7. Open Cycle Gas Turbine

This section provides an assessment of the key environmental issues identified in the Environmental Assessment Requirements issued by the Director-General of Planning in relation to an OCGT power station. The key environmental issues are air quality, plume rise assessment, greenhouse gas generation, noise, hazard and risk and water, and these are addressed in Sections 7.1 to 7.6 respectively. Other issues relating to ecology, Aboriginal heritage, visual and landscape, traffic and transport and waste are addressed in Sections 7.7 to 7.11 respectively. The assessment considers the impacts during both construction and operation (as appropriate) and outlines any mitigation, monitoring and management measures which will be applied. An assessment of the effectiveness and reliability of the measures and any residual impact after the implementation of the measures is provided.

7.1 Air quality

A comprehensive air quality assessment has been undertaken to assess the air quality impacts of the power station operations, with this assessment relating to the proposed Tallawarra Stage B OCGT power station. The study assesses the cumulative air quality impact of the full generation capacity of the Stage A and Stage B power plants operating to a nominal total of 800 MW, in particular an assessment of nitrogen dioxide (NO_2), particulate matter (PM_{10}) and sulphur dioxide (SO_2). The assessment report for the air quality assessment and photochemical smog analysis are included in **Appendix B**, with an overview of the assessments provided in this section.

For the purpose of the air quality assessment, the modelling uses emission estimates for 2 x Alstom 13E2 machines for Tallawarra B. The 13E2 was chosen because it was determined to have higher NO_X emissions than other possible gas turbine options. In most cases, NO_X emissions were very similar for the various two unit configurations assessed and the 13E2 generally had marginally higher NO_X emissions, thus providing a worst case scenario. A three unit option was also assessed in the form of 3 x GE LMS100 aeroderivative machines. The NO_X emission rate for 2 x 13E2s was considerably higher than 3 x LMS100s.

7.1.1 Air quality objectives

Air quality standards and objectives relevant to the Tallawarra Stage B power station are as follows:

- *Protection of the Environment Operations (Clean Air) Regulation* (NSW DEC 2002);
- NSW DECC Impact Assessment Criteria (NSW DEC 2005); and
- National Environment Protection Measure (NEPM) for Ambient Air Quality (NEPC 1998).

The *Protection of the Environment Operations (Clean Air) Regulation 2002* sets maximum limits on emissions for a number of substances, including acid gases such as nitrogen oxides (NO_X). Schedule 3 of the Regulation provides standards of concentration for emissions from activities including plant used for electricity generation. The Tallawarra Stage B power station belongs to Group 6, that is, plants that operate after 1 September 2005. The relevant standards are provided in **Table 7-1**.

Table 7-1 Relevant Emission Limits (Clean Air Regulation)

Electricity Generation		
Air Impurity	**Activity or Plant**	**Standard of Concentration**
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Any turbine operating on gas, being a turbine used in connection with an electricity generating system with a capacity of 30 MW or more	70 mg/m^3 (34 ppmv)
	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 (44 ppmv)

The NEPM for air quality provides uniform standards for ambient air quality (NEPC, 1998). The NSW DECC impact assessment criteria are based on NEPM guidelines. The NEPM/NSW DECC objectives relevant to ambient air quality in the Illawarra airshed are listed in **Table 7-2**.

Table 7-2 Ambient Air Quality Objectives

Pollutant	Averaging Period	Maximum Concentration		Source
		ppm	µg/m^3	
Nitrogen Dioxide (NO_2)	1 hour	0.12	246	NEPC 1998
	Annual	0.03	62	NEPC 1998
Photochemical oxidants (such as ozone, O_3)	1 hour	0.10	214	NEPC 1998
	4 hours	0.08	171	NEPC 1998
Particulates (as PM_{10})	24 hours		50	NEPC 1998
	Annual		30	NSW EPA 1998
Sulphur Dioxide (SO_2)	10 minutes	0.25	712	NEPC 1998
	1 hour	0.20	570	NEPC 1998
	24 hours	0.02	228	NEPC 1998
		ppm	**mg/m^3**	
Carbon Monoxide (CO)	15 minutes	87	100	WHO 2000
	1 hour	25	30	WHO 2000
	8 hours	9	25	NEPC 1998

7.1.2 Project specific DECC requirements

The Department of Environment and Climate Change (DECC) in a letter to the Department of Planning (DoP) set out its expectations for the air quality assessment of the proposed power station. These requirements are reflected in the Director-General's Requirements (DGRs) for the project.

The key pollutant of concern for the proposed development will be nitrogen oxide (NO_X) emissions and the possible impact of the new emissions source in relation to the NSW State Plan clean air target. State Plan Priority E3 for clean air is for NSW to meet the National Environmental Protection Measures (NEPM) for Ambient Air Quality (Air NEPM) goals (refer to **Table 7-2**). The Illawarra region has exceeded the ozone goal for eight of the past 13 years (DECC correspondence 25/10/07). The Air NEPM goal allows for one exceedance day per year, for the maximum one-hour and four-hour averaged ozone concentration (NEPC, 1998). The Illawarra region will not achieve ongoing compliance with the Air NEPM ozone goal by the compliance date of 2008. The DECC recognises that although there are advantages in extending the state's power generation capacity, a new source of NO_X emissions may compromise timely and cost-effective achievement of the State Plan clean air target.

To maintain the capacity to meet the State Plan, the DECC requires that the Environmental Assessment for Tallawarra address the following:

a) 'Demonstrate that the proposed Tallawarra Stage B development is either NO_X neutral or incorporates best available control technology (BACT) to reduce NO_X emissions'

The development consent for the Tallawarra Stage A CCGT included a consent limit for NO_X emissions of 900 tonnes per annum (tpa). The DECC requires that the combined emissions of Stage A and Stage B would be below the 900 tpa consent limit. This may be achieved by:

- The proponent implementing BACT to reduce emissions from either Stage A or Stage B to achieve a NO_X emission concentration of 10 mg/m^3 as a three hour rolling average; or
- The proponent undertaking off site projects in the Illawarra airshed to off-set NO_X emissions from the Stage B development.

b) 'Air quality impact assessment in accordance with the Approved Methods for Modelling and Assessment of Air Pollutants in NSW, (NSW DEC, 2005)'

Since the original consent was granted for Tallawarra A, new residential and industrial developments have been approved in the vicinity of the power station. The DECC requires that the air quality assessment applies a methodology consistent with the *Approved Methods* (NSW DEC 2005), including consideration of the following:

- High NO_X emission scenarios associated with start up, shut down and part load operations at the power station;
- The impact of the power station operations within the context of recent land use changes, such as known and likely population centres; and
- The impact of NO_X emissions on ozone formation in the Illawarra airshed, taking into account days conducive to photochemical smog formation and the extent, duration and size of regional NO_X and ozone exposure. The proponent may wish to consult with the DECC on the assessment methodology**.**

The approval conditions for Tallawarra Stage A station required NO_X emissions concentrations not to exceed 25 parts per million by volume (ppmv) with a mass load limit of 900 tonnes per annum (tpa). It is expected that at full load the Tallawarra Stage A plant will achieve NO_X emissions less than 25 ppmv. Further detail relating to specific programs may be obtained from recent DECC publications (NSW DECC 2007b, 2007c).

While no decisions regarding NOx offsets have yet been made for Tallawarra B project, TRUenergy will commit to offset any NOx over and above the approved 900 tpa if required.

It should be noted that the cumulative modelling assessments provided below for both local NO_2 and regional photochemical smog (O_3) demonstrate compliance with the relevant air quality criteria, without any offsets being provided for Tallawarra B. That is, NOx emissions from the gas turbine plant occurring at 25 ppmv, as approved for Tallwarra A. As such, while TRUenergy are committed to providing NOx/VOC offsets for Tallawarra B, if required, the modelling assessments clearly demonstrate that no offsets are required in terms of local and regional air quality management as relevant to the project.

7.1.3 Assessment methodology – local impacts

The assessment methodology of air quality impacts from the Tallawarra Stage B power station is consistent with the *Approved Methods for Modelling and Assessment of Air Pollutants in New South Wales* (NSW DEC, 2005) and the Director-General's requirements for the project dated 31 October 2007 (refer to **Appendix A**). The assessment utilises The Air Pollution Model (TAPM), developed by CSIRO Atmospheric Research (Hurley 2002, Hurley *et al.* 2002). It consists of coupled components for prognostic meteorology and air pollution concentrations, eliminating the need to have site-specific meteorological observations, although their inclusion via a data assimilation option can be beneficial (Hurley 2002, Hurley *et al.* 2002). The model predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses (Hurley *et al*. 2002).

A range of scenarios has been modelled to assess the potential impact of the Tallawarra Stage B OCGT power station, as required by the NSW DECC, in accordance with the requirements for the project. The stack characteristics are described below:

- **Tallawarra Stack A** (CCGT), location MGA Zone 56 [298,826 (mE), 6,177,714 (mN)], stack height 60 m, radius 2.75 m
- **Tallawarra Stacks B1 & B2** (OCGT), locations [298,876 (mE), 6,177,792 (mN)] and [298,892 (mE), 6,177,777 mN], stack height 40 m, radius 3 m

The air quality impacts of the Tallawarra Stage A and Stage B power stations were modelled for a range of alternatives, which considered operations under full load conditions as well as various scenarios of start-up load operations, as described below. **Table 7-3** and **Table 7-4** summarise the parameters of the respective emission scenarios. The emissions parameters for Tallawarra Stage A presented in **Table 7-3** are consistent with emissions assessed as part of the original approval for Tallawarra Stage A. For Tallawarra Stage B, emission parameters have been generated with the gas turbine software GTPro to provide worst case emissions for a range of normal operating regimes as well as start up and part load operations on natural gas and diesel fuels.

The emission parameters of Tallawarra A for cold, warm and hot starts are:

- **Cold Start** – this start occurs when the plant is first started or after an indefinite period of shut-down, where the heat recovery system generator (HRSG) would be cold and the start occurs over a longer period of time, to bring both the gas and steam turbine plant up to base load. During a cold start the gas turbine would be below 30 percent load for about 100 minutes where the NO_X emission concentration may be above 25 ppm;
- **Warm Start –** this start occurs after a period of about 36 hours shut-down and the gas turbine would be below 30 percent load for about 60 minutes where the NO_X emission concentration may be above 25 ppm; and
- **Hot Start –** this start occurs after a period of less than 36 hours shut-down and the gas turbine would be below 30 percent load for about 20 minutes where the NOX emission concentration may be above 25.

To model the impacts of the Tallawarra Stage B OCGT plant in combination with the Tallawarra Stage A CCGT plant, the start-up emissions for Tallawarra Stage A were based on “hot-starts” (refer to **Table 7-3**). Under most scenarios, the Tallawarra Stage A plant would be operating prior to starting up the Stage B plant.

- **Table 7-3 - Tallawarra Stage A Air Emission Scenarios**

Modelling Scenario	Stack	Velocity (m/s)	Temp (°C)	NO_2 Emission Conc. ppm	Emission Rate NO_X per unit g/s	Emission Rate PM_{10} per unit g/s	Emission Rate SO_2 per unit g/s
Full Load	A	26	78	25	29.4	2.3	1.9
Hot Start Hour 1	A	19.0	80	32	22.9	-	-
Warm Start Hour 1	A	12.4	70	87	41.7	-	-
Warm Start Hour 2	A	21.8	80	30	24.8	-	-
Cold Start Hour 1	A	12.4	40	92	48.4	-	-
Cold Start Hour 2	A	13.1	60	81	42.4	-	-
Cold Start Hour 3	A	25.9	60	31	29.9	-	-

- **Table 7-4 - Tallawarra Stage A CCGT and Stage B OCGT Emission Scenarios**

Modelling Scenario	Stack	Velocity (m/s)	Temp (°C)	NO_2 Emission Conc. ppm	Emission Rate NO_X per unit g/s	Emission Rate PM_{10} per unit g/s	Emission Rate SO_2 per unit g/s
Tallawarra A CCGT(Gas Fired) and B OCGT (Diesel Fired)							
Full Load Stacks A and B	A	26	78	25	29.4	2.3	1.9
	B1	41.7	526	45	37.5	4.2	12.1
	B2	41.7	526	45	37.5	4.2	12.1
Stack A Start Stacks B Full Load	A	19.0	80	32	22.9	-	-
	B1	41.7	526	45	37.5	-	-
	B2	41.7	526	45	37.5	-	-
Stack A Full Load Stacks B Start Load	A	26	78	25	29.4	-	-
	B1	38	500	94	66	-	-
	B2	38	500	94	66	-	-
Start Stacks A and B	A	19.0	80	32	22.9	-	-
	B1	38	500	94	66	-	-
	B2	38	500	94	66	-	-
Stack A Full Load Stacks B Part Load 50%	A	26	78	25	29.4	-	-
	B1	31.9	497	45	27	-	-
	B2	31.9	497	45	27	-	-

Note: Under most scenarios, the Tallawarra Stage A plant would be operating prior to starting up the Stage B plant.

For the OCGT plant, the only applicable starts are "normal starts" and "fast starts", although "fast starts" are not desired as the time gained over "normal starts" is small and the reliability of the start is lower. During a "normal start" emissions would be above 25 ppm up to approximately 30 percent load, and this would usually be for the first 20 minutes of starting. The start-up modelling for the Tallawarra Stage B OCGT plant is based on "normal starts". During a "fast start" emissions would be above 25 ppm for a shorter period of time and hence maximum NO_X emissions for the first hour of starting would be lower than those for a "normal start".

This assessment of Tallawarra power station analyses NO_X impacts using the USEPA Ozone Limiting Method (OLM), which is approved by DECC (NSW DEC, 2005). The method assumes that the amount of NO that is converted to NO_2 is limited by the ambient ozone concentration. The DECC Level 1 and 2 assessment were used which required analysis of the TAPM-predicted 1-hour average ground level concentrations of NO_X and the contemporaneous (same hour) 1-hour average ambient measurements of NO_2 and O_3 recorded at Kembla Grange in 2002, the same period as the modelling year.

7.1.4 Local air quality impact assessment

Air pollution modelling using TAPM (Hurley, 2002) predicted the impacts on ground level concentrations of NO_2, SO_2 and particulate matter (as PM_{10}). TAPM predictions identified NO_2 as the air pollutant causing the highest concentrations relative to the NSW DECC criteria for air quality impact assessment. The impacts on concentrations of SO_2 and PM_{10} are very low in comparison to the NSW DECC criteria.

Nitrogen dioxide

Table 7-5, **Table 7-6, Table 7-7** and **Figure 7-1** present the results of modelling NO_2 emissions, by the OLM. **Figure 7-2** to **Figure 7-11** show contour plots of the incremental hourly-averaged NO_X ground level concentrations for full load and the range of start and part emissions scenarios.

For an OCGT plant, there are two types of start: a "normal "start and a "fast" start. During a normal start it will take a 150 MW gas turbine in the order of 20 minutes to reach 50 – 60 percent load, the point at which NOx emissions concentrations reduce to below 25 ppmv. On a fast start, 50 – 60 percent load and NOx emissions less than 25 ppmv can be achieved within approximately 12 minutes of starting. Based on these results it can be seen that in the starting hour of an OCGT plant the mass emission rate of NOx will be higher for a "normal" start, where it will take almost twice as long for the gas turbine NOx emission concentration to reduce below 25 ppmv than for a "fast" start. When considering exhaust temperature and flow rate (velocity) which are also important for air quality impacts, the average temperature and flow rate will be lower in the first hour of a "normal "start compared to a "fast" start. In summary, with higher NOx emissions and lower temperatures and velocities for a "normal" start, it is clear that air quality impacts will be higher for “normal” starts than is the case for “fast” starts. Hence the reason the modelling is based on “normal” starts is to provide worst-case impacts when compared with a “fast” start.

The results of the air quality assessment indicate that the impact on NO_2 concentrations would be within the DECC criteria set for NO_2 1-hour average concentration (246 µg/m^3) and the annual average concentration (62 µg/m^3) for Tallawarra Stage A operating in combination with Tallawarra Stage B under normal operating conditions, as well as a set of start-up and part load operating conditions.

Table 7-5 – Highest Predicted NO_2 1-Hour Average Impacts and Contemporaneous Background Concentration ($\mu g/m^3$) Tallawarra A CCGT (Gas Fired) and Tallawarra B OCGT (Diesel Fired)

Scenario	Tallawarra A Full Load + Tallawarra B1 and B2 Full Load			Tallawarra A Full Load + Tallawarra B1 and B2 Start Load			Tallawarra A Start Load + Tallawarra B1 and B2 Full Load			Tallawarra A Start Load + Tallawarra B1 and B2 Start Load			Tallawarra A Full Load + Tallawarra B1 and B2 Part Load 50%		
Sensitive Receptor Location	Max Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Max Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Max Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Max Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Max Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact
SE Dapto	44	4	48	32	3	35	27	5	32	53	4	57	30	3	33
Dapto South	75	3	78	75	3	78	75	3	78	75	3	78	75	3	78
Avondale	45	3	48	63	5	68	49	9	58	61	3	64	41	9	50
Yallah	46	5	51	25	19	44	22	7	28	56	5	60	21	5	27
Oak Flats	30	6	36	42	11	53	33	11	45	30	6	36	27	10	37
Mt Warrigal	37	3	40	55	20	75	48	18	66	52	3	55	38	18	55
Windang	57	0	57	70	3	72	47	0	47	73	0	73	38	0	38
Barrack Hts	31	6	36	54	7	61	40	5	45	37	42	80	34	5	39
Primbee	30	7	37	55	0	56	38	2	40	46	3	49	35	2	37
Pt Kembla	28	7	35	54	3	57	42	3	45	43	7	49	35	3	38
Average	42		47	53		60	42		48	53		60	37		43

■ **Table 7-6 - Highest Background Concentration and Contemporaneous Predicted NO_2 1-Hour Average Impacts ($\mu g/m^3$) for Tallawarra A CCGT (Gas Fired) and Tallawarra B OCGT (Diesel Fired)**

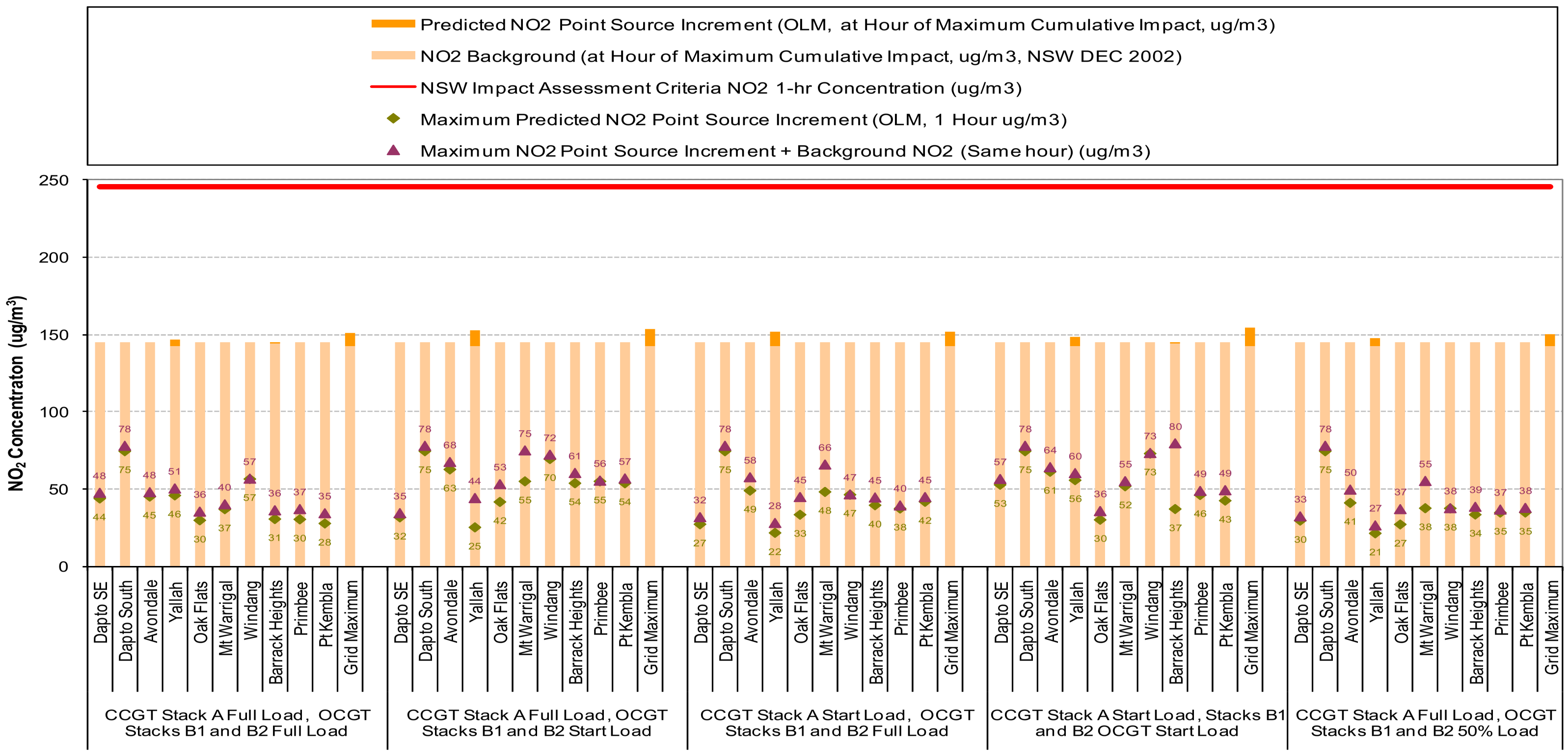
Scenario	Tallawarra A Full Load + Tallawarra B1 and B2 Full Load			Tallawarra A Full Load + Tallawarra B1 and B2 Start Load			Tallawarra A Start Load + Tallawarra B1 and B2 Full Load			Tallawarra A Start Load + Tallawarra B1 and B2 Start Load			Tallawarra A Full Load + Tallawarra B1 and B2 Part Load 50%		
Sensitive Receptor Location	Predicted Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Predicted Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Predicted Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Predicted Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact	Predicted Incremental NO2 by OLM	Background Concentration (same hour)	Cumulative Impact
SE Dapto	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Dapto South	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Avondale	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Yallah	0	145	145	0	145	145	9	142	152	0	145	145	0	145	145
Oak Flats	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Mt Warrigal	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Windang	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Barrack Hts	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Primbee	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Pt Kembla	0	145	145	0	145	145	0	145	145	0	145	145	0	145	145
Grid Maximum	3	145	147	0	145	145	10	142	152	4	145	148	0	145	145

▪ **Table 7-7 Example Highest Cumulative Concentrations for Tallawarra A CCGT and Tallawarra B OCGT (Diesel Fired)Showing Contemporaneous Predicted NO_2 1-Hour Average Impacts and Background Concentration**

Tallawarra A Start Load + Tallawarra B1 and B2 Start Load	Total NO_2 Point Source Increment By OLM (ug/m3)	NO_2 Background (DECC Kembla Grange same hour) (ug/m3)	Total NO_2 Cumulative Impact (same hour) (ug/m3)
Yallah			
20021004	6	142	148
20021030	0	145	145
20021016	30	82	113
20021030	0	108	108
20021016	11	91	102
20021030	0	101	101
20020924	0	100	100
20020924	0	99	99
20021016	29	68	97
20020924	1	89	90
At Any Point Across the Grid			
20021004	13	142	155
20021030	4	145	148
20021016	34	82	116
20021030	4	108	112
20020924	7	100	108
20021030	6	101	107
20021007	37	70	107
20020411	37	70	107
20021016	12	91	103
20020924	3	99	101

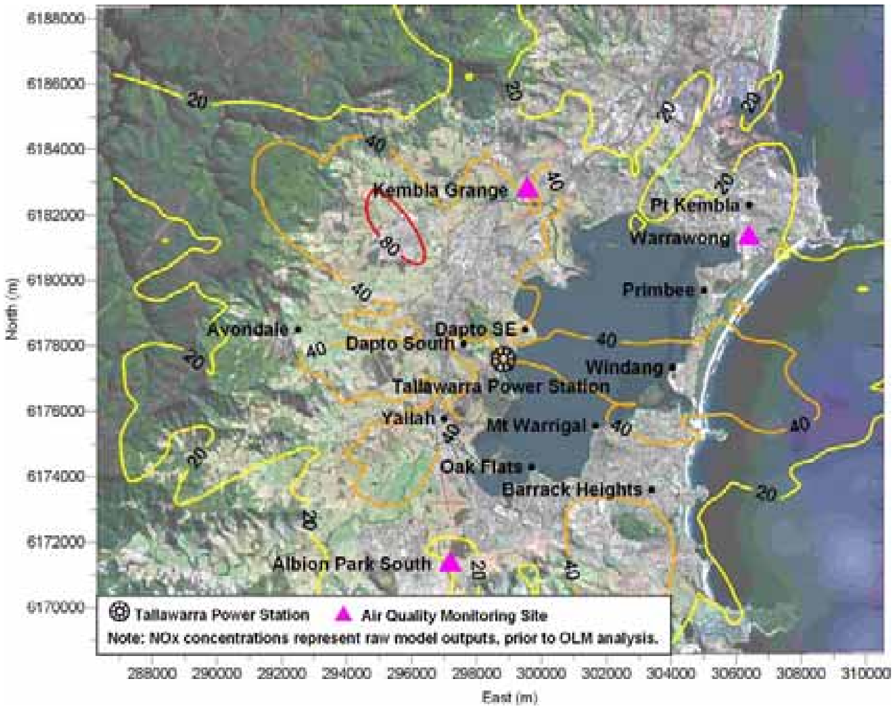
Note: The maximum cumulative impact may occur when neither the incremental impact nor the background are at maximum concentration

Figure 7-1 Tallawarra A CCGT and Tallawarra B OCGT (Diesel Fired) Local Scale Predicted Maximum NO_2 Impacts at Sensitive Receivers

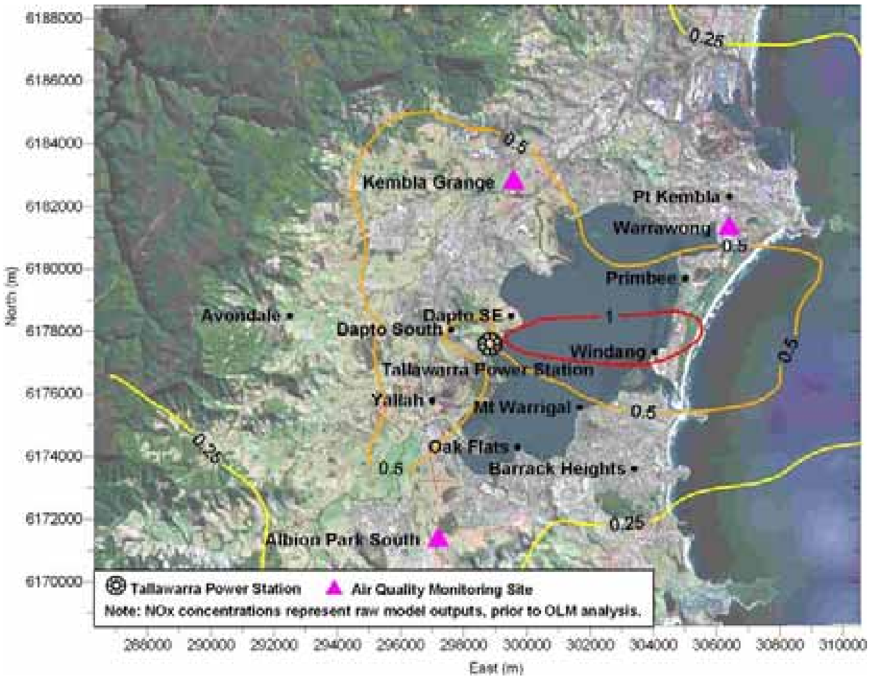


Note:
The shaded bars illustrate that the highest cumulative impacts generally resulted from the maximum 1-hr average background NO_2 concentration, 145 $\mu g/m^3$, combined with a relative low incremental impact of the plume from the power station, in the corresponding hour.

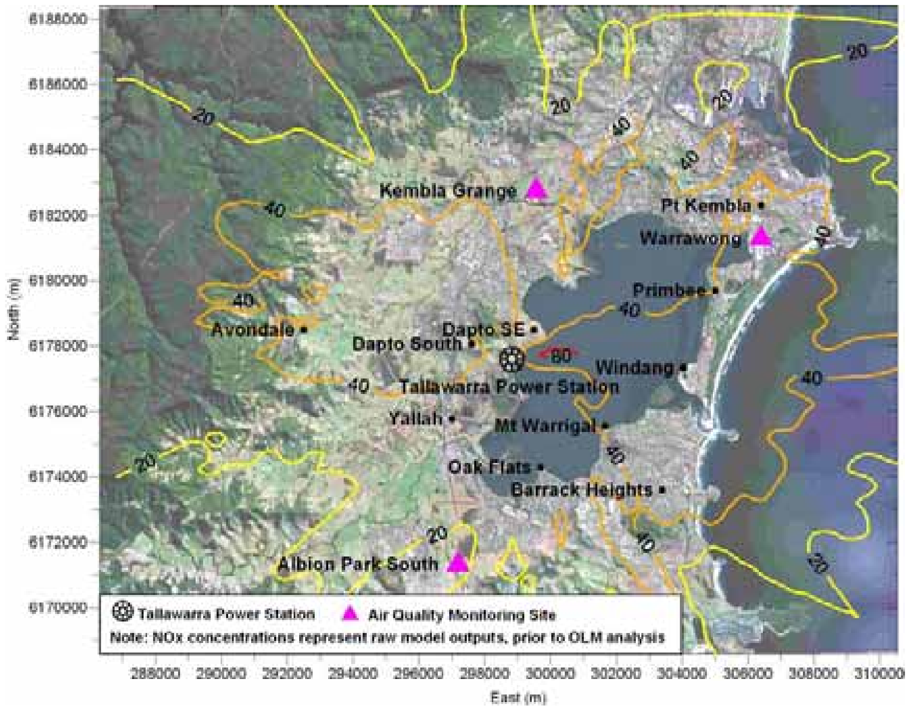
- **Figure 7-2: Tallawarra A CCGT Full Load and Tallawarra B OCGT Full Load (Diesel Fired) Incremental NO_X Maximum 1 hr Concentrations (µg/m^3)**



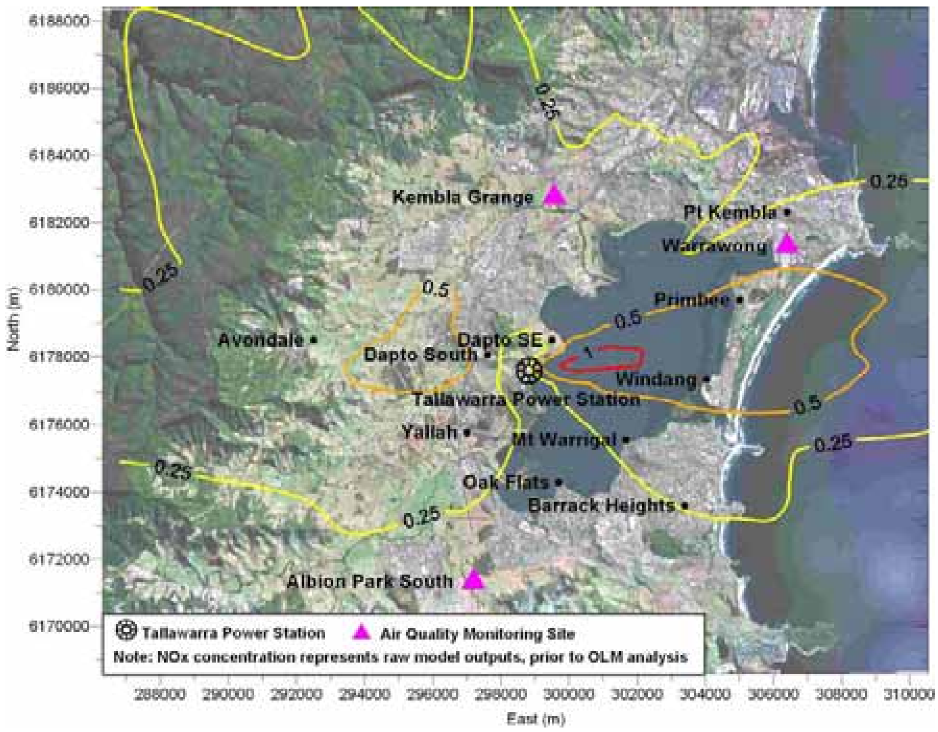
- **Figure 7-3: Tallawarra A CCGT Full Load and Tallawarra B OCGT Full Load (Diesel Fired) Incremental NO_X Annual Average Concentrations (µg/m^3)**



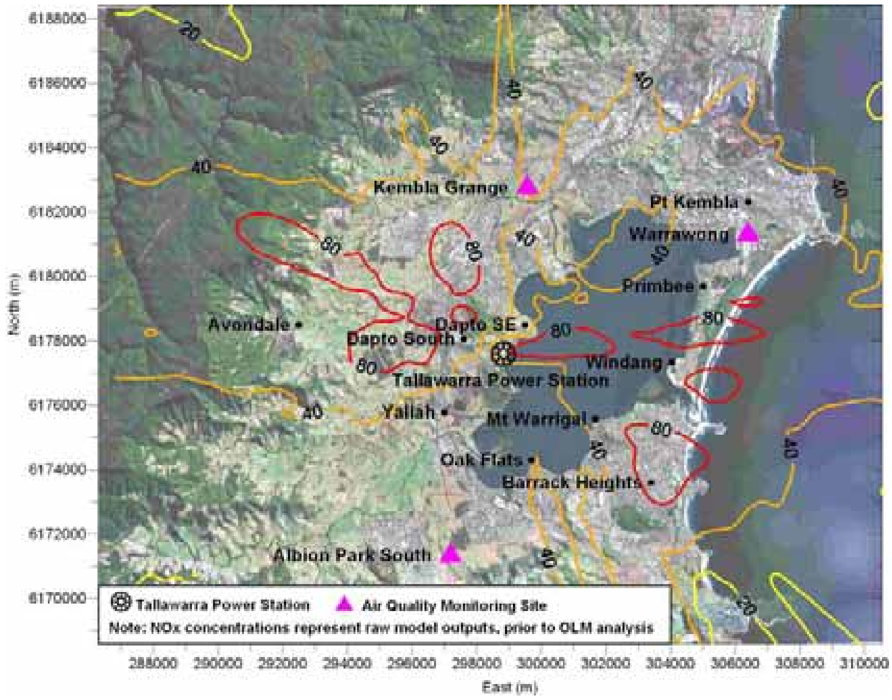
- **Figure 7-4: Tallawarra A CCGT Start Load and Tallawarra B OCGT Full Load (Diesel Fired) Incremental NO_X Maximum 1 hr Concentrations (µg/m^3)**



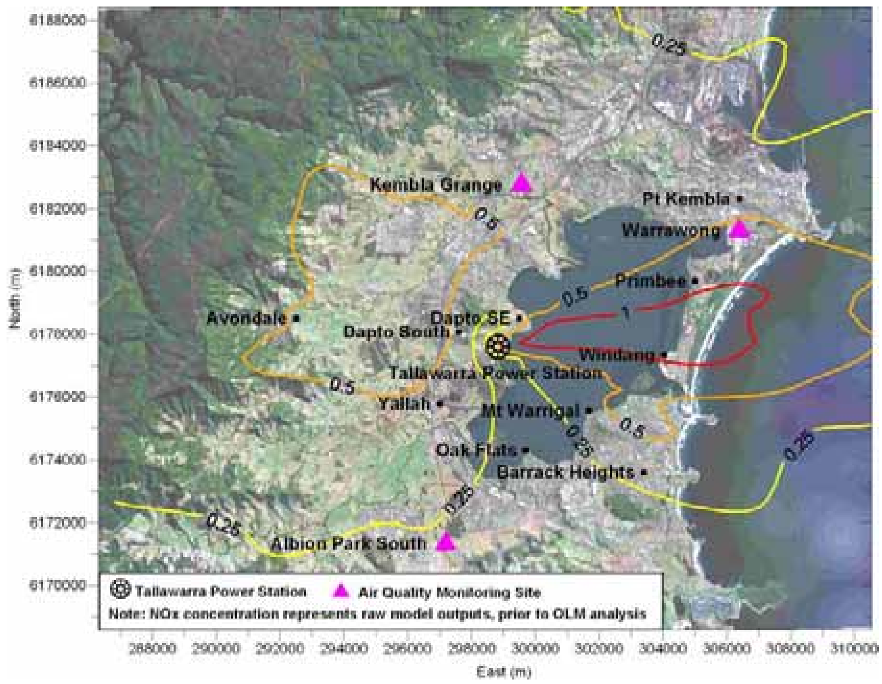
- **Figure 7-5: Tallawarra A CCGT Start Load and Tallawarra B OCGT Full Load (Diesel Fired) Incremental NO_X Annual Average Concentrations (µg/m^3)**



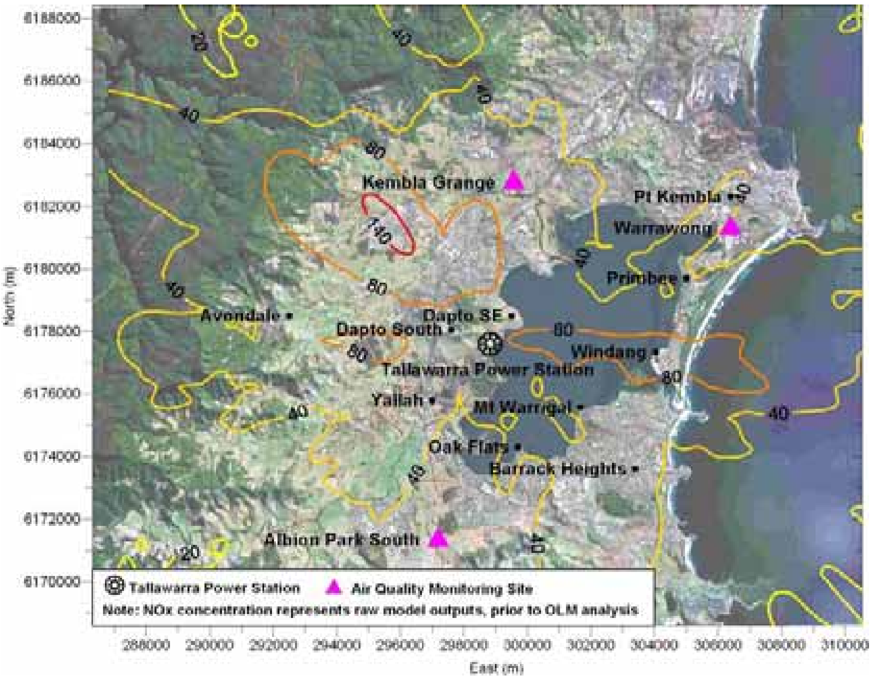
- **Figure 7-6: Tallawarra A CCGT Full Load and Tallawarra B OCGT Start Load (Diesel Fired) Incremental NO_X Maximum 1 hr Concentrations (µg/m^3)**



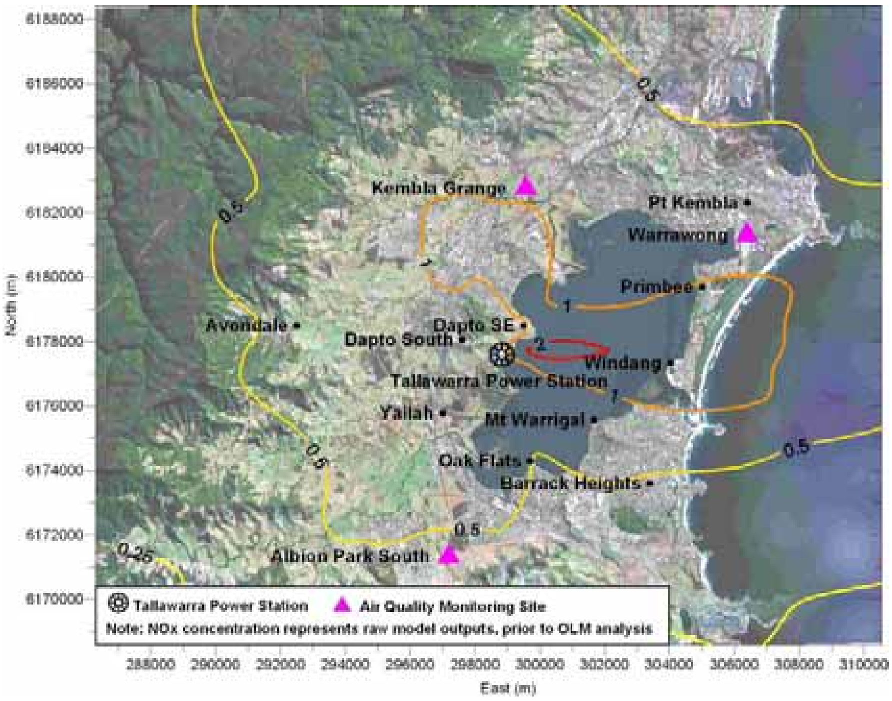
- **Figure 7-7: Tallawarra A CCGT Full Load and Tallawarra B OCGT Start Load (Diesel Fired) Incremental NO_X Annual Average Concentrations (µg/m^3)**



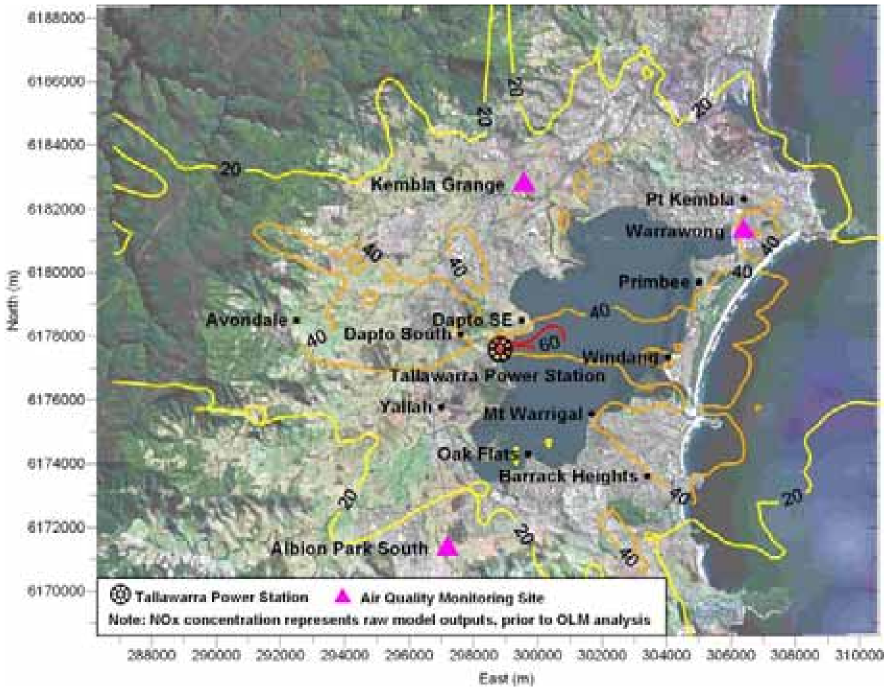
- **Figure 7-8: Tallawarra A CCGT Start Load and Tallawarra B OCGT Start Load (Diesel Fired) Incremental NO_X Maximum 1 hr Concentrations (µg/m^3)**



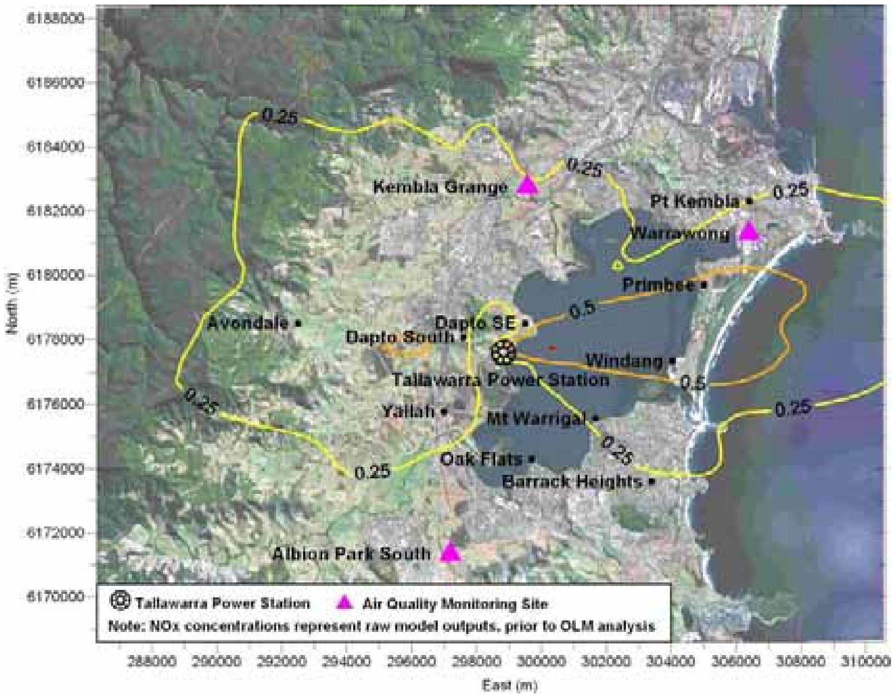
- **Figure 7-9: Tallawarra A CCGT Start Load and Tallawarra B OCGT Start Load (Diesel Fired) Incremental NO_X Annual Average Concentrations (µg/m^3)**



- **Figure 7-10: Tallawarra A CCGT Full Load and Tallawarra B OCGT (Part Load 50% Diesel Fired) Incremental NO_X Maximum 1 hr Concentrations (µg/m³)**



- **Figure 7-11: Tallawarra A CCGT Full Load and Tallawarra B OCGT Part Load (50%) (Diesel Fired) Incremental NO_X Annual Average Concentrations (µg/m³)**



Sulphur dioxide and particulate matter

Modelling results predicted for the approved Tallawarra Stage A plant operating alone under normal operating conditions and in combination with the proposed Tallawarra Stage B plant are presented in **Table 7-8**. These results indicate that SO_2 and PM_{10} concentrations would be very low and within the criteria set by the DECC.

- **Table 7-8 Summary of incremental SO_2 and PM_{10} Results for Tallawarra Stage A Plant and Tallawarra Stage B Plant (Diesel Fired).**

Air Pollutant	Averaging Period	NSW DEC Criteria	Min Conc.	Max Conc.		Conc. at Sensitive Receivers	
		($\mu g/m^3$)	($\mu g/m^3$)	($\mu g/m^3$)	% of Criteria	($\mu g/m^3$) approx	% of Criteria
Tallawarra A CCGT Plant							
SO2	1 Hour	570	0.28	4.30	<1	2	<1
	Annual	60	0.06	1.33	<3	0.02	<1
PM10	24 Hour	50	0.08	1.6	<4	0.08	<1
	Annual	30	0.004	0.106	<1	0.04	<1
Tallawarra A CCGT Plant Combined with Tallawarra B OGCT Plant							
SO2	1 Hour	570	1.59	26	<5	5-8	1-2
	Annual	60	0.02	0.23	<1	<0.2	<1
PM10	24 Hour	50	0.16	3.99	<8	<2	<5
	Annual	30	0.009	0.152	<1	<0.1	<1

Summary of Local Air Quality Assessment

The maximum impacts on ground level concentrations predicted to result from Tallawarra Stage A in combination with Tallawarra Stage B OCGT (diesel fired) meet the relevant DECC criteria for NO_2 (refer to **Table 7-9**). Considering Tallawarra Stage A and Stage B under full load operations, the maximum cumulative NO_2 1-hour average concentration at any point across the modelling domain is predicted to be 151 $\mu g/m^3$, resulting from a high background concentration (142 $\mu g/m^3$) coinciding with a low plume increment (9 $\mu g/m^3$). This result represents approximately 61 percent of the DECC criterion of 246 $\mu g/m^3$.

The annual average incremental impact of Tallawarra Stage A and Stage B at full load was predicted to be 2 $\mu g/m^3$. The maximum cumulative annual average impact of Tallawarra Stage A and Stage B was 17 $\mu g/m^3$, which represents approximately 27 percent of the annual average concentration (62 $\mu g/m^3$).

Considering start and part load operations of Tallawarra Stage A and Tallawarra Stage B, the maximum cumulative 1-hour NO_2 concentration at the sensitive receiver sites is predicted to be 78 µg/m^3, representing 31 percent of the DECC criterion. The maximum cumulative 1-hour NO_2 concentration at any point within the modelling domain (the local study area) is predicted to be 155 µg/m^3 during hot start load operation of Stage A and normal start operation of Stage B.

In reference to **Table 7-9**, Tallawarra Stage A, operating under normal operating conditions, in combination with Tallawarra Stage B meet the criteria set by DECC for both SO_2 and PM_{10}.

- **Table 7-9 Tallawarra A CCGT and B OCGT (diesel fired) Summary Modelling Results**

Air Pollutant	Emission Scenario - Worst Case Conditions	NSW DECC Criteria µg/m3	Maximum Incremental Concentration at Sensitive Receptors (Due to the Power Station)		Maximum Cumulative Concentration at Sensitive Receptors		Maximum Cumulative Concentration across Modelling Domain	
			Conc µg/m3	% of Criteria	Conc µg/m3	% of Criteria	Conc µg/m3	% of Criteria
NO_2 (1-Hr)	Full Load	246	75 Dapto South	30%	78 Dapto South	31%	151	61%
NO_2 (Annual)	Full Load	62					17	27%
NO_2 (1-Hr)	A Full Load B1&B2 Startup	246	75 Dapto South	30%	78 Dapto South	31%	153	62%
NO_2 (Annual)	A Full Load B1&B2 Startup	62					16	26%
NO_2 (1-Hr)	A Hot Start B1&B2 Startup	246	75 Dapto South	30%	78 Dapto South	31%	155	63%
NO_2 (Annual)	A Hot Start B1&B2 Startup	62					18	29%
SO_2 (1-Hr)	Full Load	570			8	2%	26 (increment)	< 5%
SO_2 (Annual)	Full Load	60					0.2 (increment)	< 1%
PM_{10} (24-Hr)	Full Load	50			2	< 5%	4 (increment)	< 8%
PM_{10} (Annual)	Full Load						0.2 (increment)	< 1%

Note:
Cumulative concentrations for 1-hour impacts were derived by adding the highest NO_2 increment due to the plume (resulting from OLM analysis of raw model NOx outputs) and background NO2 concentration recorded for the corresponding hour at Kembla Grange in corresponding year, modelling year 2002.
Annual impacts for NO2 were derived by adding the highest incremental annual average concentration across the modelling domain due to the plume (assuming conservatively that all NO_X output is NO_2) and the annual average concentration of 15 µg/m3 recorded at Kembla Grange for the monitoring year 2002

7.1.5 Regional air quality impacts

Regional scale air quality (photochemical smog) impacts have been investigated using two air dispersion models namely TAPM-GRS and TAPM-CTM. The following sections provide a summary of results of these two detailed investigations.

Regional Photochemical Impacts of Tallawarra A CCGT and B OCGT using TAPM-GRS

This assessment methodology, prescribed by DECC, investigated the impact of the Tallawarra power station on ozone concentrations at air quality monitoring sites in the Illawarra region, during the four summer periods (November to March) for the years 2000-01, 2003-04, 2004-05 and 2005-06.

Site-study days were selected according to the following criteria:

- Days displaying hours during which the observed hourly average concentrations recorded at the monitoring sites were > 60 ppb; and
- Within 20 ppb of TAPM base case concentration predicted for same hour at the relevant site.

The assessment has identified the following:

- 19 study days over the four summer periods with hours that met the criteria;
- 53 time-specific one-hour-events, that is, hours which met the criteria at one or more of the four monitoring sites. For example, on the study day 30th November 2000, three hours met the criteria at one or more sites; and
- 67 site-specific one-hour events. For example, on the study day 30th November 2000, five site-specific one-hour events occurred, namely, two one-hour events at Warrawong (12:00 and 15:00) and three at Wollongong (11:00, 12:00 and 15:00).

In summary, the analysis predicted that there would be no increase to the average ozone concentrations as a result of Tallawarra power station (A and B) however some increases and decreases to maximum ozone concentrations were predicted. In general, the average and maximum ozone concentrations at each DECC monitoring location were over-predicted.

Model predictions showed that the additional emissions from Tallawarra A and B OCGT would result in predominantly no change in high ozone plume duration events. There were a small number of hours with predicted increased or decreased duration of high ozone plume concentration events.

Results of the investigations suggested that the spatial variation in ozone levels was not consistently well represented by the model.

Regional Photochemical Impacts of Tallawarra A CCGT and B OCGT using TAPM - CTM

This methodology used the photochemical transport model, TAPM-CTM, to model an ozone event in the Illawarra during 4th -10th February 2004. A base case scenario in the Illawarra (existing emissions of NO_X and VOCs from the Sydney GMR, excluding Tallawarra power station) was compared with a test case (base case plus NO_X emissions from Tallawarra A CCGT and B OCGT).

The modelling results for the ozone event show that the impact of emissions from Tallawarra power station would be:

- an increase in the regional maximum hourly averaged NO_2 concentration of 0.07 ppb;
- an increase in the maximum hourly averaged NO_2 concentration at Kembla Grange of 0.01 ppb;
- a decrease in the regional maximum hourly averaged O_3 concentration of 0.01 ppb; and
- no change in the maximum hourly averaged O_3 concentration at Kembla Grange.

Generally, at most points across the modelling domain, NO_2 concentrations were unaffected by the addition of Tallawarra power station. That is, at most points, the predicted O_3 impact of the power station is close to 0 ppb, especially at the lowest and the higher concentrations. The largest increases (up to 3.3 ppb) were predicted to occur in areas where the base-case concentrations are less than 40 ppb. Many points, with base case concentrations between 55 ppb and 80 ppb, are predicted to experience a decrease in the maximum hourly-average concentration of up to 3.3 ppb.

In summary, the emission from Tallawarra A CCGT and B OCGT are predicted to have no adverse effects on regional concentrations of NO_2 and O_3 and to result in no additional exceedances of DECC air quality criteria.

7.1.6 Mitigation measures

During the construction phase of the project, the primary potential impact on air quality would be the generation of dust as a result of construction activities such as excavation. Dust control procedures will be implemented during the construction phase of the project if there is a possibility of wind-blown dust affecting residential areas. The measures are:

- In dry, windy conditions, water carts will be used to dampen soils prior to excavation and handling. Exposed surfaces and stockpiles will be watered, sprayed and covered if required;
- Vehicles will only be loaded to their carrying capacity and loads of fill will be covered or dampened during transport. Any soil adhering to the undercarriage and wheels of the trucks will be removed prior to departure from the site; and

- Any long-term stockpiles of soil will be stabilised using fast-seeding grass or synthetic cover spray.

In addition, construction plant and equipment used on the site for the project will be well maintained and regularly serviced so that emissions from construction plant and vehicles remain within applicable air quality guidelines and standards.

During the operational phase of the project, the management objective from an air quality perspective is to minimise emissions from the plant and equipment. As such, the proposal will be designed and implemented to ensure that the NSW DECC criteria for each pollutant identified in **Tables 7-1** and **7-2** are not exceeded. Continuous emissions monitoring of NOx will be undertaken to ensure the ongoing compliance of the plant with emission concentration and load limits prescribed in the conditions of approval. In the event of an excursion of NOx emissions above the prescribed limit, plant operators would be immediately informed of the exceedence and remedial action will be undertaken to reduce NOx levels to below the limit. Additionally, the need or otherwise for NOx offsets will be determined by; the actual operating data from Tallawarra A, the predicted operating data from Tallawarra B and finally by the actual operating data from Tallawarra B.

7.2 Plume rise assessment

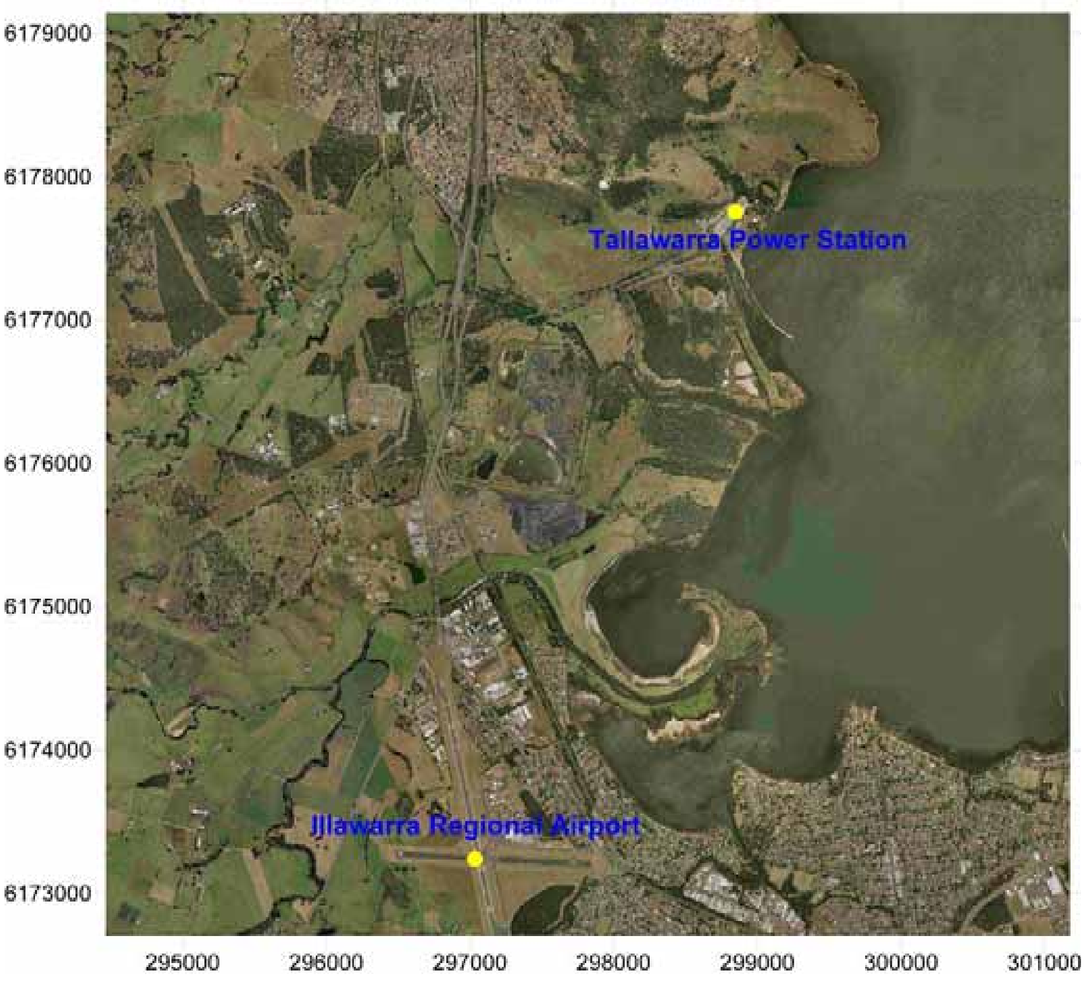
Due to the proximity of the proposed power station to the Illawarra Regional Airport (**Figure 7-12**), the Civil Aviation Safety Authority (CASA) has identified the need to assess the potential hazards to aviation due to the vertical velocity from gas efflux that may cause airframe damage and/or affect the handling characteristics of an aircraft in flight. Aviation authorities have established that an exhaust plume with a vertical velocity in excess of 4.3 metres/second may cause damage to an aircraft frame or upset an aircraft when flying at low levels. Typically low level flying operations are associated with the following phases of flight and flight operations:

- Approach, landing and take-off:
- Specialist flying activities such as crop dusting, cattle mustering, pipeline inspection, power line inspection, fire fighting etc;
- Search and rescue operations; and
- Military low-level manoeuvres.

The risk posed by an exhaust plume to an aircraft during low level flight can be managed or reduced if information is available to pilots so that areas of likely air disturbance can be avoided. As such, CASA requires the proponent of a facility with an exhaust plume which has an average vertical velocity exceeding the limiting value of 4.3 metres/second at the aerodrome Obstacle Limitation Surface (OLS) or at 110 metres above ground level anywhere else, to be assessed for the potential hazard to aircraft operations. The OLS for Illawarra Regional Airport is 52 metres. If the results of the assessment of plume rise from both the Stage A CCGT plant and the Stage B OCGT plant determine plume rise heights above the OLS (which is likely as the stack height of the approved CCGT plant exceed this level) then an application for Operational Assessment of Proposed Plume Rise must be made.

The plume rise assessment is provided in **Appendix C**, and a summary of the results is provided below.

- **Figure 7-12 Proximity of Illawarra Regional Airport**



7.2.1 Assessment methodology

As required by the Director-General's requirements, a plume rise assessment has been undertaken in accordance with an Advisory Circular (AC 139-05(0)) published by CASA - *Guidelines for Conducting Plume Rise Assessments* (2004), which includes a methodology for the assessment of plume rise using the TAPM v2 model. **Table 7-10** provides a summary of the minimum requirements for the assessment of plume rise using TAPM, as set out by CASA. Modelling conducted in this assessment complies with these criteria.

▪ **Table 7-10 CASA model requirements**

Requirement	Assessment
The entire horizontal grid domain should be a square region with 25 by 25 (or more) grid points, with 30 km outer grid and two nested grids at 10 km and 3 km.	✓
A further sub-3 km nested grid may be added at the user's discretion provided it is not less than 800m.	✓
The horizontal domain should be less than 1000 km by 1000 km.	✓
The number of vertical layers should be at least 25.	✓
The grid centre coordinates should be close to the plume source (or centroid of the sources) as allowed by the resolution of the user interface.	✓
Terrain height database should be extracted from the AUSLIG 9 second DEM database for the region under consideration.	✓

Since the publication of the CASA advisory, TAPM v3 has been released. TAPM v3 has several options not incorporated into TAPM v2, including an advanced plume rise module. This module has the potential to generate hourly plume rise information as well as final plume height. The latest version of TAPM (version 3) has been used in this assessment.

The plume rise assessment has been based on the operation of the OCGT stacks on diesel fuel instead of natural gas, as this would create greater flow in the stack, leading to greater plume rise. Therefore, the model would provide a conservative assessment. The parameters used in the model are outlined in **Table 7-11**.

▪ **Table 7-11 Plume Rise Model Scenario**

Parameter	Stage A CCGT plant	Stage B OCGT (on diesel fuel)
▪ Number of stacks	1	2
▪ Stack height (m)	60	40
▪ Stack radius (m)	2.75	3
▪ Temperature (^oC)	78	799
▪ Exit velocity (m/s)	26	41.7
▪ Buoyancy enhancement factor	1	1.99

7.2.2 Plume rise results

Vertical plume velocity

An analysis of plume velocities was undertaken to determine the maximum, minimum and average heights at which the plume vertical velocity exceeded 4.3 m/s. Results of this analysis are presented in **Table 7-12**.

- **Table 7-12 Critical Vertical Velocity Exceedance Summary**

Turbine	Maximum Height (m)	Minimum Height (m)	Average Height (m)
OCGT	1179	40 (stack height)	198

Additional analysis concerning plume vertical velocity was undertaken to determine the height at which the plume vertical velocity exceeded 4.3 m/s for a defined proportion of the modelled period. CASA (2004) defines the percentile bands to be examined. Results are presented in **Table 7-13**.

- **Table 7-13 Proportional Exceedance of Critical Vertical Velocity**

Percentile Exceedance of 4.3 m/s	Height (m)	Percentile Exceedance of 4.3 m/s	Height (m)
100%	82	7%	347
90%	124	6%	364
80%	134	5%	383
70%	146	4%	406
60%	157	3%	440
50%	170	2%	489
40%	185	1%	586
30%	205	0.5%	673
20%	239	0.3%	747
10%	308	0.2%	800
9%	320	0.1%	877
8%	332	0.05%	955

Horizontal plume displacement

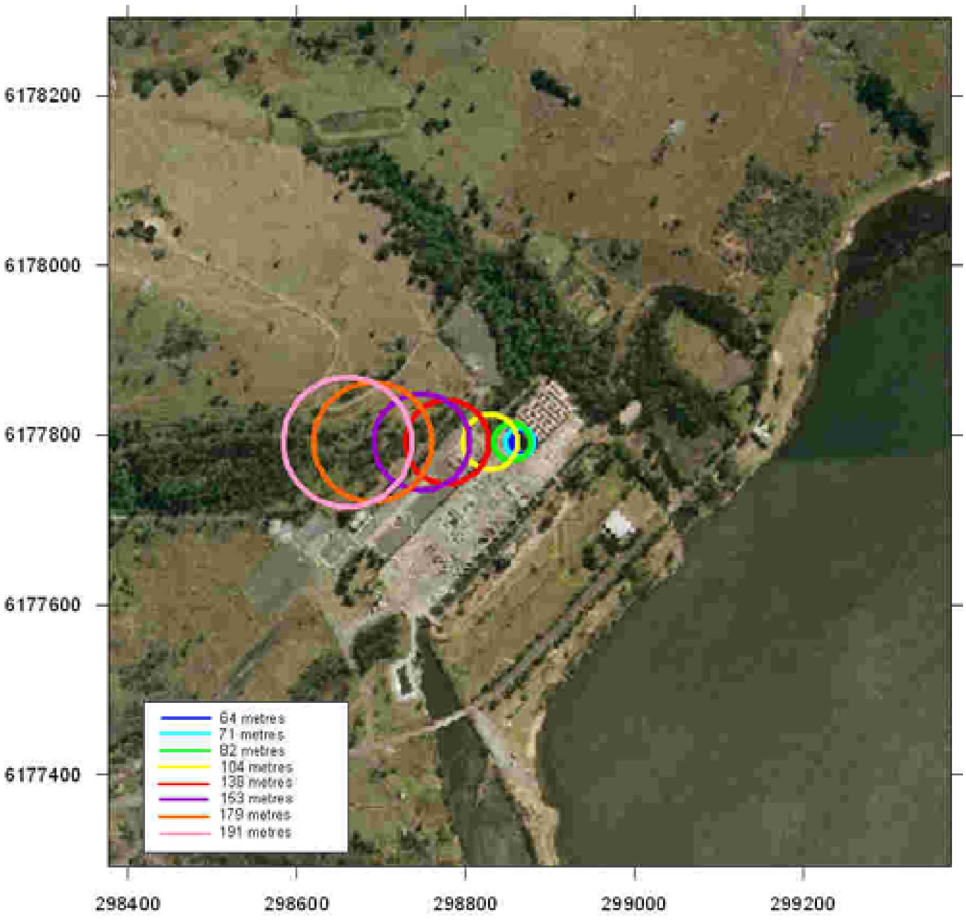
Plume development, based on average plume characteristics, were analysed for the period 2000 to 2004. **Table 7-14** shows the development of the average plume through 8 vertical levels for the Stage B OGGT plant. The vertical heights of the plume analysed are between the height of the point source and the average height where the plume vertical velocity decreases to 4.3 m/s.

▪ Table 7-14 Average Plume Development (2000 – 2004)

Vertical Velocity (m/s)	Height (m)	Horizontal Plume Radius (m)
12.40	64	14
10.81	71	17
9.11	82	22
7.19	104	32
5.58	138	49
5.12	153	57
4.48	179	70
4.23	191	76

Figure 7-13 shows a schematic plot of the average plume horizontal dispersion for the proposed OCGT stacks.

▪ Figure 7-13 Average Plume Horizontal Dispersion



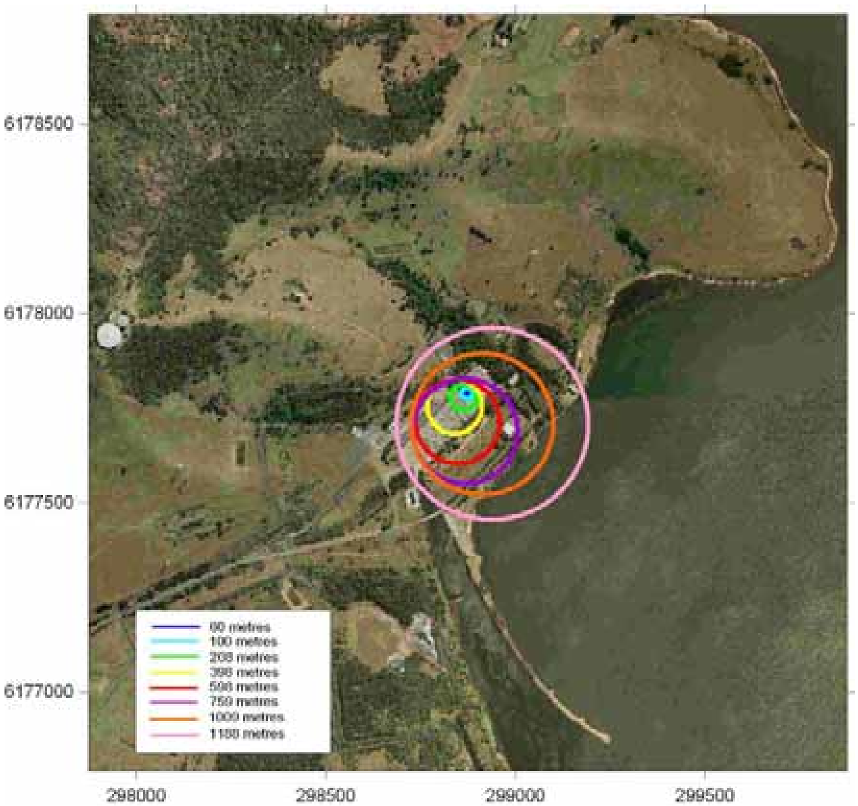
The peak plume development was selected as the hour in the modelled period that had the maximum height above ground level. The hour identified as the having peak plume development for the OCGT stacks was found to be the 11^{th} hour of the 14 July 2000.

Table 7-15 shows plume characteristics for the peak plume development at 8 well-spaced levels between the point source height and the height at which the plume vertical velocity has fallen to 4.3 m/s. **Figure 7-14** shows the spatial extent of the peak plume with respect to height.

- **Table 7-15 Peak Plume Development (11^{th} hour – 14/07/00)**

Time (s)	Vertical Velocity (m/s)	Height (m)	Horizontal Plume Radius (m)
1	21.51	61	8
5	15.82	100	15
20	11.54	208	35
55	8.77	398	72
100	7.57	598	111
140	7.04	759	138
210	5.82	1009	187
275	4.19	1188	253

- **Figure 7-14 Peak Plume Horizontal Dispersion**



7.2.3 Summary

Examination of average plume vertical velocity and extent found that the average plume would decrease to below the critical vertical velocity by 200 metres above ground level. The maximum height reached by the plume before decreasing in vertical velocity to 4.3 m/s was 1,179 metres. These plumes are considered to be the peak plume and were analysed for horizontal displacement at 8 vertical levels. The horizontal displacement of the peak plumes are considered minimal, with the plumes lateral extent being confined above the Tallawarra site until the vertical velocity decreases to below 4.3 m/s.

On the basis that the plume rise does exceed 4.3 m/s and the Illawarra Regional Airport has an OLS of 52 AHD, an application will need to be made to CASA for an Aircraft Operational Assessment.

7.3 Greenhouse gas generation

An assessment of greenhouse gas generation was undertaken in **Appendix D**. A summary of the results is provided below.

7.3.1 Construction greenhouse gas generation

During the construction phase sources of greenhouse gas emissions will include the use of vehicles and equipment. Equipment that will be used during the construction phase will include excavators, front-end loaders, backhoes, graders, semi tipper trucks, scrapers, bull dozers, rollers, water trucks cranes and compactors.

This equipment will consume fuel (primarily diesel) resulting in the emission of greenhouse gases (GHGs). The quantity of greenhouse gases is difficult to estimate as it is dependent on the distances travelled and work done by this equipment, which are dependent on the construction method and timetable, the location of pick-up and drop-off points and many other factors not known at this stage. The greenhouse gases emitted during the construction phase would be relatively short term and would be minimal compared to the operation phase. For these reasons the greenhouse gas emissions of the construction phase were not quantified.

7.3.2 Operational greenhouse gas emissions

The following activities are sources of greenhouse gas emissions associated with the operation of the Tallawarra Stage B OCGT power station:

- Natural gas extraction;
- Transportation of natural gas; and
- Combustion of natural gas at the power station.

The following assessment is based on the operation of Tallawarra Stage A and Tallawarra Stage B.

7.3.3 Emission forecasting methodology

Prediction of the greenhouse gas emissions that are likely to be associated with the project has been undertaken using the methodologies outlined in the DCC National Greenhouse Accounts (NGA) Factors, 2008. The workbook aims to provide a consistent set of emission factors, adopting the emissions categories of the international reporting framework of the World Resources Institute / World Business Council for Sustainable Development. The framework is known as *The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (GHG Protocol 2006).

The NGA Factors provides three types of assessment categories –

1) Scope 1 covers **direct emissions** from sources within the boundary of an organisation such as fuel combustion and manufacturing processes.
2) Scope 2 covers **indirect emissions** from the consumption of **purchased electricity, steam or heat** produced by another organisation.
3) Scope 3 includes all **other indirect emissions** that are a consequence of an organisation's activities but are not from sources owned or controlled by the organisation; that is, emissions from offsite waste disposal, emissions associated with the production of fuels, and emissions from the generation of purchased electricity. Scope 3 emissions vary on a state by state basis. NSW has the second highest Scope 3 emissions, due to the sources of natural gas being located outside the state. Such emissions are outside the control of TRUenergy.

Scope 1 and 2 emissions categories are carefully defined to ensure that two or more organisations do not report the same emissions in the same scope.

Estimates of emissions from natural gas may be calculated using the following formula:

GHG Emissions (t CO2-e) = Q x EF / 1000

where:

Q is the quantity of natural gas consumed and expressed in GJ, and
EF is the relevant emission factor.
Division by 1000 converts kg to tonnes.

The following formula can be used to estimate greenhouse gas emissions from the combustion of fuels excluding natural gas:

GHG Emissions (t CO2-e) = Q x EC x EF / 1000

where:
Q is the quantity of fuel in tonnes or thousands of litres,
EC is the energy content of fuel in GJ/tonne or GJ/kL, and
EF is the relevant emission factor.
Division by 1000 converts kg to tonnes.

7.3.4 GHG emission estimates

The estimation of greenhouse gas emissions for the Tallawarra Stage B OCGT power station has been undertaken using forecast operating capacities, plant efficiency and fuel usage. At this stage TRUenergy is unable to determine the exact operating regime of the Tallawarra Stage B 300MW OCGT plant. However, for the purpose of this assessment, the Stage B OCGT has a capacity of 2 to 35 percent on an annual basis.

Greenhouse gas emission estimates for the proposal have been calculated and summarised in **Table 7-16.** Provided is a summary based on full fuel cycle i.e. Scopes 1 and 3 combined. Full emission calculations are presented in **Appendix D**.

- **Table 7-16 Full Cycle CO_2 Equivalent Emissions for Power Generation at Tallawarra**

	Stage B OCGT 2%	Stage B OCGT 35%	Units
Generating Capacity			
-gas	320	320	MW
-diesel	342	342	
Hours/ annum			
-gas	173.4	3035.3	
-diesel	1.8	30.7	
kt CO_2-e/year			
-gas	41.4	726	
-diesel	0.5	9.1	
Total Annual Emissions	42	735	kt CO_2-e/year
Total Generating Capacity	56	981	GWh
Emissions Intensity	**750**	**750**	**tonnes CO_2-e/GWh**

It should be noted that the above stated greenhouse gas intensities are full fuel cycle (FFC) emission intensities and include both direct (Scope 1) and indirect (Scope 3) emission factors. With respect the actual emission performance of the proposed gas turbine plant only Scope 1 emissions are relevant and these are as follows:

- OCGT – 585 tonnes CO_2-e/GWh (gas fuel)

Plant emissions intensities will vary for a variety of reasons including plant type, fuel quality and ambient conditions, and as such the above stated intensity is a guide only, it is however, considered current best practice for open cycle industrial gas turbine plant.

Assuming a 30 year project lifetime this would equate to a total greenhouse gas emissions of between 1.26 and 22.1 Mt CO_2-e.

From **Table 7-17** it can be seen that the total greenhouse gas emissions in NSW in 2005 was 158.2 million tonnes CO_2-e. Stationary energy emissions were 75.7 million tonnes CO_2-e and include fossil fuel combustion in electricity and heat production, and manufacturing and construction industries. Approximately 14.2 million tonnes of CO2-e were emitted as fugitive emissions during the extraction and production of coal, oil and gas (DECC, 2007).

- **Table 7-17 State Territory and Greenhouse Gas Emissions for 2005**

State	2005 Emissions (Mt CO_2-e)
New South Wales	158.2
Queensland	157
Victoria	121.9
Western Australia	66.6
South Australia	28.1
Northern Territory	13.5
Tasmania	11
ACT	1.1
Total	**557.4**

For the proposed Tallawarra Stage B OCGT power station the greenhouse gas emissions produced will be equivalent to approximately 0.03 and 0.46 percent of NSW emissions (2005) operating at 2 and 35 percent capacity factors respectively. If the plant were to operate at 2 percent capacity this would correspond to only 0.01 percent of national emissions (2005) and if the plant were to operate at 35 percent capacity would correspond to 0.13 percent of national emissions.

Through the burning of natural gas to produce electricity the Tallawarra Stage B OCGT power station (operating with a 35 percent capacity factor) will emit approximately 735 kilotonnes of carbon dioxide equivalents each year of its proposed 25-30 year life span. This emission rate corresponds to an approximate emission intensity of approximately 750 tonnes CO_{2}-e/GWh.

This emission intensity is low when compared to other power stations around the country which produce up to 1,400 tonnes CO_2-e/GWh. This relatively low emission intensity is compliant with the action contained within the *National Greenhouse Strategy*, which aims to lower the emission intensity associated with electricity production.

7.3.5 Proposed management measures

Greenhouse gas emissions from the Tallawarra Stage B OCGT plant will be monitored throughout the operation phase of the project through the metering of fuel supplies and electricity outputs. These emissions will be reported under the National Greenhouse Inventory. A number of management measures including regular maintenance and use of up to date technology will be used to create continual improvement in relation to greenhouse gas emissions.

In order to calculate and report greenhouse gas emissions over the lifespan of the project, TRUenergy will measure fuel consumption and obtain fuel composition from the supplier. This will allow the greenhouse gas emissions of the project to be calculated and reported in the project's Annual Environmental Report. The project's greenhouse gas intensity will be calculated annually based on measurements of electricity sent out and steam used.

Details of the systems relevant to emissions calculations are as follows:

- Fuel Gas Metering: The gas turbine generator (GTG) will be fitted with a fuel gas flow meter to measure the flow rate of gas entering each GTG, at an accuracy of 1 percent. The flow rate of gas will be corrected for temperature and pressure, which will be measured directly; and
- Electricity Metering: All sent out electricity will be metered at the point of connection to the grid, at an accuracy of 1 percent.

The monitoring and reporting of emissions will also provide for its incorporation into the state and national greenhouse inventories, as required in the National Greenhouse Strategy and the emerging National Greenhouse and Energy Reporting (NGER) System.

A 'continuous improvement approach' will be adopted, with advances in technology and potential operational improvements of plant performance to be assessed on an annual basis and reported. The type of improvements that can be assessed annually will include:

- Appropriate maintenance of equipment to maintain or improve greenhouse efficiency;
- The use of up-to-date technology (with a focus on greenhouse efficiency) when sourcing components for maintenance and overhaul activities;
- Minimisation of vehicle use; and
- Minimisation of diesel fuel use.

7.4 Noise

The assessment of noise emissions has been undertaken for the proposed Tallawarra Stage B OCGT plant in order to predict the level of impact expected at the nearest noise sensitive receiver location. The assessment report is included in **Appendix E**, with an overview of the assessment provided in this section.

The assessment of noise impacts includes the measurement of the existing noise environment with attended and unattended noise surveys. This provides the basis for the setting of appropriate noise limits for the project, in accordance with NSW environmental policies. The noise impacts were assessed at locations both external to and within the boundary of the Tallawarra Lands. The potential impacts are compared to the guidelines provided by DECC, to indicate where the likelihood of an unacceptable noise emission may occur. Where impacts are expected to be above the guideline noise levels, mitigation measures would be required to be incorporated as part of the project design.

7.4.1 Assessment criteria

In January 2000, DECC released the *NSW Industrial Noise Policy* (INP). This document provides the framework and process for deriving project specific noise limits for impact assessments and limits for licences that will enable the authority to regulate noise emissions from premises that are scheduled under the *Protection of the Environment Operations Act 1997*. The INP is designed to determine an acceptable level of impact expected at a community level and has been used as a guideline for the noise impact assessment for the proposed power station extension. Where the INP criteria are met, no adverse noise impacts would be reasonably expected at the closest receivers. The specific noise objectives that are presented were derived in accordance with the INP.

The INP requires that the noise from a development under assessment complies with the lower of the amenity or intrusive noise criteria. The intrusive criterion is determined by the difference between the industrial noise under assessment being no more than 5 dB(A) above the Rating Background Level (RBL). The intrusive noise criteria are designed to account for shorter duration noise impacts and are often the most appropriate tool for assessing the effects of noise at a residential location. The amenity criterion is based on the zoning of the residences likely to be affected by noise, the general land use near the receiver location and the extent of the existing industrial noise in the area. In general the amenity levels are more suited to planning of noise levels rather than the assessment of project specific impacts. However, where there is an existing industrial noise influence, the amenity criteria are decreased in accordance with Table 2.2 of the INP.

A noise source is considered to be non-intrusive if:

- The $L_{Aeq,\ 15\ minute}$ level does not exceed the RBL by more than 5 dB(A) for each of the day, evening and night-time periods; and

- The subject noise does not contain tonal, impulsive, or other modifying factors as detailed in Chapter 4 of the INP.

From **Table 6-4,** the lowest RBL noise levels for day, evening and night have been applied to the monitoring locations outside the Tallawarra Lands site as the assessment criteria. The corresponding intrusive noise criteria for the day, evening and night time periods are presented in **Table 7-18**. The amenity criteria apply to the L_{Aeq} level determined for the period of assessment of day, evening or night. The definition of the noise amenity classification for the area surrounding the Tallawarra site is “urban” and “suburban” depending on the proximity to the road and rail network. Urban regions are generally defined as having characteristically heavy and continuous traffic flows during peak periods, and are near commercial or industrial districts. Suburban areas are typically those with local traffic flows with decreasing noise levels during the evening period and limited commerce or industry. The INP recommends that for residences located in an urban area, acceptable amenity criteria would be an $L_{Aeq\ (Period)}$ of 60, 50 and 45 dB(A) for the day, evening and night periods respectively. For residences located in an suburban area, acceptable criteria would be an $L_{Aeq\ (Period)}$ of 55, 45 and 40 dB(A) for the day, evening and night periods respectively.

The INP aims to control cumulative noise impacts from the combined effects of a proposed project and existing industrial noise sources by modifying the amenity criteria according to the level of an existing industrial noise impact. Based on site observations and the result of noise measurements, there is no existing noise from industrial noise sources at the Carlyle Street site.

The amenity criteria used for the Wyndarra Way site would be for a suburban area having a night time criterion of 40 dB(A). This criterion is then modified to account for the influence from existing industrial noise sources, estimated at approximately L_{Aeq} 38 dB(A). From Table 2.2 of the INP, a penalty of -4 dB(A) is applied to the Acceptable Amenity Criteria, making the Project Specific Noise Criterion at Wyndarra Way 36dB(A) during the night time period. The Amenity Criterion for the area around Carlyle Street remains unmodified due to the absence of any identifiable industrial noise influences. The noise amenity criteria for each residential receiver are presented with the other criteria in **Table 7-18**.

The Wyndarra Way site is shown in bold to indicate the modified night time criteria. The lower of the Amenity or Intrusive criterion has been selected as the project specific level for each location.

The Amenity Criteria for the night time (bold) are the most stringent of the noise goals and these will be used to assess the potential for noise impacts for the proposed Tallawarra Stage B power station. The day, evening and night time limits at the various locations would apply to noise generated by the power station operations at any residential dwelling or noise sensitive receiver. The noise criteria for other sites assessed as part of the previous EIS for Tallawarra A have been updated to meet INP assessment methodology and included in the assessment of noise impacts at these locations.

- **Table 7-18 Derivation of Project Specific Noise Criteria**

Criteria Description	Day	Evening	Night-time
Intrusiveness Criteria	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$
Project Intrusiveness Criteria	RBL + 5 dB(A)	RBL + 5 dB(A)	RBL + 5 dB(A)
Project Specific RBL levels			
Carlyle Street, Koonawarra (T2)	41 + 5 dB(A)	43 + 5 dB(A)	38 + 5 dB(A)
Wyndarra Way, Koonawarra (T4)	34 + 5 dB(A)	36 + 5 dB(A)	33 + 5 dB(A)
Amenity Criteria	$L_{Aeq\ 12hr}$	$L_{Aeq\ 4hr}$	$L_{Aeq\ 8hr}$
Carlyle Street, Koonawarra (T2)	60 dB(A)	50 dB(A)	45 dB(A)
Wyndarra Way, Koonawarra (T4)	55 dB(A)	45 dB(A)	40 dB(A)
Project Noise Criteria	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$	$L_{Aeq15\ min}$
Carlyle Street, Koonawarra (T2)	46 dB(A)	48 dB(A)	43 dB(A)
Wyndarra Way, Koonawarra (T4)	39 dB(A)	41 dB(A)	**36 dB(A)***

*Note: * modified night-time criteria*

7.4.2 Operational noise impact assessment

The assessment of noise impacts is concerned with noise emissions from the combined operations of the approved Tallawarra Stage A CCGT and the proposed Tallawarra Stage B OCGT plants and the impact that this would have on nearby sensitive receivers. To determine the potential for noise emissions to cause an unacceptable impact, operations of the individual and combined units have been modelled using SoundPLAN noise modelling software, incorporating meteorological and topographical conditions. The results of predictions from the modelling exercise are compared to the DECC criteria, as outlined above.

The modelling of noise results have been based on a design that incorporates attenuation in the turbine building such as equipment enclosures and insulation in the walls and roof. Other external noise sources such as air intake and stack opening also include noise attenuation measures. Major noise sources included in the model are shown in **Table 7-19**.

- **Table 7-19 Modelled noise levels**

Plant Item	Sound Power Level dB(A)	Emission Height Range (m)
Diffuser Housing	102	0-8
Stack Mouth	100	40
Stack Casing	100	0-40
Main Transformer	100	0-3
Turbine building	99	0-11

Plant Item	Sound Power Level dB(A)	Emission Height Range (m)
HVAC System	95	0-3
Lube Oil Cooler	94	0-4
Air intake	90	15-22

The assessment scenarios are as follows:

- Scenario 1 – Tallawarra Stage A CCGT and Tallawarra Stage B OCGT showing the results for neutral weather conditions plus a 5 dB(A) low frequency noise penalty; and
- Scenario 2 – Tallawarra Stage A CCGT and Tallawarra Stage B OCGT showing the results for noise enhancing weather conditions plus a 5 dB(A) low frequency noise penalty.

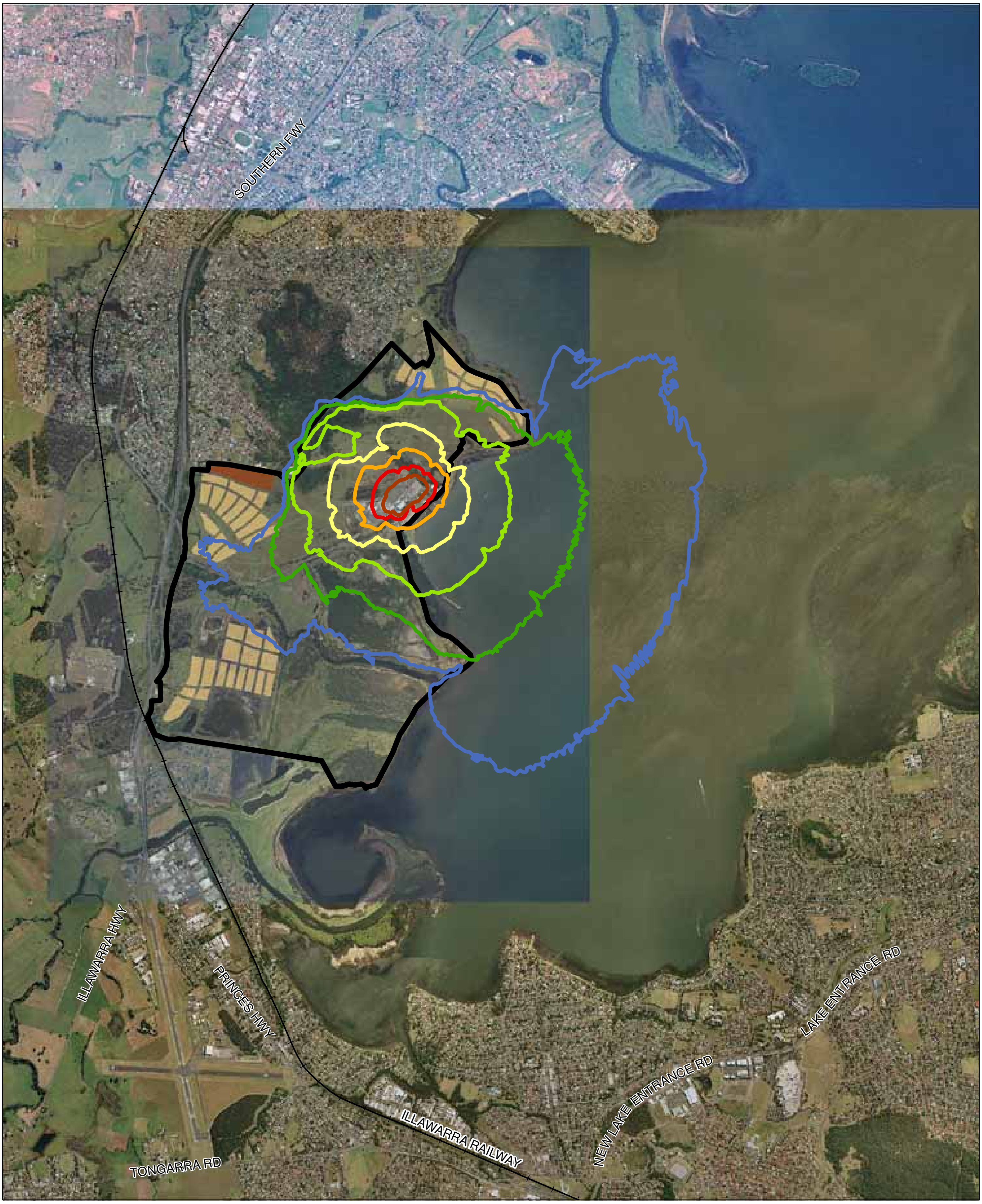
The results of the noise modelling for each scenario are presented as noise contour calculations on aerial photography. **Figure 7-15** and **Figure 7-16** present the predicted noise levels for the combined operation of the Tallawarra Stage A CCGT and the proposed Tallawarra Stage B OCGT power stations for Scenario 1 and Scenario 2 respectively.

Table 7-20 presents the point calculations of the cumulative noise impact assessment for the Tallawarra Stage A CCGT and Tallawarra Stage B OCGT combined operations, which includes the 5dB(A) penalty and adverse weather conditions.

- **Table 7-20 Predicted Noise Levels Tallawarra Stage A CCGT and Tallawarra Stage B OCGT Plants**

Description	Predicted Noise Level Neutral Conditions	Predicted Noise Level Adverse Conditions	Noise Goal
Carlyle Street, Koonawarra (T2)	27 dB(A)	28 dB(A)	43 dB(A)
Wyndarra Way, Koonawarra (T4)	26 dB(A)	27 dB(A)	36 dB(A)
Central Park, Mogurah Pt	30 dB(A)	33 dB(A)	38 dB(A)
Boonarah Pt	30 dB(A)	33 dB(A)	37 dB(A)
Haywards Bay Estate, Yallah	25 dB(A)	28 dB(A)	44 dB(A)

The modelling indicates that under neutral conditions, at all receiver locations external to the Tallawarra Lands boundary, noise levels are predicted to be lower than the identified noise criteria. When a 5 dB(A) low frequency noise penalty is added to the predicted results and under adverse weather conditions, these locations would still remain lower than the criteria in **Table 7-18**.



Legend

Site boundary

Tallawarra Lands Structure Plan

Large Lot Residential

Low Density Residential

Noise Levels

35dB(A)

40dB(A)

45dB(A)

50dB(A)

55dB(A)

60dB(A)

65dB(A)

0 650 1,300

Metres

1:40,000 At A4

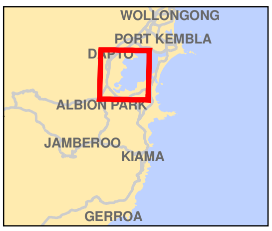


Figure 7-15: Noise Contours – Stage A CCGT and Stage B OCGT

Scenario 1 - Neutral Meteorological Conditions

Source: Topographic data by Streetworks.
Site Aerial - TRU Energy, Jan 2009

April 24, 2009
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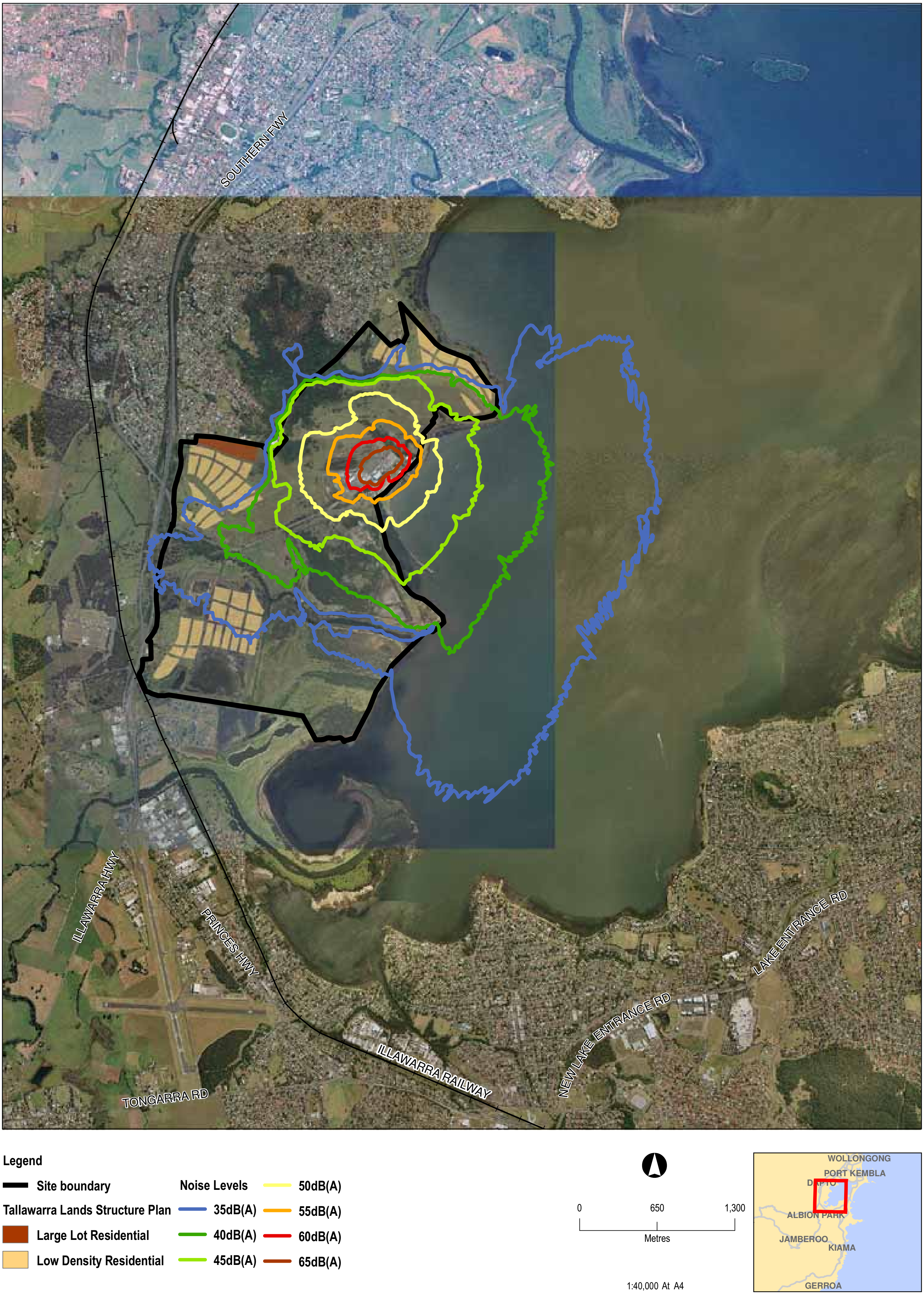

Figure 7-16: Noise Contours - Stage A CCGT and Stage B OCGT

Scenario 2 - Adverse Meteorological Conditions

Source: Topographic data by Streetworks.
Site Aerial - TRU Energy, Jan 2009

April 24, 2009
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The locations west and north of the site will benefit from a significant amount of topographic shielding, as well as a large distance separation between the power station and the residential areas. This influence is highlighted by the noise contours showing an exaggerated effect in a south easterly direction across Lake Illawarra.

In addition to the assessment of noise impacts for sensitive receivers external to the Tallawarra site, DECC have requested that Project Specific Noise Levels (PSNL) be developed in accordance with the INP for the Tallawarra Lands area. The predicted noise levels from Tallawarra A and Tallawarra B are shown in **Figure 7-15** and **Figure 7-16**.

Setting PSNL for the Tallawarra Lands is considered premature at this stage of the project as this development will be the subject of a separate approval process and as such there are no firm development plans for the site, which is a key consideration when developing noise criteria. A more appropriate approach would be to set PSNL when an application is made for the land development at which time the power station operation and its impacts on the proposed Tallawarra Lands may be assessed in accordance with the relevant guidelines.

The setting of project noise goals for the Tallawarra Lands development would need to include the operations of the Tallawarra A plant which has recently entered commercial operation. As the application for development and the final design of the Tallawarra Lands Development Project will be post the operational start up of the Tallawarra A, the noise criteria for the development must consider this existing influence.

The INP does not provide design noise criteria or assessment procedures for future residential developments in areas that have an existing industrial noise influence and therefore the development of noise criteria for the proposed Tallawarra Lands development is not straightforward. There are several methods that may be used to develop suitable noise criteria for the Tallawarra Lands project which are discussed below, although these should be explored further during the approvals process for the Tallawarra Lands development.

The INP provides two forms of noise criteria to limit noise impacts from industrial developments; the intrusiveness and amenity criteria. The intrusiveness criteria can only be used to develop noise criteria for a proposed industrial development to inform the design of the site so as to generate a L_{Aeq} noise level at an existing receiver of no more that background plus 5 dB(A). These criteria cannot be imposed on an existing industrial noise source and therefore the amenity criteria should be used to determine the appropriate level for a new receiver.

The acceptable noise levels for an urban receiver identified in Table 2.1 of the INP are 60, 50 and 45 dB(A) for day, evening and night time respectively. In areas exposed to industrial noise impacts up to 39 dB(A), the level of industrial noise compared to the night time amenity criteria would be 6 less than the ANL. When referenced to Table 2.2 of the INP, this noise level would attract no additional cumulative noise penalties, making development within areas with existing industrial noise impacts less than this level acceptable.

It must be noted that future residential development in areas exposed to more than 39 dB(A) may also be acceptable through the adoption of architecturally designed buildings. For example the DECC's ECRTN identifies a night time noise criteria of 50 dB(A) as being acceptable for new residential developments affected by road traffic noise, with mitigation measures including location, internal layout and the choice of building materials and construction for dwellings. Other codes and standards recommend internal noise levels of between 30-45 dB(A), which would be achievable for the Tallawarra Lands Development for areas above 39 dB(A).

The predicted noise contours in **Figure 7-15** and **Figure 7-16** show a similar level of noise impact within the Tallawarra Lands. For the proposed residential areas on the western boundary, the predicted noise impact from the power station is likely to be lower than the noise influence generated by road traffic on the Southern Freeway.

7.4.3 Construction noise impact assessment

Construction activities on the site have been completed for the Stage A CCGT plant. These activities were not audible from the residential monitoring locations during the attended noise survey. The same distance separation and topographic shielding that provides noise attenuation for the Stage A CCGT works would also provide significant benefit to the construction activities for the proposed Stage B plant. It is expected that the construction activities for the proposed Stage B plant would be of a similar noise level and therefore would not be audible at residential locations during normal construction hours.

7.4.4 Mitigation and management of noise impacts

The noise emissions data used for modelling noise impacts is taken from a similar equipment model to that which is currently proposed for the OCGT plant, although a specific supplier or design has not yet been determined. The Sound Power Levels were taken from manufacturer's data for a design that incorporates significant attenuation measures in the construction of the plant. While there are a number of suppliers of this type of equipment, similar attenuation controls could possibly be implemented on other OCGT designs in order to meet the project specific noise goals. TRUenergy will investigate specific noise mitigation measures during the design phase, in consultation with the manufacturer. To minimise operational noise impacts, the project noise goals listed in **Table 7-18**, developed in accordance with the Industrial Noise Policy (INP), will be adhered to during the operation of the plant.

Noise impacts from start up and shut down procedures may be louder than the normal operations of the plant. These events would include noise from start up ejectors, blow down valves, sirens, circuit breakers and the like. Some of these are process requirements and some are safety requirements.

Due to the intermittent nature of these activities, their effect on the predicted noise level emissions from Tallawarra B have not been included in the modelling of normal operations of noise emissions at the external receivers. The infrequent nature of these sources is evidenced by their function, which occurs at start up, shut down or during abnormal operations.

Safety valves are expected to operate only a few times per year and last for about 30 seconds duration. Circuit breakers, which have an impulsive impact, can have noise levels of 105 dB at 25 metres distance. Measured noise levels from the supply gas line purge during a shutdown indicate similar noise levels of 103 dB(A) at 20 metres.

These impacts have been assessed against the DECC sleep disturbance guidelines to determine the potential for impacts during these periods. It is noted that these noise events which are described as generally instantaneous have durations of up to 30 seconds, and in other cases, circuit breakers for example, the duration maybe less than 1 second. Integrating these instantaneous noise events back into a 15-minute noise assessment period would have no effect on increasing the overall noise from the power station.

The results of the modelled predictions for sleep disturbance from non-continuous noise emissions from an OCGT shut down are given as worst case adverse meteorological conditions for each receiver and are presented in **Table 7-21**.

- **Table 7- 21 Predicted L_{AMax} Noise Levels Adverse Meteorological Conditions**

Location ID	Description	Predicted Noise Level Adverse Conditions	Sleep Disturbance Noise Goal
T2	Carlyle Street, Koonawarra	31 dB(A)	53 dB(A)
T4	Wyndarra Way, Koonawarra	30 dB(A)	46 dB(A)
ML# 9	Central Park, Mongurah Pt	42 dB(A)	48 dB(A)
ML# 10	Boonarah Pt	43 dB(A)	47 dB(A)
ML# 11	Haywards Bay Estate, Yallah	38 dB(A)	54 dB(A)

The results of the predictions indicate that even under adverse meteorological conditions the sleep disturbance criteria would not be exceeded. Furthermore, the noise emissions from shutdowns, circuit breakers and other abnormal operational noise sources have the potential to be mitigated where necessary.

The following mitigation measures are aimed at minimising the impact of construction on the surrounding residences:

- Construction will be carried out during the hours specified in Table 9-1 under 'Environmental Management - Manage hours of construction work';
- Practical measures will be used to manage noise from construction equipment, particularly in instances where extended hours of operation are required;
- Suppliers of construction equipment will be required to comply with Australian Standard AS 2436-1981 *Guide to Noise Control on Construction, Maintenance and Demolition Sites*. All equipment used on-site will need to demonstrate compliance with the noise levels recommended within AS 2436-1981;
- Contractors will be required to design and construct the proposed plant to comply with applicable noise criteria. Noise limits and guidelines will be given to suppliers of plant equipment so that compliance with the project specific noise goals is achieved; and
- Noise compliance monitoring will be carried out (as an extension of the noise monitoring undertaken for Stage A) for all major equipment and activities on the power station site. Investigative monitoring of noise will be carried out in response to specific complaints.

7.5 Hazards and risk

As part of the Tallawarra Stage A OCGT power station operation, a number of dangerous goods will be stored and handled at the site, resulting in a requirement of the facility to be assessed under State Environmental Planning Policy (SEPP) No.33, "Hazardous and Offensive Industries". SEPP 33 requires a Preliminary Hazard Analysis (PHA) to be conducted for the site to demonstrate that the proposed power station is only potentially hazardous and not actually hazardous. The PHA is included in **Appendix F**, with an overview of the assessment provided in this section.

7.5.1 Methodology

A detailed hazard identification process was conducted for all site operations, each of which was assessed qualitatively in light of proposed safeguards (technical and management controls). Where a potential offsite impact was identified, a qualitative review was undertaken to determine whether safeguards are adequate to control the hazard. For those incidents where safeguards would not minimise potential offsite impacts, a detailed consequence analysis was conducted. The analysis modelled the various hazardous incidents and determined impact distances from the incident source. The results were compared to the criteria listed in Hazardous Industry Planning Advisory Paper No.4: Risk Criteria for Land Use Safety Planning (HIPAP No.4).

Where an incident was identified to have an offsite effect and a simple solution was evident (i.e. move the proposed equipment further away from the site boundary), the solution was recommended and no further analysis was performed. If a simple solution for managing consequence impacts was not evident, each incident identified to have potential offsite impact was subjected to a frequency analysis. The analysis considered the initiating event and probability of failure of the safeguards (both hardware and software). Where incidents were identified to have an impact offsite and where a consequence and frequency analysis was conducted, the consequence and frequency analysis for each incident was combined and compared to the risk criteria published in HIPAP No.4. Where the criteria were exceeded, a review of the major risk contributors was performed and recommendations made regarding risk reduction measures.

7.5.2 Hazard analysis

As part of the power station development, it is likely that the dangerous goods (DG) listed in **Table 7-22** will be stored, handled and used on site.

Table 7-22 Possible dangerous goods usage

No.	Type of Goods	Nature of the Material	DG Class	Packaging Group	Qty Proposed for Storage (m^3 or kg)
1	Natural Gas (methane)	Flammable Gas	2.1	III	No storage
2	Diesel Fuel	Combustible Liquid	C1	-	$2000m^3$
3	Lubricating Oil*	Combustible Liquid	C2	-	$20m^3$
4	Transformer Oil#	Combustible Liquid	C2	-	$65m^3$

*Per oil tank (2 tanks)
#Per transformer (2 transformers)

Based on the above storage, handling and use of dangerous goods, a hazard analysis was conducted, which included the development of a hazard identification table that can be found in **Appendix F**.

7.5.3 Consequence and frequency analysis

The hazardous analysis conducted for the project identified a number of hazards that have the potential to impact adjacent offsite areas. These incidents have been carried forward for consequence analysis to determine whether incident impacts have the potential to exceed consequence criteria published in HIPAP No.4. The incidents carried forward for consequence analysis include:

- Gas fitting line incident leading to gas leak as a result of external interference;
- Gas leak into the gas turbine enclosure, ignition and explosion/jet fire;
- Diesel fuel leak into the gas turbine enclosure, ignition and pool fire;

- Oil leak into the gas turbine enclosure, ignition and pool fire;
- Transformer oil leak, oil ignition and pool fire in the bund surrounding the transformer;
- Diesel fuel storage tank fire;
- Diesel fuel storage bund fire;
- Diesel delivery/transfer pool fire; and
- Contaminated fire water release.

Of these hazards that were subjected to the consequence analysis, the following were carried forward for frequency analysis:

- Gas fitting line incident leading to gas leak as a result of external interference; and
- Gas leak into the gas turbine enclosure, ignition and explosion/jet fire.

7.5.4 Risk analysis

Both of the hazards subject to frequency analysis were progressed to the risk analysis stage.

Gas fitting line rupture – Domino risks

The gas fitting line incidents occur in the nominal fitting line easement to the south of the turbine area. A pipeline failure (rupture), and ignition, would result in the jet flame directed parallel to the pipeline, with heat radiated from the flame towards the areas adjacent to the piperack. The heat radiation impact at $23kW/m^2$ (the level at which adjacent areas may be impacted), occurs at a distance of 54m. Buildings and structures on site are within the heat radiation envelope and, hence, may be impacted by the incident, resulting in domino effect.

The potential for domino incident is a function of the heat radiation impact and exposure time. In the event a release occurs, and is ignited, the resultant flame would radiate the heat towards the adjacent structures and eventually cause structural failure and or ignition of combustible materials in these areas. However, if the gas supply to the leak is isolated, then the flame will be extinguished before incident growth can occur. The gas supply line to the power station is fitted with a metering and valve station at the site boundary (incoming line), which incorporates an automatic isolation valve that operates on downstream pressure loss in the line. Hence, in the event of a line break (rupture), the automatic isolation will be activated, cutting the gas supply to the leak. The fire will then be extinguished and the domino incident avoided.

Hence, the risk of domino incident is a function of the line failure (rupture frequency), the probability of ignition and the failure of the isolation valve to activate.

The failure rate of a shut down valve to close on demand has been estimated to be $2.5x10^{-3}$p.a. To determine the failure probability of the valve to close on demand, Fractional Dead Time (FDT) theory is used, where:

FDT = ½ λ t where: λ = component failure rate (p.a.)
t = test period (1/no.tests per annum), assumed 1 in this case

Hence, FDT = 0.5 x $2.5x10^{-3}$ x 1 = $1.25x10^{-3}$

For this study, the ignition probability has been selected as 0.3 for massive leaks (>50kg/s) and therefore the domino risk is:

Domino Risk = Ignition probability x leak frequency x probability valve fails to close
= 0.3 x $1x10^{-4}$ p.a. x $1.25x10^{-3}$
= 0.0375 chances in a million per year (pmpy)

The risk of domino incident and onsite impact is extremely low and well below any established criteria for offsite impacts. Hence, in the event of a domino incident occurrence, and potential for fire growth on site causing additional incidents and offsite impact, the incident risk does not exceed the published risk criteria.

Gas fitting line rupture – flash fire risk

In the event of a gas fitting line failure (rupture) and gas major gas release, there is a potential for delayed ignition and flash fire. People caught within the envelope of the flash fire would be considered fatalities and those outside the flash fire would not be considered fatalities. In the event of a release of natural gas (methane), the gas would rise and dissipate into the atmosphere as the gas is buoyant. Notwithstanding this, if (conservatively), it is assumed that the gas does reach the boundary or residential areas, then delayed ignition and flash fire may result in fatalities in these areas and the probability of fatality would be considered to be 1.

The assessment conducted above has estimated the probability of immediate ignition of the gas release to be 0.3. If, conservatively, it is assumed that the probability of delayed ignition is 1-immediate ignition, then the delayed ignition probability is estimated to be 0.7. The flash fire fatality risk at the site boundary or residential areas would therefore be a function of the pipeline failure frequency by the probability of delayed ignition by the probability of failure of the isolation valve to close on demand. Using the values estimated above and a delayed ignition probability of 0.7, the fatality risk at the site boundary or residential areas would be:

Flash Fire Fatality Risk = 0.7 x $1x10^{-4}$ p.a. x $1.25x10^{-3}$ = $8.75x10^{-8}$ pmpy.

Hence, the risk at the site boundary and the closest residential areas is below the published risk criteria of 1 pmpy.

Notwithstanding the above assessment, it is noted that in the event of a fire or flash fire incident there may be an impact offsite. Hence, to ensure the risks are maintained in the ALARP range, the following recommendations are made:

- The gas fitting line be clearly marked with "HIGH PRESSURE GAS PIPELINE" at regular intervals (20m) to ensure that personnel working in the area (especially on the piperacks) understand that a high pressure gas fitting line is present.
- A safety management system element be developed specifically for the fitting line maintenance and inspection, this element should include regular fitting line route and equipment inspections on a regular basis.

Turbine explosion injury risk

A review of the distance from the turbines to the fenced site boundaries indicates that, as a result of the postulated explosion in the turbine enclosure, explosion overpressure at the fence line surrounding the site exceeds 100kPa. However, the power station site boundaries extend well beyond the fenced area and a buffer zone has been established around these sites such that no industrial, residential or commercial developments can be established within a specific distance of the power station site. The analysis conducted identified that in the event of an explosion there would be insufficient overpressure at the buffer zone boundary to cause fatalities. However, the analysis indicated that there would be sufficient pressure to cause injuries.

The explosion assessment indicates that at the closest residential area on the boundary of the buffer zone, the explosion overpressure would result in an injury probability of 10% (0.1). The explosion frequency has been estimated to be 1.58×10^{-6} p.a.

Injury Risk (Turbine Enclosure Explosion) = 0.1 x 1.58x10-6 = 0.158 pmpy.

HIPAP No.4 (Ref.1) indicates that the accepted injury risk at residential areas is 50 pmpy, hence, the criteria is not exceeded in this case.

7.5.5 Mitigation

The preliminary hazard analysis identified that the risks associated with the operation of the proposed power station do not exceed the published risk criteria in HIPAP No.4. Hence, the facility may be classified as potentially hazardous and not actually hazardous within the definitions detailed in State Environmental Planning Policy No.33 Hazardous and Offensive Developments. Therefore the proposed power station extension (Stage B) would be permitted and appropriate within the land zoning.

Notwithstanding this assessment, it is noted that in the event of a fire there will be an immediate impact offsite. Therefore, the following mitigation measures will be applied:

- The distance between the marker signs located along the fitting line route will be decreased such that signs are no more than 50 metres apart, irrespective of any clear visibility along a straight flat sections of the fitting line route; and
- Update the Tallawarra A safety management system to incorporate the Tallawarra B fitting line. This element should include regular fitting line route and equipment inspections (every 5 years).

It was also identified during the assessment that in the event of fire there is a potential for contaminated fire water to escape off-site, resulting in environmental damage. To minimise the risk of this occurrence, the site first flush triple interceptor/separator will be designed to contain a minimum of 216 m^3. This will ensure the fire water, applied in accordance with the applicable Australian Standards, is retained on site.

The following studies will be completed prior to commencement of operations:

- Fire Safety Study, in accordance with HIPAP No.2;
- Hazard and Operability Study, in accordance with HIPAP No.8;
- Emergency Response Planning in accordance with HIPAP No.1;
- Construction Safety Study in accordance with HIPAP No.7;
- Safety Management System assessment in accordance with HIPAP No.9; and
- Hazard Audit within 12 months of commencement of operations in accordance with HIPAP No.5.

7.6 Water

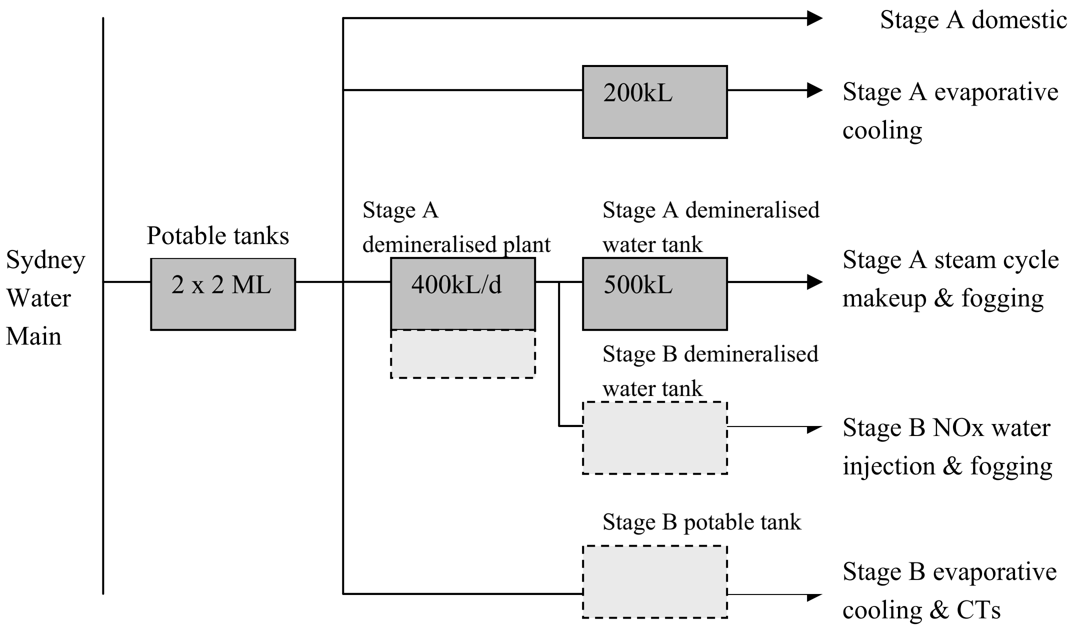
Water quality is listed as a key issue in the Director-General's requirements, but mainly in the context of extraction of water from Lake Illawarra and the release of cooling water. For the OCGT plant, water usage will be from potable sources and there will be no release of cooling waters to the lake. This assessment deals only with the use of water on the site and the potential impacts of flooding.

During operation of the plant, water would be required at the site for the following uses:

- Process water, for operation of the proposed power station plant; and
- Domestic water, for amenities.

A simplified process water diagram (**Figure 7-17**) indicated the major inputs and outputs to the site's water cycle.

- **Figure 7-17 – Water process flow diagram**



7.6.1 Water demand

The Tallawarra Stage B OCGT power station will require potable water for evaporative inlet air cooling and demineralised water for fogging/wet compression and compressor washing. Wet compression is a type of "turbine inlet air cooling" method which adds more fog to the turbine inlet air than can be evaporated under the conditions of the ambient air. The turbine inlet air stream carries the excess fog into the compressor section of the combustion turbine where it further evaporates and cools the compressed air, and then creates extra mass for boosting the output.

The annual water demand of the Tallawarra Stage B OCGT plant has been calculated based on the following:

- 30 hot days per year;
- Stage B operates on distillate 40 hours per year;
- Stage B power augmentation is used for operation on gas only; and
- Stage B evaporative cooling is operational for 50 percent of the overall operating time.

The calculations are considered to be conservative, illustrating potential quantities which are summarised in **Table 7-23** below.

- **Table 7-23 Annual Water Demand for Stage B.**

	E-class			LMS100		
Capacity Factor	2%	5%	10%	2%	5%	10%
Potable [1] [ML]	10	20	36	35	87	175
Demineralised [ML]	8	13	23	7	17	34

1. Includes feed to demin plant.

7.6.2 Flooding

The proposed Tallawarra Stage B site is located on the western foreshore of Lake Illawarra, immediately south of Yallah Creek. No flood studies have been undertaken for Yallah Creek. The closest location for available data is Duck Creek located approximately 1.5 km south of the site.

The Tallawarra Lands area has been the subject of flood studies associated with the Tallawarra Lands project. Relevant studies to the development site have been summarised in **Section 6.1.4**.

Using the previous studies, an assessment of flood risk to the site has been made based on the following factors:

- Historical evidence – There is a record of major floods in Lake Illawarra dating back to 1919 (Floodplain Risk Management Study, 2005). In the documentation reviewed there is no reference to flooding of Yallah Creek in any of these 'major'events;
- Flood Mechanism – as noted in the Floodplain Risk Management study the steep slope of the escarpment has a marked influence on rainfall in the Tallawarra region. The rate of precipitation is increased as the escarpment forces the air to rise and cool more rapidly. Yallah Creek has only a small contributing catchment (0.35 km^2) resulting in a flashy flow response to the receiving rainfall. It is expected that Yallah Creek would experience a sudden rise and fall of flood levels over a short duration of time;
- Artificial Influences on the flood regime –there is an artificial wetland and diversion pipe which influence the natural hydrological regime of Yallah Creek. Flow is diverted into the wetland to reduce the flow going down Yallah Creek. The creek flows through a culvert adjacent to the site with no open channel sections. The wetland occupies an area of approximately 0.32 hectares. Flow in the creek itself is further reduced by the northern drain diversion pipe which passes under the development site;
- Defacto Flood Defence –the riparian corridor between the creek and the development is elevated and would provide a natural barrier to any overland flow. In doing so, it is unlikely that the

overland flow would encroach on the 35m 'buffer' area between the creek and the development. If higher (and rarer) flows were experienced in the catchment (i.e.greater than 100 year flows) the natural 'bund' may be supplemented with sandbags or temporary defence structures to protect the development. Floodplain Storage – the Tallawarra Stage B power station plant will replace an existing building on the Tallawarra site. In doing so, there will be no loss or gain in storage volume for the Yallah Creek floodplain; and

- Flooded Extent – the work carried by Northrop indicates a flood width of approximately 20 metres for Yallah Creek for the 1 percent AEP event (**Figure 6-5**). The development site is not included within this inundated area.

The Lake Illawarra Floodplain Risk Management Study and Plan is currently being updated to include impacts of climate change on flood levels in the catchment. Yallah Creek is a minor tributary in the north of the Tallawarra site and is not a key feature considered in the development of flood management in the area. Based on the information currently available it is clear that flood waters on Yallah Creek are managed by the artificial wetland and diversion pipe discussed above.

The development of the Tallawarra Stage B power station should not alter these current operations and therefore further floodplain management of Yallah Creek is not considered appropriate at this time. The scoping report carried out has drawn upon information from previous reports, observations made during site visits and Geographic Information System (GIS) data for the area. Assessment of flood risk has been qualitative and is based on a number of assumptions of how the catchment operates during a flood event. A basic calculation of flood width undertaken by Northrop Engineers states the approximate flood width for Yallah Creek is 20 m. The proposed development is not located in this inundated area.

The risk of flooding from Yallah Creek is considered to be minimal and it is not anticipated that any further flood management operations are required.

7.7 Ecology

As illustrated in **Figure 6-7**, the proposed Tallawarra Stage B power station will be located on a hardstand area associated with the decommissioned coal fired power station. As such, the plant will not result in the removal of native vegetation remnants within the broader project site.

Remnant vegetation associated with Yallah Creek is located to the north of the power station plant and will be marked with flagging tape or similar to minimise the risk of accidental clearing or incursion into this area. Existing laydown areas and carparking areas will also be utilised for the Tallawarra Stage B project.

In addition, other auxiliary components of the project, such as the additional gas fitting line and water storage tanks will be located within the Tallawarra Stage A pipeline corridor and hardstand area, respectively, and will not result in the clearing of native vegetation. The potential effects of removing redundant transmission lines traversing the Tallawarra Lands site (refer to **Figure 5-7**) would be limited to minor, short-term ground disturbance at the base of existing towers within a grassed easement. The disturbed areas will be reshaped and stabilised as necessary to prevent erosion.

A number of threatened species, as listed under the *Threatened Species Conservation Act 1995* and *Environmental Protection and Biodiversity Conservation Act 1999*, are known to occur or are likely to occur in the vicinity of the Tallawarra Lands area. Potential impacts and the need for further assessment of these threatened species have been addressed in **Table 7-24** and **Table 7-25** below.

Table 7-24 Potential Impacts on threatened flora species

Scientific Name / Common Name	TSC	EPBC	Habitat	Likelihood of occurrence on project site	Further assessment required
Pterostylis gibbosa Illawarra Greenhood Orchid	E	E	Small terrestrial orchid occurring in Illawarra Lowlands Grassy Woodlands community on the Illawarra coastal plain on loam to clay loam soils derived from Berry Formation	Low likelihood of occurrence. Species not recorded during any of the previous studies despite targeted surveys (Burcher, 1997 and Mills, 1997) and no suitable habitat was recorded. The closest population of this species is known from Transgrid's Yallah substation, to the west of the site.	Not required. No potential impact on the species or its habitat
Cynanchum elegans White-flowered Wax Plant	E	E	This climber typically occurs in remnant stands of dry rainforest, usually on volcanic soils. Often recorded in ecotone between dry subtropical rainforest and sclerophyll/woodland communities (dry lowland grassy woodlands, tea tree scrub)	Low likelihood of occurrence. Species not recorded during any of the previous studies despite targeted surveys (Burcher, 1997 and Mills, 1997) and no suitable habitat was recorded. Nearest population of this species is known from Whytes Gully, about 5km north of the site.	Not required. No potential impact on the species or its habitat.
Zieria granulate Illawarra Zieria	E	E	This shrub occurs on dry, rocky ridgetops and outcrops with shallow volcanic soils. Often seen in variety of plant communities, including subtropical rainforest, lowland grassy woodland and tea tree/melaleuca scrub	Low likelihood of occurrence. Species not recorded during any of the previous studies despite targeted surveys (Burcher, 1997 and Mills, 1997) and no suitable habitat was recorded.	Not required. No potential impact on the species or its habitat
Pimelea spicata	E	-	This small inconspicuous shrub occurs in grassland and open woodland on clay soils usually on ridges and headlands. Needs to be in flower to be detected.	Low likelihood of occurrence. Species not recorded during any of the previous studies despite targeted surveys (Burcher, 1997 and Mills, 1997) and no suitable habitat was recorded.	Not required. No potential impact on the species or its habitat

Note: E – Endangered; V - Vulnerable

Table 7-25 Potential Impacts on threatened fauna species

Scientific Name / Common Name	TSC	EPBC	Habitat	Likelihood of occurrence on project site	Further assessment required
Mammals					
Pteropus poliocephalus Grey-headed Flying Fox	V	-	Forages on nectar and pollen in sclerophyll forests and on rainforest fruits and vines, orchards, gardens.	May occasionally forage over northern gully line and in grassy woodland and rainforest along northern ridgeline and slopes of Mount Brown and Mount Brown Reserve	Yes, although negligible foraging habitat would be impacted upon as a result of proposed works.
Scoteanax ruepellii Greater Broad-nosed Bat	V	-	Forages along well vegetated gullies and open flyways through forest. Roosts in tree hollows.	Recorded by Richards (1997) in Casuarina forest south of the main access road. May occasionally forage over gully lines as part of a much wider foraging range. Species is more likely to forage in extensive areas of escarpment forest in National Park estate to the west of the site.	Yes, although negligible foraging habitat would be impacted upon as a result of proposed works.
Saccolaimus flaviventris Yellow-bellied Sheathtail-bat	V	-	Forages high above tree canopy for insects and roosts in tree hollows.	Recorded by Richards (1997) in wet sclerophyll forest on the site. May occasionally forage over gully lines as part of a much wider foraging range. Species is more likely to forage in extensive areas of escarpment forest in National Park estate to the west of the site. No potential roost trees would be impacted upon as a result of the proposed works.	Yes, although negligible foraging habitat would be impacted upon as a result of proposed works.
Myotis macropus Southern Myotis	V	-	Roosts in caves and cave substitutes in southern parts of its range. Forages over waterbodies for insects and small fish.	May occasionally forage over gully lines as part of a wider regional foraging range. Richards (1997) captured 12 individuals during surveys conducted on the site in 1997 but failed to detect any site roosts.	Yes, although negligible foraging habitat would be impacted upon as a result of proposed works.
Miniopterus schreibersii Common Bent-wing Bat	V	-	Dry sclerophyll forest and woodland in valleys where it forages for insects above the tree canopy. Roosts in caves and cave substitutes although has been found roosting in trees on occasion	May occasionally forage over gully lines as part of a wider regional foraging range. Much more likely to forage in wet sclerophyll forest in Macquarie Pass National Park adjacent to the escarpment rather than in very patchily distributed vegetation on the subject site. One call of this species was recorded by Turton (1996).	Yes, although negligible foraging habitat would be impacted upon as a result of proposed works.
Aves					
Calyptorhynchus lathami Glossy Black-cockatoo	V		Open forest and woodlands of the coast and the Great Dividing Range in which stands of she-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. Dependent	She-oaks are present in the study area, and records occur for the locality, therefore it is likely that Glossy Black-cockatoo forages on occasion. The subject site and study area are generally void of large hollow-bearing trees suitable as nest hollows for this species, therefore no nesting habitat is considered to be available.	Yes, although negligible foraging habitat would be impacted upon as a result of proposed works.

Scientific Name / Common Name	TSC	EPBC	Habitat	Likelihood of occurrence on project site	Further assessment required
			on large hollow-bearing eucalypts for nest sites (DECC, 2005)		
Stictonetta naevosa Freckled Duck	V	-	Densely vegetated freshwater wetlands, mostly an inland species. A rare coastal visitor. Prefers Cumbungi dominated wetlands	Low likelihood of occurrence. Sections of the drainage line that bissects the main access road in between the two access gates supports Typha (Cumbungi) reedland, considered to be potential habitat for this species. The proposed power station in the vicinity of this area will not, however, impact upon this habitat. Species is much more likely to utilise large ash dams south of Duck Creek where it was regularly recorded in 1980s.	Not required. No potential impact on the species or its habitat
Botaurus poiciloptilus Australasian Bittern	V	-	Permanent freshwater wetlands dominated by sedges, reeds, rushes. Occurs in wet tussocky paddocks and in broad areas of dense reed beds on the edges of lagoons, swamps and slow flowing rivers.	Low likelihood of occurrence. Suitable habitat not recorded. Sections of the drainage line that bisects the main access road in between the two access gates supports Typha reedland, considered to be potential habitat for this species (albeit marginal, at best). The proposed Peaking Station in the vicinity of this area will not, however, impact upon this habitat. This species may utilise sections of Duck Creek on the site, although given the general absence of suitable habitat on the site for this species, would be expected to occur on an occasional or transitory basis, if at all. Recorded in several wetlands in the Lake Illawarra basin.	Not required. No potential impact on the species or its habitat
Ixobrychus flavicollis Black Bittern	V	-	Edges of permanent wetlands, rivers and creeks with dense fringing vegetation, often in tidal zones of watercourses, estuaries	Low likelihood of occurrence. Suitable habitat not recorded. A small sections of the drainage line that bisects the main access road in between the two access is fringed by a narrow band of Swamp Oak woodland, considered to be potential habitat for this species, although its small size and lack of connectivity to other suitable habitat on the site (Duck River) would likely preclude the use of this habitat by the species. The proposed Power Station in the vicinity of this area will not, however, impact upon this habitat. No records of the species exist on the site since the 1980s. Recorded occasionally in estuaries in the Lake Illawarra basin.	Yes, proposed Peaking Station in the vicinity of the Swamp Oak Forest has the potential to impact upon the habitat of this species, although such impact is considered to be negligible.
Pandion haliaetus	V	-	Coastal areas, lower reaches of rivers,	Low likelihood of occurrence.	Not required. No

Scientific Name / Common Name	TSC	EPBC	Habitat	Likelihood of occurrence on project site	Further assessment required
Osprey			estuaries. Nests in tall, dead trees	No suitable habitat recorded. No potential nest trees recorded during the present study	potential impact on the species or its habitat
Haematopus longirostris Pied Oystercatcher	V	-	Intertidal; mudflats, ocean beaches	Low likelihood of occurrence. No suitable habitat recorded.	Not required. No potential impact on the species or its habitat
Reptiles					
Litoria aurea Green and Golden Bell Frog	E	V	Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predator fish	Low likelihood of occurrence. Potentially suitable habitat recorded in Yallah Creek by Australian Museum, although a dedicated search for this species did not detect it. Sections of the drainage line that bisects the main access road in between the two access gates supports Typha reedland, considered to be potential habitat for this species. The proposed Power Station in the vicinity of this area will not, however, impact upon this habitat.	Yes, due to the potential habitat identified. No potential impact on the species or its habitat is predicted.

Note: E – Endangered; V - Vulnerable

7.7.1 Significance assessments

Threatened Species Conservation Act (TSC Act) assessment

Assessment steps have been identified by the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005). These guidelines apply specifically to projects being assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act), which negates the need for assessments of significance under Section 5A of the EP&A Act. The guidelines contain a series of questions which are used in identifying potential effects of the proposal on threatened species, populations or ecological communities, or their habitats:

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Bats

There is the potential for disturbance of TSC Act listed microbats and Grey-headed Flying-fox during construction phase which may temporarily make this area less appealing as foraging habitat. No roost sites are known for any of these species, therefore they are not predicted to be dependent on this marginal habitat for their survival. This level of disturbance is not expected to displace these species. No significant impacts on the lifecycle of these bats are predicted.

Birds

Due to the general lack of hollow-bearing trees in the area of the project site, roosting habitat is not available for Glossy Black-cockatoos.

There is the potential for disturbance of Glossy Black-cockatoo during the construction phase which may temporarily make this area less appealing as foraging habitat. No known roost sites are known for any of these species, therefore they are not predicted to be dependent on this marginal habitat for their survival. This level of disturbance is not expected to displace these species. No significant impacts on the lifecycle of this species are predicted.

Black Bittern has not been recorded in the locality for over a decade, and the potential habitat that has been identified for this species near the project site is small and isolated from larger tracts of suitable habitat in Duck Creek. If this species were to occur in the Swamp Oak Forest near the project area, pairs or individuals would be vulnerable to being preyed upon, particularly by cats, due to the limited areas of dense vegetation cover. The proposal is not likely to make this area less appealing as foraging or nesting habitat for this species. No significant impacts on the lifecycle of this species are predicted.

Frogs

An area of reed land near the project site was previously identified as potentially suitable habitat for Green and Golden Bell Frog (Australian Museum, 1997). This section of the intermittent drainage line is not connected, however, to any areas of the other potentially suitable creeks and wetlands on the Tallawarra Lands. Known populations of Green and Golden Bell Frogs occur in the Wollongong local government area (LGA), the nearest being at Coomonderry Swamp in Berry, which is 30 km away and isolated from the project site by existing development. The proposal is not likely to make this area less appealing as foraging or nesting habitat for this species. No significant impacts on the lifecycle of this species are predicted.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Although no forest is to be removed for the proposal, there is the potential for edge-effects from the proposed development to further impact on existing habitat. There is the potential for further weed invasion into the drainage-line through the movement of soil in the area and the movement of machinery from an area of weeds to the project site. This will be limited due to the presence of existing roads.

Due to the project site being downslope of Yallah Creek, it is unlikely for run-off to naturally make its way into the creek, although should any water or waste materials be discharged into the creek, this may impact on water quality and further degrade potential habitat for species such as Green and Golden Bell Frog.

The Swamp Oak Floodplain Forest endangered ecological community (EEC) has the potential to be impacted by such edge-effects, particularly through weed invasion, which is already threatening the fragmented remnants adjoining the project site. However, all works will be conducted to in a controlled manner, as specified in the construction management plans, and measures such as soil and water run-off controls will reduce the potential for such impacts.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

None of the threatened species known or expected to occur are at the known limit of their distribution on the site.

How is the proposal likely to affect current disturbance regimes?

Due to the uses of the site, a natural fire regime is not maintained in the forest and woodland areas, particularly in the location of the proposed Tallawarra Stage B OCGT power station, which will adjoin forest in Yallah Creek. Other disturbances such as flooding flows are not likely to be modified as the drainage line will remain unaltered.

How is the proposal likely to affect habitat connectivity?

A regional wildlife corridor has been identified from west of Mount Brown linking with Lake Illawarra, including much of the Tallawarra Lands and the project site. However, development already fragments this corridor. Due to the location of works being within an existing development footprint, no further isolation of habitat areas will occur as a result of the proposal.

How is the proposal likely to affect critical habitat?

No critical habitat has been identified by the TSC Act as occurring on the Tallawarra Lands or project site.

Environment Protection and Biodiversity Conservation Act (EBPC Act) assessment

A review of the matters listed as being of national environmental significance (NES) under the EPBC Act, has been conducted to assess the significance of impacts associated with the proposal. The results are shown in **Table 7-26**.

- **Table 7-26 EPBC Act assessment**

Matter of NES	Comments
National Threatened Species	The results of the search of the national threatened species database indicate that there are a number of nationally threatened species that could potentially occur in the wider area (10km radius). On the basis of the habitat types present in the study area two of these species could potentially occur near the Subject site, the Grey-headed Flying Fox (*Pteropus poliocephalus*) and Green and Golden Bell Frog (*Litoria aurea*). *P. poliocephalus* Potential foraging habitat occurs for this species is the general area. The proposal will not involve removal of tree or shrub species, providing potential food resources and will not impact on a roost camp of this species. The proposal is highly unlikely to cause a significant impact on this species. Further assessment is discussed below. *L.aurea* Potential habitat occurs in the small tributary of Yallah Creek and in the broader study area within Ash Dams and wetlands to the south of Duck Creek. The species was not detected during field surveys although as a precautionary basis, this species is considered to potentially recolonise these areas. Further assessment is provided below. The assessment considers whether the action is likely to have a significant impact on a threatened species if it is likely to:

Matter of NES	Comments
	1. *Lead to a long-term decrease in the size of an important population of a species.* The proposal would not involve removal of a significant area of habitat for these species and no individuals were recorded on site. Therefore the proposal is unlikely to lead to the long-term decrease in a population of these species. Appropriate measures for protection of habitat are detailed in the report.
	2. *Reduce the area of occupancy of an important population* Whilst a small area of disturbed vegetation would be removed for the proposal, this would not result in the loss of an area currently occupied by a nationally threatened species.
	3. *Fragment an existing important population into two or more populations* There is no evidence to suggest that the project site supports an important population of either of these species.
	4. *Adversely affect habitat critical to the survival of a species* There is a register of critical habitat in the EPBC Act and only three locations are listed, none of which relate to the project area.
	5. *Disrupt the breeding cycle of an important population* It is not considered that there would be any significant impacts on the breeding/ reproductive cycle of populations of these species.
	6. Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline The proposal would not involve significant declines in the habitat of these species. Measures designed to protect potential habitat during construction have been proposed.
	7. *Result in invasive species that are harmful to a vulnerable species becoming established in the threatened species habitat* As the proposal involves only minimal vegetation removal, the surrounding areas are not expected to be threatened by weed invasion, provided that appropriate mitigation measures are implemented.
	8. Interferes substantially with the recovery of the species Currently there are no species recovery plans produced for these species. It is considered that the proposed safeguards outlined in **Chapter 9** would ensure that the populations are protected.
	The proposal is not likely to result in any impacts on nationally threatened species and no further provisions of this Act apply to the proposal in relation to threatened species.
National Endangered Ecological Communities	No known nationally endangered ecological communities occur in the study area.
Ramsar wetlands	No Ramsar Wetlands have been listed in the locality.
Nuclear Actions	The proposal is not a nuclear action.
Commonwealth Marine Areas	The proposed works would not affect the marine environment in any way.
World Heritage Areas	This proposal does not adjoin a World Heritage area

Matter of NES	Comments
Migratory Species	The habitats present within the immediate disturbance area are not considered significant for migratory species, although suitable habitat is located on the broader Tallawarra Lands site in the form of former ash dam wetlands, SEPP 14 wetlands and Duck Creek. Construction of the proposed Tallawarra Stage B power station will include an extension of the Tallawarra A segregated drainage system. The system will ensure all waste water is captured for reuse or treatment prior to discharge. Segregated drains will direct all waste water through oil and grit traps, designed to remove any oil and minimise suspended solids. Any oil which is collected will be reclaimed while the solids will be disposed of off-site. As with Tallawarra A, excess water will be transferred to a constructed wetland system, including two large settling basins, prior to discharge to Lake Illawarra. The SEPP 14 wetlands are not part of this treatment system. The small increase in surface area attributed to Tallawarra B is not considered likely to affect the quality of the constructed wetland system or visitation rates and behaviours of migratory species in the locality.

No significant impacts on matters listed as triggers to the EPBC Act assessment process have been identified. No referral to the Commonwealth Minister for Environment is deemed to be required.

Fisheries Management Act (FM Act) assessment

This section addresses information required to satisfy an assessment of potential impacts under the *Fisheries Management Act 1994* (FM Act), the Fish Habitat Protection Plan No.1 and the document *Policy and Guidelines – Aquatic Habitat Management and Fish Conservation* (NSW Fisheries, 1998).

Based on the documented distribution of NSW freshwater fish species and on the documented habitat type, it is considered unlikely that any threatened fish species would occur. Considering that the type of development proposed will not impede nor impact on the known or potential habitat of a threatened species as listed in the FM Act, no assessment of impact (under Section 5A of the EP&A Act) is required under Schedules 4 and 5 of the Act. Further, the study area does not contain ‘critical habitat’ as listed in the FM Act.

Schedule 6 of the FM Act, relates to key threatening processes and lists three of these, being:

- The introduction of fish to fresh waters within a river catchment outside their natural range;
- The removal of large woody debris; and
- The degradation of native riparian vegetation along NSW watercourses.

The proposal would not affect any threatened species or key threatening processes as scheduled in the FM Act. Provided the works are carried out with appropriate sediment and erosion control devices, construction and operation of the proposal is not expected to have an impact on fish habitat.

7.7.2 Summary

The proposed Tallawarra Stage B OCGT power station is situated within the footprint of the decommissioned coal-fired power station and therefore the site has been previously disturbed. For this reason it is not expected that any threatened species or endangered ecological communities which are known to occur on the site will be further impacted upon by the proposal.

7.7.3 Mitigation measures

The following mitigation measures have been developed to minimise the likelihood of impacts on terrestrial, aquatic and riparian habitats:

- The proposed disturbance footprint will be clearly defined on-ground, using temporary fencing, to avoid unnecessary vegetation and habitat removal.
- Appropriate weed management strategies will be implemented during construction to ensure they are not spread throughout the study area.
- Sediment and erosion controls will be adopted to minimise the impact on water quality. Appropriate measures to store and manage fuels and oils on the project site will be adopted and spill containment equipment will be available on site at all times to prevent and contain accidental spills near local waterways.
- Monitoring of the revegetated areas will be undertaken to ensure they are functioning as designed.

7.8 Aboriginal heritage

7.8.1 Assessment of impacts

The proposed Tallawarra Stage B OCGT power station would not impact directly upon Aboriginal sites/items of archaeological significance. The power station would be located where the coal fired power plant was formerly. None of the items on the Australian Heritage Information Management System (AHIMS) is within the area of proposed works, and due to the previous disturbance of the area, it is unlikely unrecorded items exist in the area.

There are areas of high Aboriginal significance in close proximity to the site, associated with Yallah Creek and the foreshore of Lake Illawarra. These areas would be reserved as cultural landscapes.

The proposed transmission lines would cross Yallah Creek, and would therefore be in close proximity to the four recorded AHIMS sites, particularly Yallah Gully 2. However, due to the location of the transmission lines, no direct impacts on any recorded Aboriginal heritage sites are expected. In addition, the transmission line poles would be located to avoid impacts on and disturbance of Aboriginal heritage sites.

7.8.2 Mitigation and management

As the area has been subject to previous heritage assessments, no further archaeological survey of the site is necessary. The following mitigation measures would be implemented to ensure that significant Aboriginal items or sites are not destroyed or disturbed.

- Location of existing Aboriginal sites close to the proposed works should be noted. A suitable buffer would be physically marked and construction personnel made aware of their obligations under the *National Parks and Wildlife Act 1974*;
- All construction personnel would be inducted on the potential to find previously unrecorded Aboriginal items;
- If an item (or suspected item) of Aboriginal heritage is discovered during works, all work would cease if it is likely to affect the object(s). DECC would be informed and further investigation would be undertaken by an archaeologist before recommencement of work; and
- Consultation with local Aboriginal community groups to ensure input into any further management measures required for the sites.

7.8.3 Summary

Due to the past land use impacts directly associated with the power station area, it is considered that the proposed site contains little potential for the discovery of surface or sub-surface archaeological material. With the implementation of mitigation measures, there are no known Aboriginal heritage constraints which would prevent the establishment of the power station.

On the basis of implementing these mitigation measures, impacts on Aboriginal heritage would be regarded as low or negligible.

7.9 Visual

This section provides an assessment of the potential visual impacts of the Tallawarra Stage B OCGT power station. It describes the methodology used to consider the existing and the proposed visual environment and the potential visual impacts to provide an assessment of the significance of impacts to sensitive receptors in the area.

7.9.1 Methodology

The visual assessment included an analysis of existing maps, photographs, survey and contour data, followed by a viewshed analysis using a Geographic Information System (GIS). The GIS output included a map of the potential locations, based on the existing topography, from which the proposed facility could be viewed. This did not take into consideration the screening effect of existing vegetation; as such it produced a worst case assessment for visual intrusion. A site visit was also conducted to review the design of the plant, existing sensitive receivers, screening and to determine the locations from which the proposed facility could be viewed.

The purpose of the visual assessment was to establish the visual impact of the proposed Tallawarra Stage B OCGT power station by considering the visual modification and visual sensitivity of the surrounding areas.

7.9.2 Visual modification

The degree of visual modification resulting from the proposed development is the level of visual contrast between the new facility and the existing visual setting in which it is to be located. The different levels of visual modification are described in **Table 7-27**. The degree of visual modification generally decreases as the distance between the proposed development and the viewer increases.

- **Table 7-27 Levels of visual modification**

Level of visual modification	Description
High	The proposed development is a major element that contrasts strongly with the existing environment. There is little or no natural screening or integration with the existing environment.
Medium	The proposed development is visible and contrasts with the surrounding environment, but is integrated to some degree. Surrounding vegetation/topography provides some visual screening.
Low	The proposed development may be noticeable but does not markedly contrast with the existing environment. There is a high level of integration in terms of form, shape, colour and texture.

7.9.3 Visual sensitivity

Visual sensitivity is a measure of how critically a change to the existing landscape would be viewed from various areas. The visual sensitivity depends on a range of characteristics such as land use, the number of viewers, the viewing time and the distance between the proposed development and the viewer. These characteristics were considered when developing the different levels of visual sensitivity from land uses surrounding the proposed Tallawarra Stage B OCGT power station. The levels of visual sensitivity are shown in **Table 7-28**.

▪ **Table 7-28 Levels of visual sensitivity**

Land use	Foreground		Middleground		Background
	0-0.5km	0.5-1km	1-1.5km	1.5-2km	>2km
Residential	H	H	M	M	L
Recreation	H	M	M	L	L
Local roads	H	M	L	L	L
Major Roads	L	L	L	L	L

H = high, M = medium, L = low

Typically residential areas are more sensitive to changes in the visual environment than roads or recreation areas. This is primarily due to the different lifestyle contexts associated with the land uses and the duration of exposure. As a result, residential areas have been rated quite highly in terms of their visual sensitivity. The local roads have been given a relatively high visual sensitivity rating due to the number of people that could view the development whilst travelling on these roads. The main roads, Princes Highway and Southern Freeway have been rated low due to the small extent of structures visible and the short duration of view from the roads due to the high speed of travel. The recreation areas have been rated high as users of the foreshore and Lake Illawarra for water based activities would be able gain views of the plant.

7.9.4 Visual impact

The visual impact of the proposed development is determined by considering both the degree of visual modification and the visual sensitivity. A matrix has been developed to identify the level of impact for each combination of visual modification and visual sensitivity (as shown in **Table 7-29**).

▪ **Table 7-29 Visual impacts matrix**

		Modification		
		High	Medium	Low
Sensitivity	High	H	H	M
	Medium	H	M	L
	Low	M	L	L

H = high, M = medium, L = low

Visual management units

The site of the proposed Tallawarra Stage B OCGT plant would be located in what can be defined as a single distinct visual management unit (VMU). The VMU reflect areas where the landform, vegetation and land use are relatively consistent throughout the unit. The VMU for the Tallawarra Stage B OCGT plant is the old Tallawarra coal fired power station footprint adjacent to the approved Tallawarra Stage A CCGT power station.

Visual absorptive capacity

The visual absorptive capacity (VAC) of an environment is the measure of the relative ability of the landscape to absorb visual modification. A landscape with a high VAC is able to incorporate more visual modification without significant impact to the viewer than one with a low VAC. The degree of absorptive capability is influenced by topography and vegetation. In general, there are more opportunities to minimise the visual impact of a development in varied and undulating landscapes than areas of flat terrain.

In areas where the topography does not conceal the development from the surrounding areas, vegetation can be used to screen the development from sensitive viewpoints. The height, density, colour and seasonal change of the vegetation can all affect the VAC of the environment to conceal the development. In general, smaller trees with low canopies can be used effectively on gentle slopes or flat areas to screen developments, and taller trees with high canopies are more effective on steeper slopes. The VAC of the natural environment to absorb the Tallawarra Stage B OCGT plant would be moderate, given the undulating topography and the fact that the site currently supports industrial looking buildings associated with the previous coal-fired power station. Intervening vegetation on the northern and eastern boundaries of the site also increases the VAC.

7.9.5 Visual impact assessment

Visual characteristics of the project

The proposed works would involve the installation of the Tallawarra Stage B OCGT plant adjacent to the Tallawarra Stage A CCGT plant (**Plate 1**), and would be located on the edge of Lake Illawarra. The new structures to be installed on site that will have an impact on the visual environment include the gas turbine generators and ancillary plant, high voltage switchyard, gas receiving station, diesel tanks and unloading station, emergency diesel generator and two above ground diesel storage tanks. The proposed exhaust stacks would be approximately 40 metres in height and 7 metres in diameter and would be approximately 15 metres taller than the proposed turbine building. In addition to these new structures, the power station would utilise existing infrastructure which are currently visible including overhead power lines and concrete canals adjacent to the lake as well as the control room, administration, amenities and workshop buildings and the wastewater treatment system. **Plate 1** shows the location of the proposed Tallawarra Stage B OCGT power station area.

Plate 1 – The site showing location of the proposed Tallawarra Stage B OCGT plant and Tallawarra Stage A CCGT plant which is under construction

Visual modification

There would be a moderate level of visual modification as a result of the proposal. Views of the Tallawarra Stage B OCGT plant would be obscured by the Tallawarra Stage A CCGT plant from the south. The proposed Tallawarra Stage B plant would be consistent with the nature of the site as it is located immediately adjacent to the Tallawarra Stage A CCGT plant, and is within the footprint of the former coal fired power station. There would be some opportunities for placing temporary and permanent screening of some structures.

Visual sensitivity

Planned residences associated with the Tallawarra Lands project to the north of the site, to be constructed on the slopes of Mount Brown, would be slightly elevated above the power station site. As such they would have direct views down to the proposed power plant, in particular the upper portion of buildings and exhaust stacks which will be about 25 and 40 metres above ground level respectively.

Future industrial development within the Tallawarra Lands project, which would have views of sight, would be less sensitive to the industrial view provided by the proposed plant.

There would be middle-ground views of the site from the Tallawarra Lands recreational land located to the south of the site. The Tallawarra Stage A CCGT power plant would provide significant screening and vegetation would be planted along the southern boundary.

Properties along the Lake Illawarra shoreline would have distant background views of the plant. The notable features visible would be the exhaust stacks against the backdrop of Mount Brown. However, the vegetation surrounding the proposed plant would provide significant screening. The embankment would be built up and additional vegetation would be planted on top of the mound.

7.9.6 Visual impact

A viewshed analysis was conducted to determine the locations from which the proposed power station may be visible (**Figure 7-18**). The model assumes no existing vegetation coverage or screening from other objects and structures and has been modelled on a maximum height of 40 metres, which would be associated with the stacks. Hence the zone of influence is a 'worst case' and the power station may not actually be visible from all locations shown. As can be seen in **Figure 7-18**, Mount Brown would screen views of the proposed power station from the existing residential areas to the north of the site.

The extent of visual impacts can be more easily identified from the visual simulation provided in **Figure 7-19** which shows the view from the north and the photomontage in **Figure 7-20**, which shows the view from the east on Lake Illawarra.

Figure 7-19 shows that the Tallawarra Stage B power station would be visible to users of the recreation areas to the east and to a lesser extent to the north east of the site and to residences along Mount Warrigal on the eastern shores of Lake Illawarra. However, the Tallawarra Stage B OCGT plant is to be constructed in a consistent style to the Tallawarra Stage A CCGT plant, a much larger structure, which will shield it from views from the south. In addition it is considered that the extensive screening afforded by vegetation around the site would result in only minor visual impacts for residences and recreational users in the area. As the views are unlikely to be significantly different from that which would exist with the Tallawarra Stage A CCGT power station, the impacts on visual amenity are considered to be low to moderate. Increasing the density of vegetation planting along the boundaries would provide some screening to minimise impacts further still.

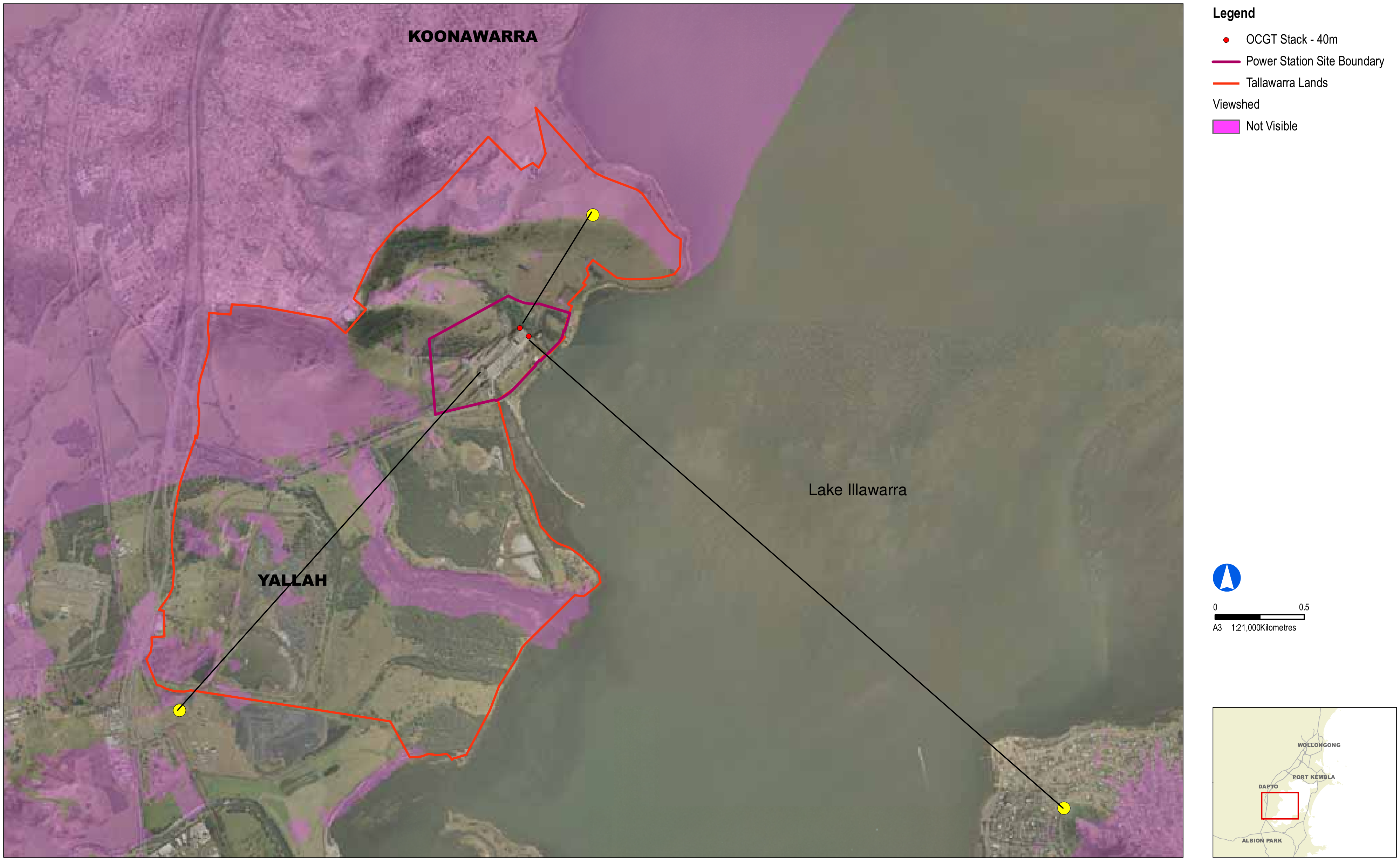


Figure 7-18: Viewshed generated from OCGT Stack (40m high)

EN02239 - Tallawarra Power Station

Version 1

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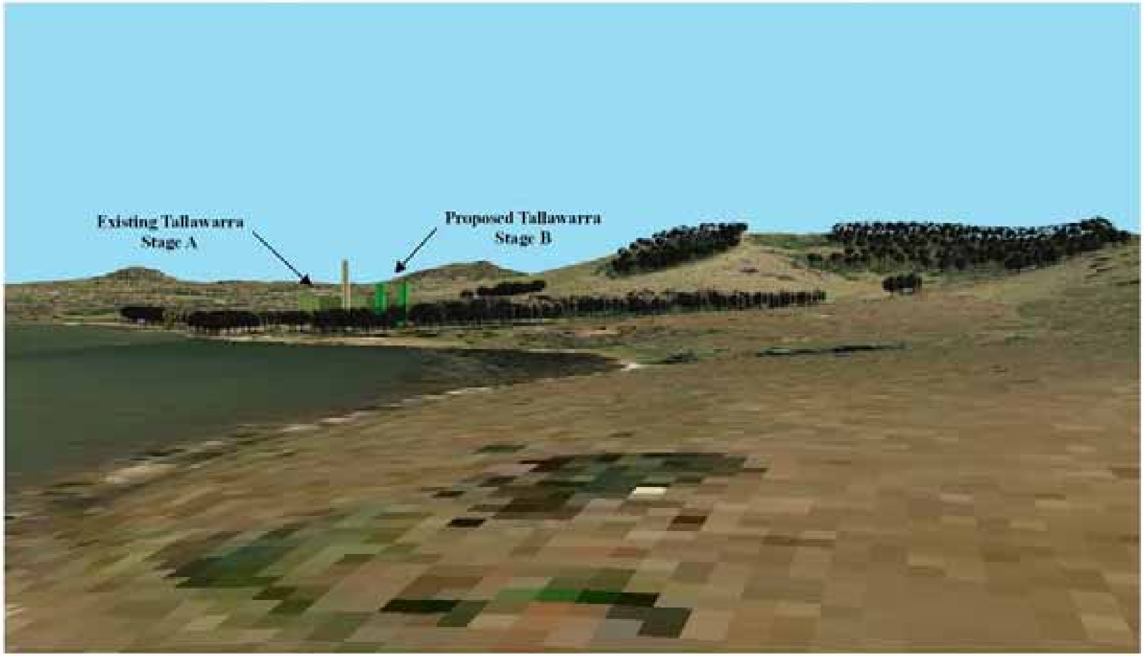
- **Figure 7-19 3D visual simulation – looking south**



7.9.7 Mitigation measures

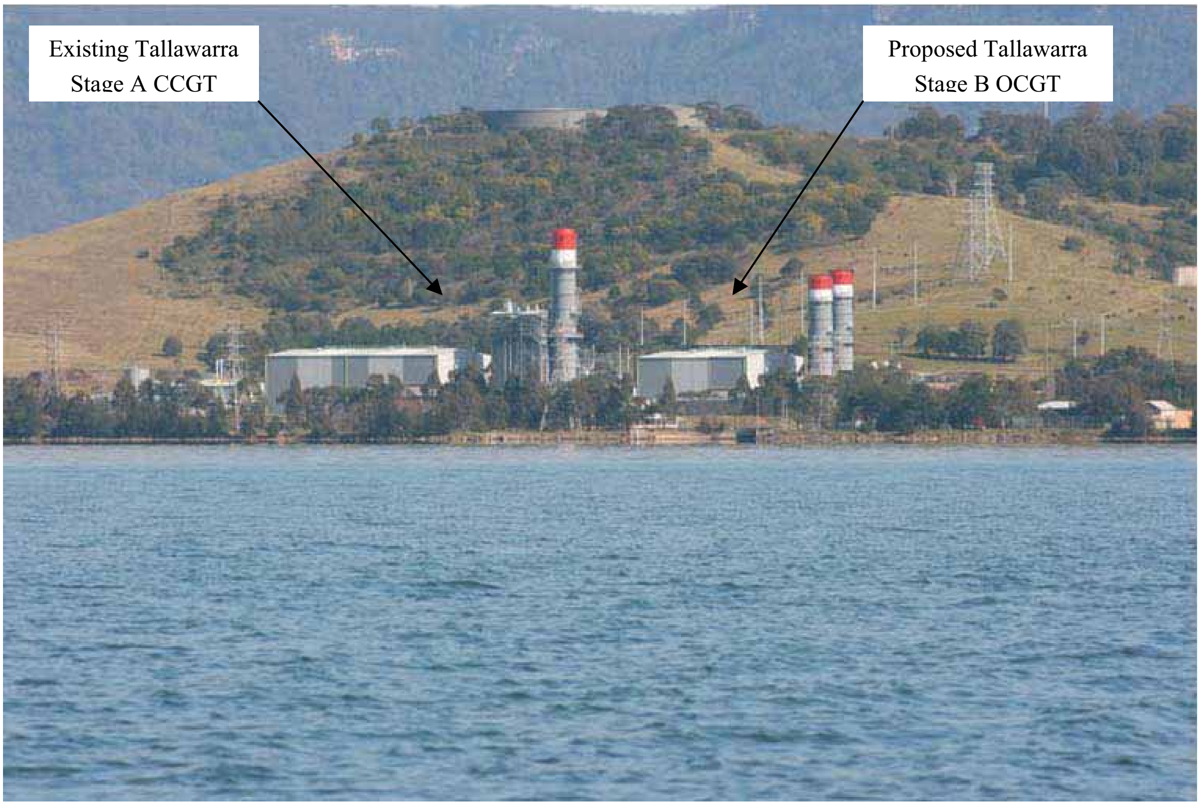
Location

The Tallawarra Stage A plant was sited on the former coal fired site as the area has been highly disturbed. The Tallawarra Stage B power station site was chosen as it is located directly adjacent to the Tallawarra Stage A CCGT power station, allowing the utilisation of existing infrastructure including electricity transmission and gas pipelines. By utilising components of the Tallawarra Stage A power station, new infrastructure is not required at a separate location for the Stage B plant. Although this co-location would concentrate the visual impacts associated with the ancillary infrastructure, it would also minimise the extent of visual impacts.

Design

The plant would be designed to ensure it is consistent with the adjacent Tallawarra A power station, to minimise intrusion impacts to local residences. The design and colour scheme chosen for the built components would be selected to ensure they do not stand out within the natural settings.

- **Figure 7-20 Photomontage of the proposed Tallawarra Stage B OCGT Power Station looking west**



Landscaping

A Landscape Management Plan has been prepared for the site as part of the existing Tallawarra A operations. This plan will be amended to include the proposed Tallawarra B power station. The plan includes measures to minimise the impacts on visual amenity through landscape planting and bunding at key locations around the site. The exhaust stack could potentially be visible from some distance, as it is elevated above adjacent structures.

7.9.8 Summary

The visual impact of the proposed Tallawarra Stage B OCGT plant would be moderate for residents to the north associated with the new Tallawarra Lands project. The residential dwellings would be slightly elevated above the power station as they climb the ridges of Mount Brown and would have direct views down to the power plant.

The views of the exhaust stack, the most visible component of the proposed plant, would not be significantly different from the power plant facilities adjacent to the site. The exhaust stack would protrude approximately 15 metres above the power station building. However the power station would be similar in style to Tallawarra Stage A CCGT power station, and would be located in an area which is subject to existing industrial land uses. The exhaust stack would be visible from surrounding areas associated with recreational land to the south and residential land to the north and on the eastern foreshore of Lake Illawarra.

Increasing the density of existing vegetation along all boundaries of the power station would reduce views of the plant. The embankment to the east of the site would be built up to further screen the power station from residences along the foreshore, with additional vegetation planted on top.

On the basis of implementing these mitigation measures, residual visual impacts would be regarded as low.

7.10 Traffic and transport

7.10.1 Assessment of impacts and mitigation measures

Construction traffic

The number of workers required to carry out the construction of the Tallawarra Stage B plant is significantly fewer than that associated with the Tallawarra Stage A plant. It is estimated that 200 workers will be required during the peak period of construction. Assuming 1.25 persons per vehicle, this equates to a total of 320 vehicle trips per day (including 160 inbound and 160 outbound trips). This is substantially lower than the number of trips to the site experienced during the construction of the Tallawarra Stage A plant. In addition, a small number of heavy vehicle trips will be required for the delivery of materials. Construction will take place on weekdays between 7am and 6pm and on Saturdays between 7am and 1pm. No construction will occur on Sundays and public holidays.

During construction of the Tallawarra Stage B plant, the Tallawarra Stage A plant will be fully operational. Hence, the operational traffic from the Tallawarra Stage A power station must be taken into account when determining traffic volumes during the construction of the Tallawarra Stage B power station. The additional 136 light vehicle trips per day (including 68 inbound and 68 outbound) and 11 heavy vehicle trips will result in a total of approximately 470 vehicle trips per day (including 235 inbound and 235 outbound).

The hardware and materials for construction will be hauled to site by truck. RTA approval will be required to haul oversized loads, namely the turbines which will need to be transported from Port Kembla.

Construction workers will utilise the temporary car park used by Stage A workers. Hence, access will be via the southern access and service road. This should minimise interactions between construction vehicles and other vehicles in the vicinity of the main entrance (mainly employee and visitor traffic).

Operational traffic

The additional staff required to operate the Tallawarra Stage B plant will be minimal. The majority of operations will be undertaken by the staff already employed to operate the Tallawarra Stage A plant. It is expected that an additional one or two staff members may be required. This would result in an additional 2 employee vehicles, and a small number of delivery, maintenance and waste removal trucks.

As there is minimal increase in operational traffic volumes as a result of the Tallawarra Stage B power station, the impact of the proposed Tallawarra Stage B plant on the surrounding road network would be negligible.

Site access

Vehicles will continue to gain access to the site via the Southern Freeway / Princes Highway and Yallah Bay Road, and enter the site via the southern access and service road. The continued use of this route and access by construction traffic is considered acceptable.

The F6 (Southern) Freeway currently terminates immediately after Yallah Bay Road. The RTA has plans to extend the F6 freeway to the south, with the potential for a full interchange to be provided at Tallawarra. This interchange would consist of a large roundabout on either side of the freeway. Construction of this freeway would greatly improve access to the power station.

Mitigation measures and safeguards implemented for the construction of the Tallawarra Stage A plant should be reinstated for the construction of the Tallawarra Stage B power station. In particular, warning signs for the general public and employees should be retained/replaced, and regular inspections of Yallah Bay Road’s surface condition should continue to be carried out. This will help to ensure the safety of employees and the public using Yallah Bay Road.

7.10.2 Summary

During construction, new traffic movements would be generated by construction workers and material deliveries to and from the project construction sites. The construction traffic impacts of the Tallawarra Stage B power station are expected to be less significant than those associated with the Tallawarra Stage A plant, with the number of vehicle trips per day predicted to decrease from 800 vehicle trips to 320 (including both inbound and outbound) vehicle trips per day. Construction vehicles will utilise the same route and parking areas as used for the construction of the Tallawarra Stage A plant. Access to the site will be via Yallah Bay Road (the existing Tallawarra Stage A CCGT power station access road) off the Princes Highway, south of Dapto. The existing road network is considered sufficient to accommodate the increased traffic movements from the proposed development.

The operational traffic impacts of the Tallawarra Stage B power station are expected to be minimal and in the order of an additional one or two vehicles per day.

Safeguards and mitigation measures implemented for the construction of the Tallawarra Stage A plant will be reinstated to ensure that the same level of public and employee safety is maintained. Consultation would be undertaken before construction with the appropriate roads authority regarding the works that may affect roads or traffic. A Traffic Management Plan (TMP) would also be developed as part of the Construction Environmental Management Plan (CEMP).

The impacts on road traffic are considered to be minimal, short-term and localised and therefore traffic is not considered to be a key issue.

7.11 Waste

The development of the Tallawarra Stage B OCGT power station has the potential to generate moderate quantities of liquid and non-liquid wastes. The key waste streams identified include:

- Demolition waste (building and structural materials);
- Construction waste (timber formwork, masonry, scrap metal, pallets, packaging material, plastics and cardboard);
- General waste from operation of the facility (waste water, packaging materials and office wastes).

Detail on each of these waste streams is provided below.

7.11.1 Statutory framework for waste management

The main legislation and guidelines that govern the management of waste for the proposal are:

- *Waste Avoidance and Resource Recovery Act*, 2001;
- *Protection of the Environment Operations Act*, 1997;
- *Protection of the Environment Operations (Waste) Regulation*, 2005; and
- Wollongong City Council Development Control Plan (DCP) – Management of All Wastes Associated with Building Sites - Technical Policy, 1999.

The principles of waste avoidance, waste reduction, waste re-use or waste recycling would be adopted during the construction and operation phases of the project, in accordance with the relevant legislation and policies that provide the statutory framework for waste management in NSW.

7.11.2 Potential wastes generated from the project

The two distinct construction and operational phases of the proposal would generate different amounts and types of wastes according to the activity undertaken. A summary of the expected waste streams generated from either phase is outlined below.

Green waste

It is also expected that during the earthworks a small amount of green waste would be generated from the removal of vegetation mostly comprising weeds.

Construction and demolition waste

Building wastes include such items as timber, masonry, scrap metal, packaging materials and plastics would be generated during construction. Excess spoil volumes generated by the proposal are expected to be in the order of 18,000m^3. The spoil would contain scrap metal and other refuse materials that would be unsuitable for construction purposes. It is proposed to sort this material for re-use with the excess to be transported off-site for disposal. In addition, a small quantity of waste (sewage and domestic rubbish) would be generated from the construction compound.

Demolition waste includes concrete, asphalt, bricks and scrap metal of the existing power station building. Any concrete, asphalt or masonry would undergo processing (crushing) offsite and be recycled. A small volume or concrete may be crushed on-site for re-use. Scrap metal would be recycled.

Operational waste

Waste generated from the operation of the Tallawarra Stage A OCGT power station would be associated with the power station servicing and repairs, and ancillary office uses. These activities are likely to result in the following wastes generated:

- Wastes sewage and other waste water;
- Metals associated with power station repair activities;
- Used oils, rags, packaging, oil drums and discarded components associated with on-site equipment and plant maintenance;
- Clean up materials used in accordance with emergency response procedures for accidental spillages; and
- Paper and associated stationery waste associated with office activity.

7.11.3 Waste management

A Waste Management Plan (WMP) would be developed for the construction phase of the proposal for incorporation in the Construction Environmental Management Plan (CEMP). The plan would be prepared in accordance with *Waste Avoidance and Resource Recovery Act,* 2001*, Protection of the Environment Operations Act, 1997* and *Environmental Guidelines: Assessment, Classification and Management of Non-Liquid and Liquid Waste* (EPA, 1999).

The WMP would detail any procedures for the management of construction wastes from the site. In addition, the plan would contain an inventory of all waste types anticipated and the preferred options for re-use, recycling or disposal, and would seek to ensure that all waste generated and its fate is recorded such that waste minimisation can be achieved.

Waste management would be a component of the Operational EMP for the operational phase of the facility. It would ensure that initiatives for the sustainable management of waste are given consideration.

7.11.4 Mitigation measures

Construction and demolition materials

- Ensure the correct quantities are ordered and delivered to the site;
- Investigate the use of recycled materials, including concrete and other construction materials;
- Existing concrete pavement material would be collected and transported to crushing and recycling plants. Some material could be crushed on-site if practicable for re-use;
- Re-use asphalt by transferring to batching plants or use as a base course layer for access roads;
- Collect and transport scrap metal to a recycling facility or reuse where suitable;
- Wastes would be securely stored in appropriate receptacles or contained areas while on-site to ensure no off-site impacts;
- Materials unsuitable for re-use would be taken off-site and disposed of at appropriately licensed management waste management or recycling facilities. Wastes would be tested and classified before disposal, in accordance with requirements of the licensed waste disposal facility.

Excavated soil

- Clean excavated fill material would be used as construction fill where suitable; and
- Excavated material not suitable for re-use as fill would be re-used for landscaping where practicable.

Hazardous materials

- Contaminated material from fuel or oil spills would be collected and disposed of in accordance relevant NSW legislation; and
- Empty oil and fuel drums to be collected in suitably designated areas and removed by a licensed waste contractor.

Green waste

- Native vegetation cleared during construction would be chipped and re-used as mulched material for revegetation;
- All noxious weeds and exotic plant species removed would be bagged and disposed of at a licensed landfill facility; and

- Vegetation not re-used on site and green waste from landscape maintenance would be transferred to a green waste facility.

Paper and packaging

- Strategies would be adopted to encourage reduction and recycling for plastics, paper and packaging products.

Sewage

- Sewage from amenities would be directed, as per current operations, to an existing on-site package sewage treatment plant to ensure that there is zero discharge from the site.

Domestic waste

- Recycling facilities would be provided to encourage the separation and recycling of all paper, aluminium, glass, and plastic products used during construction and operation of the site; and
- All domestic waste would be collected regularly and disposed of at licensed facilities as appropriate.

7.11.5 Summary

Waste management arrangements would be put in place during the construction phase of the site to maximise the reduction, recycling, and re-use of waste materials. This would be achieved through the implementation of a Waste Management Plan (WMP) during construction. The WMP would be developed and implemented in accordance with the requirements of relevant waste management legislation and policies and incorporated into the CEMP for the site. Waste management requirements for the operational phase would be incorporated into the Operational EMP for the site. The implementation of the waste management requirements during construction and operation will ensure there would be low residual risk to the environment from waste management practices.