient buffer zone to neighbouring land uses to prevent nuisance dust impacts.

5.2 Dispersion Modelling

As stated in DEC (2005a) *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales,* the preferred regulatory dispersion model for NSW is Ausplume. However, where there exists a lack of adequate meteorological data, other dispersion models such as CSIRO's "The Air Pollution Model" (TAPM) may also be used.

Through a number of verification studies (e.g. Hurley, 2005), TAPM has been identified as a suitable model of choice to simulate meteorological fields and plume dispersion in a number of situations including high temperature buoyant plumes such as power plants (CSIRO, 2005). TAPM is an incompressible, non-hydrostatic, primitive equation model with a terrain-following vertical co-ordinate for three-dimensional simulations. It includes parameterisations for cloud/rain micro-physical processes, turbulence closure, urban/vegetative canopy and soil, and radiative fluxes.

TAPM was chosen against traditional Gaussian model due to its more thorough (lagrangian) treatment of buoyant plume rise through non-uniform atmospheric profiles, as well as it's ability to address impacts associated with recirculation of emissions from previous hours (both limitations of Gaussian models).

TAPM was run to calculate meteorological fields for the modelling domain and the configuration is detailed in **Appendix B**. The following assessment has been based on dispersion modelling undertaken using TAPM. However, to ensure consistency with the dispersion modelling approach recommended by DEC (2005a), a screening validation of the TAPM predicted short term impacts was also conducted using Ausplume. The Ausplume study is provided in **Appendix E**.

5.3 Operational Scenario

In order to assess the potential impacts of the proposed plant under worst case meteorological conditions the dispersion modelling was conducted for an entire year, with operation of all three gas turbines for all 8760 hours of the year. Given the planned intermittent operation of up to 10% of any one year per gas turbine, the model predictions are considered to be conservative, especially with regard to criteria with longer averaging periods.

The operational emission rates, exhaust stack characteristics and locations used in the dispersion modelling are contained in **Tables 5.1** and **5.2**. With the exception of HAPs, lead and sulphur dioxide, the emission rates for the proposed gas turbines were provided as typical by IPRA. **Appendix F** contains calculations for oxides of nitrogen, sulphur dioxide, and Hazardous Air Pollutants (HAPs).

Section 5 Assessment Methodology

HAP emissions have been calculated from the USEPA's AP-42 emission database (USEPA 2000). Sulphur dioxide emission rates were based on the existing 50mg/kg fuel sulphur limit specified in the *Fuel Quality Standards Act* (2000) although this limit will be further reduced to 10mg/kg on the 1st of January 2009, prior to proposed commissioning of the plant.

Whilst the final gas turbine plant selection has not yet been made, exhaust stacks would be between 13m and 20m high, consequently, this assessment has assessed both stack heights.

Table 5-1 Exhaust Stack Parameters and Emission Rates (Full Load)

Stack Parameter [A]	Units	
Heights (above ground level)	(m)	13m & 20m
Diameter	(m)	4
Nominal Capacity	(MW)	Up to 50
Exit Temperature	(°C)	541
Exit Velocity	(m/s)	26
Stack Emissions (per stack)	**Units**	**Emission Rate**
Criteria Pollutants		
NO_X (as NO_2) [A]	(g/s)	15
CO [A]	(g/s)	1.4
SO_2 [A]	(g/s)	0.42
PM_{10} [A]	(g/s)	2.1
Lead [B]	(g/s)	1.17E-03
Hazardous Air Pollutants (HAP) [B]		
Benzene	(g/s)	4.58E-03
Formaldehyde	(g/s)	2.33E-02
Polycyclic Aromatic Hydrocarbons	(g/s)	3.33E-03
Metallic Hazardous Air Pollutants (HAP) [B]		
Arsenic	(g/s)	9.17E-04
Beryllium	(g/s)	2.58E-05
Cadmium	(g/s)	4.07E-04
Chromium III	(g/s)	6.44E-04
Chromium VI	(g/s)	2.73E-04
Manganese	(g/s)	6.59E-02
Mercury	(g/s)	1.01E-04
Nickel	(g/s)	3.88E-04

Notes:
[A]:Based on information supplied by IPRA or supplier. CO and PM_{10} emission data taken from Arizona Department of Environmental Quality (1999) which gives performance guarantees for CO and PM_{10} for a Frame 6 Gas Turbine operating on Fuel Oil.
[B]: Emission rates were calculated from US EPA (2000).

Table 5-2 Exhaust Stack Locations

Stack	Location	(GDA94)
Stack 1	616340mE	6225879mN
Stack 2	616363mE	6225850mN
Stack 3	616387mE	6225821mN

5.4 Start-up Scenario

Start-up scenarios were not included as part of this assessment. Given the relatively small scale of the proposed gas turbines, coupled with their open cycle configuration, they are able to reach full load within 10 minutes from the commencement of combustion. The predicted run profile for the proposed peaking power plant nominates 20-50 starts per turbine per year, which equates to a worse case start-up duty of less than 0.3% of the year.

It should also be noted that formation of NO_x, increases in intensity throughout the load profile with greatest emissions occurring during full operational load.

On this basis, full operational conditions were generally considered to represent worst case emissions, thus start-up emissions were excluded from the atmospheric dispersion modelling component of this assessment.

5.5 NO/NO_2 Conversion Calculations

The emission rates of oxides of nitrogen from the generators are modelled as total NO_X, which includes nitrogen dioxide (NO_2), nitric oxide (NO) and traces of nitrous oxide (N_2O). The principal species of concern in terms of human health effects, is NO_2 and it is this compound which has relevant ground level guidelines. While NO_2 will only make up a small proportion of the total NO_X emitted by the generators at the point of discharge, the NO_2/NO_x ratio will increase as the plume travels downwind as NO in the plume is oxidised to form additional NO_2.

DEC (2005a) propose three methods for assessing NO_x impacts, which are listed in order of increasing complexity. A summary of the methods is discussed below.

- ***Method 1: 100% Conversion of NO to NO_2.*** This method assumes all NOx emissions are emitted as NO_2 and that the highest recorded background NO_2 level is constant;
- ***Method 2: NO to NO_2 conversion limited by ambient ozone concentration (OLM)***. This method presumes all available ambient ozone will react with NO to form NO_2.
- ***Method 3: NO to NO_2 conversion using empirical relationship. (The Janssen Method)***. This method relies on the use of various atmospheric parameters.

Given the small scale of the predicted peak 1-hour NO_X impact, the conservative assumption that all NO_X exists as NO_2 results in a peak cumulative impact which is within regulatory criteria. Hence in this assessment, it has been conservatively assumed that all plant emitted NO_X exists in the form of NO_2

Section 6 Assessment of Potential Air Quality Impacts

6.1 Summary of Local Air Quality Impacts

Table 6-1 displays the results of the dispersion modelling, which are also displayed in the **Figures** section. None of the species modelled were shown to exceed the DECC regulatory criteria.

Discussion of the results is based on the results predicted using TAPM. A discussion of the worst case Ausplume predictions is provided in **Appendix E** and confirms TAPM's predictions to be conservative against Ausplume. Furthermore, a brief analysis of the dispersion mechanism under which TAPM produced the peak short term impacts is included in **Appendix G**.

Table 6-1 Dispersion Modelling Results - 13m Exhaust Stack Height

Species	Averaging Time	Maximum Predicted Impact ($\mu g/m^3$)	Maximum Background ($\mu g/m^3$)	Cumulative Impact ($\mu g/m^3$)	DECC Criteria ($\mu g/m^3$)
Criteria Pollutants					
NO_2	1 hour	67.6	131.2	198.8	246
	Annual	0.3	28.7	29.0	62
CO	15min	8	6930	6938	100000
	1 hour	6	5250	5256	30000
	8 hour	2	3500	3502	10000
SO_2	10min	2.7	61.4	64.1	712
	1 hour	1.9	42.9	44.8	570
	24 hour	0.3	14.3	14.6	228
	Annual	0.01	2.9	2.9	60
PM_{10}	24 hour	1.4	476	477.4 [B]	50
	Annual	0.05	28.1	28.1	30
Lead	Annual	0.00003	0.099	0.09903	0.5
HAPs					
Benzene	1 hour	0.021	-	0.021	29
Formaldehyde	1 hour	0.11	-	0.11	20
Polycyclic Aromatic Hydrocarbons	1 hour	0.015	-	0.015	0.4
Metallic HAPs					
Arsenic	1 hour	0.0041	-	0.0041	0.09
Beryllium	1 hour	0.00012	-	0.00012	0.004
Cadmium	1 hour	0.0018	-	0.0018	0.018
Chromium (III)	1 hour	0.0029	-	0.0029	9
Chromium (VI)	1 hour	0.0012	-	0.0012	0.09
Manganese	1 hour	0.30	-	0.30	18
Mercury	1 hour	0.00046	-	0.00046	0.18
Nickel	1 hour	0.0017	-	0.0017	0.18

Notes:
[A]: Peak NO_2 impacts are based on the assumption that all plant emitted NO_X exists as NO_2.
[B]: PM_{10} value is a worst case cumulative value. A refined contemporaneous assessment has been performed in **Section 6.1.5**.

Table 6-2 Dispersion Modelling Results - 20m Exhaust Stack Height

Species	Averaging Time	Maximum Predicted Impact ($\mu g/m^3$)	Maximum Background ($\mu g/m^3$)	Cumulative Impact ($\mu g/m^3$)	DECC Criteria ($\mu g/m^3$)
Criteria Pollutants					
NO_2	1 hour	73.8	131.2	205.0	246
	Annual	0.3	28.7	29.0	62
CO	15min	9	6930	6939	100000
	1 hour	7	5250	5257	30000
	8 hour	2	3500	3502	10000
SO_2	10min	3.0	61.4	64.4	712
	1 hour	2.1	42.9	45.0	570
	24 hour	0.2	14.3	14.5	228
	Annual	0.01	2.9	2.9	60
PM_{10}	24 hour	1.2	476	477.2 [B]	50
	Annual	0.05	28.1	28.1	30
Lead	Annual	0.00003	0.099	0.09903	0.5
HAPs					
Benzene	1 hour	0.023	-	0.023	29
Formaldehyde	1 hour	0.11	-	0.11	20
Polycyclic Aromatic Hydrocarbons	1 hour	0.016	-	0.016	0.4
Metallic HAPs					
Arsenic	1 hour	0.0045	-	0.0045	0.09
Beryllium	1 hour	0.00013	-	0.00013	0.004
Cadmium	1 hour	0.0020	-	0.0020	0.018
Chromium III	1 hour	0.0032	-	0.0032	9
Chromium VI	1 hour	0.0013	-	0.0013	0.09
Manganese	1 hour	0.32	-	0.32	18
Mercury	1 hour	0.0005	-	0.0005	0.18
Nickel	1 hour	0.0019	-	0.0019	0.18

Notes:
[A]: Peak NO_2 impacts are based on the assumption that all plant emitted NO_X exists as NO_2.
[B]: PM_{10} value is a worst case cumulative value. A refined contemporaneous assessment has been performed in **Section 6.1.5**.

6.1.1 Nitrogen Dioxide

The highest predicted 1-hour concentration of NO_2 was shown to be 205 µg/m^3, which is below the criteria of 246 µg/m$^{3.}$ Given that the result includes a conservative background NO_2 concentration of 131.2 µg/m^3 taken from a metropolitan measurement station (Chullora) and that all NO_X emitted from the stack is assumed to be in the form of NO_2, it is considered that this number is conservative and actual plant impacts of NO_2 will be significantly lower.

In addition, the maximum annual average NO_2 concentration was calculated to be 0.3 µg/m^3. This prediction is based on the assumption of constant operation for every hour of the year, despite the proposed operating limit of 10% in any one year. When added to the peak background concentration of 28.7 µg/m^3, predicted cumulative total from operation of the plant was 29.0 µg/m^3, which is below the criteria of 62 µg/m^3. Thus the long term impacts of NO_2 are considered negligible.

6.1.2 Photochemical Smog

Photochemical smog is produced during extended periods of light winds (several hours to several days) accompanied by strong sunlight, as a result of reactions involving the precursor pollutants NO_x and non-methane hydrocarbons (NMHCs). These reactions produce O_3, NO_2, peroxyacetyl nitrate and aldehydes. Aerosols are also formed, which result in visible orange-brown hazes in the atmosphere.

While there is NO_x available, the formation of photochemical smog is said to be in a “light-limiting” regime. When NO_x is limiting the formation of smog, it is called “NO_x limited”. Fresh NO_x emissions, or the reaction of nitrogen oxide with partially oxidised NMHCs, may restart these photochemical reactions.

There are few major industrial sources of hydrocarbons in the area, and emissions of NO_x and NMHCs from vehicles would be significantly lower than the levels experienced in major metropolitan air sheds such as Sydney and Melbourne. The potential for smog generation in Buronga is therefore considered to be low, and photochemical smog is unlikely to occur due to operation of the gas turbine plant.

6.1.3 Carbon monoxide

The maximum 15-minute averaged cumulative impact on CO concentrations was predicted to be 6,939 ug/m^3, of which only 9 ug/m^3 has been predicted from the operation of the plant. This figure is well below the criteria of 100,000 ug/m^3. Similarly, longer averaging periods of CO show negligible impacts from the plant. Consequently, emissions of carbon monoxide from the plant are considered to be negligible.

6.1.4 Sulphur dioxide

The maximum 10-minute averaged cumulative impact on SO_2 concentrations was predicted to be 61.4ug/m^3, of which 3.0ug/m^3 was a result from the operation of the plant. This figure is well below the criteria of 712 ug/m^3. Similarly, longer averaging periods of SO_2 show minor impacts from the plant.

This assessment has assumed that fuel-bound sulphur was present at the current (as of January 2006) limit of 50mg/kg as defined under the Clean Fuels Act (2002), and has used conservative estimates of fuel consumption. It should be noted that as of the January 1st, 2009, the sulphur content of automotive diesel will be further reduced to10mg/kg. This would reduce the emissions of sulphurous compounds to negligible levels prior to the proposed commissioning of the plant. Consequently, emissions of sulphur dioxide from the plant are considered to be negligible.

6.1.5 Particulate Matter

The region in which the plant is proposed to be located experiences frequent exceedances of regulatory criteria due to naturally occurring events (see **Figure 4-1**). For this reason particulate matter has been assessed in a contemporaneous matter, using the 241 days of available background data, from Mildura in 2005.

In the event that a region experiences exceedances of regulatory criteria, the approved methods require that it be demonstrated that no additional exceedances of regulatory criteria will occur as a result of the proposed activity.

Table 6-3 shows the top ten 24-hour averaged PM_{10} impacts for both stack heights, based on the assumption that the plant operates consistently at full load, throughout every 24-hour period of the year. In a typical year, the plant would not operate continuously for a single 24-hour period.

The results presented in **Table 6-3** indicate that despite the conservatism in the modelling methodology, the peak impact forms a small increment of 1.4 µg/m^3, relative to the peak measured background of 476 µg/m^3.

Table 6-3 Top Ten Plant Impacts - 24 hour averaged PM_{10} (ug/m^3)

Stack Height	
20m	**13m**
1.2	1.4
1.1	1.2
0.9	1.1
0.9	1.1
0.9	1.0
0.7	0.9
0.7	0.7
0.7	0.7
0.6	0.7
0.6	0.7

Table 6-4 shows the highest 25 background concentrations predicted during 2005. This data indicates that modelling predictions for the proposed plant would not have caused any additional exceedances in the periods for which monitoring data is available. The next highest background concentration, below the regulatory limit of 50 µg/m^3, is 48.6 µg/m^3. This background concentration, when added to the predicted plant impact of 0.5 µg/m^3 results in 49.1 µg/m^3. Given the peak predicted impact of 1.4 µg/m^3, as shown in **Table 6-4**, background concentrations below 48.6 µg/m^3 are too far below the regulatory criteria for a cumulative exceedance to occur, thus demonstrating that no additional exceedances are predicted to occur as a result of the operation of the proposed plant.

Table 6-4 Contemporaneous Impact of the Top 25 PM_{10} Impacts (ug/m3)

Date	Background	Plant		Cumulative	
		20m	13m	20m	13m
3/04/2005	476.0	0.3	0.3	476.3	476.3
1/03/2005	258.3	0.3	0.4	258.7	258.7
23/12/2005	203.0	0.7	0.9	203.6	203.9
1/02/2005	177.6	0.6	0.7	178.2	178.4
2/02/2005	117.5	0.4	0.4	117.9	117.9
20/01/2005	110.2	0.3	0.3	110.5	110.5
12/12/2005	104.3	0.4	0.4	104.6	104.7
15/12/2005	102.1	0.4	0.5	102.5	102.6
4/01/2005	100.8	0.7	0.7	101.5	101.5
18/02/2005	82.4	0.1	0.1	82.5	82.5
21/12/2005	75.5	0.2	0.2	75.7	75.7
10/04/2005	68.9	0.2	0.1	69.0	69.0
3/02/2005	68.4	1.2	1.4	69.7	69.8
3/06/2005	67.0	0.3	0.3	67.3	67.3
31/12/2005	64.1	0.5	0.6	64.7	64.7
17/12/2005	62.3	0.3	0.4	62.6	62.8
2/03/2005	58.4	0.4	0.4	58.8	58.8
15/03/2005	56.6	0.2	0.2	56.8	56.8
25/03/2005	53.5	0.2	0.2	53.8	53.8
6/06/2005	50.7	0.2	0.2	50.9	50.9
24/12/2005	48.6	0.5	0.5	49.1	49.1
5/12/2005	48.0	0.3	0.3	48.3	48.3
7/06/2005	45.7	0.3	0.3	45.9	46.0
13/05/2005	43.1	0.6	0.4	43.6	43.5
30/05/2005	42.9	0.3	0.3	43.2	43.2

6.1.6 Lead

Due to the minimal quantities of lead in distillate fuel, predicted lead ground level concentrations show a negligible impact. This peak annual average concentration is based on the assumption of continuous operation for every hour of the year, despite the operating limit of 10% of any one year, and has utilised the conservatively sourced DECC monitoring data for estimation of background levels.

The maximum annual averaged cumulative impact was predicted to be 0.09903 ug/m^3, of which the plant impact of 0.00003 ug/m^3 is considered to be negligible. This cumulative concentration is below the criteria of 0.5 ug/m^3. Consequently, emissions of lead from the proposed plant are considered to be negligible.

6.1.7 Hazardous Air Pollutants

Under worst case operating conditions, the species assessed were all significantly below the air quality criteria. Despite the conservative use of the 100th percentile impact (DECC criteria specify the 99.9th percentile) and emission rates based on conservatively sourced fuel consumption, the species assessed were all significantly below air quality criteria. The HAP for which the modelled impact constituted the greatest proportion of criteria was cadmium, with a maximum predicted concentration of 0.002 µg/m^3, representing 11% of the regulatory criteria of 0.018 µg/m^3.

6.2 Health Risk Assessment of Polycyclic Aromatic Hydrocarbons (PAH) and Particulates

A Health Risk Assessment (HRA) was undertaken to review health impacts associated with the release of hazardous air pollutants, in particular PAHs and particulates, from the proposed plant.

The assessment is provided in **Appendix D** and discusses the health implications of air pollutants including PAHs and particulates emitted to the air, including levels of PAHs that may be deposited to and accumulate in the soil.

This assessment demonstrates that emissions from the peaking power plant are considered to be low and not of significance with respect to immediate and long term health in areas surrounding the peaking power plant. In addition, emissions of PAHs are considered negligible and do not warrant further assessment.

6.3 Greenhouse Gas

Total greenhouse gas emissions in Australia for 2005 were estimated to be 559.1 million tonnes of CO_2-e, of which NSW was estimated to emit 158.2 million tonnes CO_2-e from all sources (28.3% of emissions from all states). Most of the greenhouse gas emissions in NSW come from stationary energy sources (48.0% of NSW emissions).

Based on a **typical operating scenario**, the Buronga Project is estimated to release 0.023 million tonnes of CO_2-e per year, which based on the 2005 inventory, represents 0.04% of the emissions from electricity generation in NSW, or 0.004% of all sources of greenhouse gas in Australia.

Based on the **theoretical upper limit of proposed operation**, total greenhouse gas emissions from the Buronga Peaking Power Plant are estimated to be 0.098 million tonnes CO_2-e per year, which based on the 2005 inventory, will contribute 0.17% of the emissions from electricity generation in NSW, and up to 0.02% of the Australian emissions of greenhouse gases for all sectors. Due to the conservative assumptions made in this scenario, actual operation will result in the release of less emissions.

Open cycle gas turbine technology is considered to represent the only feasible generator type for the operational role and location of the project. The open cycle gas turbines proposed are the most appropriate size, have the ability to reach load quickly to respond to peaking demand and have the reliability required for transmission system services.

Natural gas-fired Open Cycle Gas Turbine (OCGT) combustion technology represents best practice for a peaking plant of this type. However, as noted in **Chapter 3** of the Environmental Assessment Report, until natural gas becomes commercially available in the region, the next most appropriate best practice is distillate-fired OCGT. **Chapter 3** of the Environmental Assessment Report also provides explanation of why distillate represents the only feasible source of fuel for the project given the structure of the electricity network in the region and the objective of providing embedded generation in the region. Hence natural gas does not constitute a valid alternative and has been consequently dismissed from a best practice comparison.

The proposed plant at Buronga will be required to operate at a range of loads over which the emissions intensity varies with generation output. Whilst there exists some uncertainty of the actual loads at which the market will require the plant to operate, the greenhouse emissions *intensity* of the proposed plant operating from “full speed, no load” to full load (that is, 50MW for the largest gas turbine under consideration) will still be significantly less than attempting to use a single larger plant operating down its load range design efficiency curve with consequent performance inefficiencies and larger greenhouse gas emission footprint.

The proposed use of three small gas turbines, each up to 50MW capacity (final selection of which will be subject to tendering and plant selection processes), is considered the best greenhouse gas and overall environmental performance outcome that can be achieved at Buronga for the peaking operational role intended. For the above reasons, and as detailed in **Appendix A** of this assessment, IPRA is not proposing to implement greenhouse gas offsets for this project.

IPRA will adopt an operations management approach for the Buronga Peaking Power Plant aimed at managing emissions in a manner consistent with the environmental objectives of all relevant programs, including the current Generator Efficiency Standards and the Greenhouse Challenge Plus program.

As part of these programs, IPRA will monitor greenhouse gas emissions and comply with greenhouse gas emissions and efficiency monitoring and reporting programs, and implement programs to maintain the operational performance of the generators, and reduce greenhouse emissions.

The Buronga Peaking Power Plant will contribute to the reduction of greenhouse gas emissions at the State level by potentially displacing additional generation by more carbon-intensive larger fossil fuelled power plant. Also, by injecting power at a regional level when high local demand requires it, electrical line loss inefficiencies associated with the long distance high voltage transmission network will be reduced.

A full discussion of the impact of greenhouse gases derived from the proposed Buronga Peaking Power Plant is discussed in **Appendix A**.

6.4 Aviation Safety

Due to the plume rise from the stack emissions, a plume rise assessment based on the predicted impacts of the proposed facility has been performed and is shown in **Appendix C**.

The statistics have been compiled in accordance with the Civil Aviation Safety Authority's (CASA) Advisory Circular *"Guidelines for Conducting Plume Rise Assessments"* (June, 2004). Where there is potential for an exhaust plume with a vertical velocity greater than 4.3m/s at the Obstacle Limitation Surface (OLS) of 110m, a hazard analysis is required.

This assessment involved use of the TAPM model which was used to create site-specific meteorological data, including meteorology for the upper atmosphere. TAPM was also used to calculate plume rise trajectories for the turbine emissions.

The modelling results were based on only a 13m stack and show that the peaking power plant would produce exhaust plumes with vertical velocities that exceed 4.3m/s above the OLS for approximately 2.5% of the year (assuming the plant was running at full load for all hours of the modelled year, 2005). The maximum, minimum and average heights at which the plume velocity is greater than 4.3m/s are provided in **Table 6-5.**

Table 6-5 Maximum, Minimum and Average Critical Plume Extents

	Critical Vertical Plume Extent (m)	Critical Horizontal Plume Extent (m)
Maximum	382	84
Minimum	28	15
Average	46	24

Whilst this assessment is considered conservative with respect to the modelled operating times and operating conditions, the Civil Aviation Safety Authority (CASA) at its discretion may opt to designate this to be a potential hazard to aircraft operators in the area.

Section 7 Conclusion

An air quality assessment of the proposed Buronga Peaking Power Plant investigating local air quality impacts and aviation safety has been undertaken. A greenhouse gas assessment has also been performed.

Local Air Quality

The impact of the proposed peaking power plant on local air quality, at Buronga, has been assessed using the TAPM dispersion model. The species assessed included oxides of nitrogen (NO_x), carbon monoxide (CO), sulphur dioxide (SO_2), particulate matter (PM_{10}) and Lead. Additionally, several Hazardous Air Pollutants (HAP) were also assessed.

The dispersion modelling has used a largely conservative approach, in accordance with the DEC (2005a) *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW*. The conservative approach assumed that the peaking power plant would be running all three turbines for every hour of the year notwithstanding that the plant will only be operating up to 10% of the year.

In order to assess the cumulative impact of the plant emissions on the local air quality, background concentrations of the criteria pollutants were obtained from the relevant DECC and EPA Victoria monitoring stations. The assessment of background data showed that none of the species measured exceeded criteria with the exception of PM_{10}, which is attributable to dust storms.

The results of the worst case dispersion modelling showed that the predicted impacts on ground level concentrations of NO_2, PM_{10}, CO and SO_2 and lead, when added to peak background concentrations, were within the DECC regulatory criteria. A summary of the modelling results for each species follows:

- The highest concentration of NO_2 (1-hour average), as predicted assuming all NO_x was present as NO_2, was predicted to be 205.0 µg/m^3 against the criteria of 246 µg/m^3, which was shown to occur approximately 7km south of the site. The highest annual average NO_2 concentration was 29.0 µg/m^3 against the criteria of 62µg/m^3, however, the actual value is likely to be considerably lower than the modelling result given the intermittent operations over the year;
- Whilst elevated background concentrations were shown to be present frequently in the area, the contemporaneous 24-hour PM_{10} assessment showed the plant impacts to be minor, and not result in additional exceedances of PM_{10} in the area. The highest annual average PM_{10} impact from the plant was 0.05 µg/m^3 and when added to the background concentration of 28.1 µg/m^3, resulted in a concentration of 28.1 µg/m^3 which was below the criteria of 30 µg/m^3. However, the actual impact would be considerably lower than the predicted result given a 10% maximum annual operation time;
- SO_2 showed minor impact, with the highest predicted cumulative 1-hour average result of 45 µg/m^3 below a criteria of 570 µg/m^3. SO_2 assessed against other averaging times also showed predicted cumulative concentrations below regulatory criteria;
- CO showed a minor impact, with the highest predicted cumulative 1-hour average result of 5257 µg/m^3 below a criteria of 30,000 µg/m^3. CO assessed against other averaging times also showed predicted cumulative concentrations below regulatory criteria:
- Similarly, lead showed a minor impact, with the cumulative annual average result of 0.099 µg/m^3, against a criteria of 0.5µg/m^3; and
- HAPs were also shown to be below the regulatory criteria.

Whilst this assessment has shown the measured pollutants were below criteria during operation, it is considered that this assessment is conservative and actual impacts on local air quality from this development would be considerably lower.

Section 7 Conclusion

Greenhouse Gas

A greenhouse gas assessment was performed which estimated that based on a typical operating scenario, the Buronga Peaking Power Plant is estimated to release 0.023 million tonnes of CO_2-e per year, which based on the 2005 inventory, represents 0.04% of the emissions from electricity generation in NSW, or 0.004% of all sources of greenhouse gas in Australia.

Aviation Safety

Finally, a plume rise assessment was performed which showed that the peaking power plant would produce exhaust plumes with vertical velocities that exceed 4.3m/s above the Obstacle Limitation Surface for approximately 2.5 % of the year, based on a full year of three turbines operating.

Whilst this assessment is considered conservative with respect to the modelled operating times and operating conditions, the Civil Aviation Safety Authority (CASA) at its discretion may opt to designate this to be a potential hazard to aircraft operators in the area.

Section 8 References

Arizona Department of Environmental Quality (1999) *Technical Review and Evaluation For Yuma Cogeneration Associates Air Quality Permit No.* 1000103

Bureau of Meteorology 2007 http://www.bom.gov.au/climate/averages/tables/cw_076031.shtml

Civil Aviation Safety Authority 2004 Advisory Circular AC 139-05 (0) *Guidelines for Conducting Plume Rise Assessments* (June, 2004).

CSIRO, 2005. *The Air Pollution Model (TAPM) Version 3. Part 2: Summary of Some Verification Studies. CSIRO Atmospheric Research Technical Paper 72, 2005*.

DEC 2004 *National Environment Protection (Ambient Air Quality) Measure, 2003 Annual Compliance Report*

DEC 2005a *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.*

DEC 2005b *Quarterly Air Monitoring Reports, Part A: January – February – March 2005*.

DEC 2006a *Quarterly Air Monitoring Reports, Part B: April - May –June 2005*.

DEC 2006b *Quarterly Air Monitoring Reports, Part C: July – August – September 2005*.

DEC 2006c *Quarterly Air Monitoring Reports, Part D: October – November – December 2005*.

DEH 2005 *National Pollutant Inventory. Emission Estimation Technique Manual for Fossil Fuel Electric Power Generation Version 2.4*. 15 March 2005. Australian Government.

EPA Victoria 2005a *Airborne Particle Monitoring at Mildura – December 2004*. Publication 1004. July 2005.

EPA Victoria 2005b *AUSPLUME Dispersion Model, Version 6.0*.

Hurley, P.J 2005 *The Air Pollution Model (TAPM) Version 3.07*.

NSW EPA, 2002, *Ambient Air Quality Research Project (1996-2001) Dioxins, Organics, Polycyclic Aromatic Hydrocarbons and Heavy Metals*

NEPC 1998 *National Environment Protection (Ambient Air Quality) Measure – Revised Impact Statement*. National Environment Protection Council Service Corporation.

US EPA 2000 *AP-42*, Fifth Edition, Volume I chapter 3: Stationary Internal Combustion Sources. April 2000.

Section 9 Limitations

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