8. Combined 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 a Combined Cycle Gas Turbine (CCGT) power station. The key environmental issues are air quality, plume rise assessment, greenhouse gas generation, noise, water quality and aquatic ecology and hazard and risk, and these are addressed in Sections 8.1 to 8.6 respectively. Other issues relating to terrestrial ecology, Aboriginal heritage, visual and landscape, traffic and transport and waste are addressed in Section 8.7 to 8.11 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.

8.1 Air quality

A comprehensive air quality assessment has been undertaken to assess the impacts of the proposed Tallawarra Stage B CCGT operating in combination with the Tallawarra Stage A power station. The study assesses the cumulative air quality impacts of the full generation capacity of the Stage A and Stage B power plants operating at rated capacity, 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.

8.1.1 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 8-1**.

Table 8-1 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 ppm
	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 ppm

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 8-2**.

Table 8-2 Ambient Air Quality Objectives

Pollutant	Averaging Period	Maximum Concentration		Source
		ppm	$\mu g/m^3$	
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

8.1.2 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 8-2**). 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**.**

Further detail relating to specific offset 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 assessment clearly demonstrates that no offsets are required in terms of local and regional air quality management as relevant to the project.

8.1.3 Assessment methodology

Modelling has been undertaken to assess the potential impact of the Tallawarra Stage B power station. The assessment methodology for 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 (refer to **Appendix A**). The assessment utilises The Air Pollution Model (TAPM), developed by CSIRO Atmospheric Research. 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. 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 analysis.

The stack characteristics are described below:

- **Tallawarra Stack A** (CCGT), location MGA Zone 56 [298,826 (mE), 6,177,714 (mN)], stack height 60 metres, radius 2.75 metres.
- **Tallawarra Stack B** (CCGT), locations [298,884 (mE), 6,177,784 (mN)] and [298,892 (mE), 6,177,777 mN], stack height 60 metres, radius 2.75 metres.

The air quality impacts of the Tallawarra Stage A and Stage B power stations were modelled for options, which considered operations under full load conditions as well start-up load operations. These options were:

- **Cold Start** – this start occurs when the plant is first started or after an indefinite period of shut-down, where the heat recovery steam 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 NO_X emission concentration may be above 25.

Table 8-3 and **Table 8-4** summarise the parameters of the respective emission options. The emissions parameters for Tallawarra Stage A presented in **Table 8-3** 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. Where Tallawarra Stage A and Stage B CCGT plants operate together, operational scenarios as outlined in **Table 8-4** have been assessed. The three scenarios cover a range of expected worst-case operations in terms of air quality impacts. It is noted that the scenario of Tallawarra A cold start combined with Tallawarra B cold start has not been included in this assessment. The modelling at NO_X = 25 ppmv suggests it is possible for this scenario to exceed the DECC criteria. To avoid the potential for this to occur TRUenergy will not cold start both the Tallawarra A and B plants simultaneously, until such time that it is demonstrated by modelling that actual NO_X emissions and impacts for this scenario will not exceed DECC criteria.

- **Table 8-3 - 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 8-4 - Tallawarra A and B (CCGT) Emission Scenarios

Modelling Scenario	Stack	Velocity (m/s)	Temp (°C)	NO_2 Emission Conc. ppm	Emission Rate NO_X per unit g/s
Case 1: Full Load Stacks A &B	A	26	78	25	29.4
	B	26	78	25	29.4
Case 2: Stack A Full Load Stack B Cold Start Hour 1	A	26	78	25	29.4
	B	12.4	40	92	48.3
Case 3: Stack A Full Load Stack B Warm Start Hour 1	A	26	78	25	29.4
	B	12.4	70	87	41.7
Case 4: Stack A Warm Start Hour 1 Stack B Cold Start Hour 1	A	12.4	70	87	41.7
	B	12.4	40	92	48.3

Note: Hot start is equivalent to full load in terms of NOx emissions.

The raw data modelling results for NO_X concentrations were analysed using the Ozone Limiting Method (OLM) which is among the approved methods recommended by NSW DECC (2005). The method assumes that the amount of NO that is converted to NO_2 is limited by the ambient ozone concentration. As NO_X emissions disperse from the stacks, all NO eventually is oxidised to NO_2 and higher oxides of nitrogen. The rate at which this occurs depends on prevailing atmospheric conditions including temperature and the presence of other pollutants such as ozone. Results of the analysis are discussed below.

8.1.4 Local air quality impact assessment

Air pollution modelling using TAPM (Hurley, 2002) predicted the impacts on ground level concentrations of NO_X, SO_2 and particulate matter (as PM_{10}). TAPM predictions identified NO_X as the air pollutant causing the highest affect relative to the NSW DECC criteria for air quality impact assessment. The impacts on concentrations of SO_2 and PM_{10} are very low compared with the NSW DECC criteria. The results of the OLM analysis of the raw NO_X data show that the impacts across the study area meet the DECC criteria for the NO_2 1-hour average concentration (246 $\mu g/m^3$) and the annual average concentration (62 $\mu g/m^3$) for all hours during full load operations and the first hour of cold and warm start-up operations.

Table 8-5, **Table 8-6**, **Table 8-7** and **Figure 8-1** present the summary results of modelling Tallawarra Stage A plant in combination with Tallawarra Stage B plant. **Figure 8-2** to **Figure 8-9** show contour plots of the incremental hourly-averaged NO_2 ground level concentrations (glc) across the modelling domain for the range of full load and start load emissions scenarios. It is emphasised that the concentrations in these plots, represent the raw model outputs, which assume that the composition of the NO_X ground level concentrations at each point is 100% NO_2. The OLM analysis assumes, more realistically, that the NO_2 concentration arriving at each point is proportional to the background ozone concentration and is likely to be less than 100% of the NO_X concentration at each point.

■ Table 8-5 Highest Predicted NO_2 1-Hour Average Impacts and Contemporaneous Background Concentration (µg/m^3) Tallawarra A CCGT (Gas Fired) and Tallawarra B CCGT

Scenario	Tallawarra A Full Load + Tallawarra B Full Load			Tallawarra A Full Load + Tallawarra B Cold Start Hour 1			Tallawarra A Full Load + Tallawarra B Warm Start Hour 1			Tallawarra A Warm Start Hour 1 + Tallawarra B Cold Start Hour 1		
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
SE Dapto	54	4	57	75	4	79	70	5	75	85	7	92
South Dapto	65	18	83	97	5	102	75	3	78	92	5	97
Avondale	58	3	61	75	4	79	72	4	76	78	4	82
Yallah	68	5	73	116	10	127	97	17	113	86	5	90
Oak Flats	47	6	53	55	19	74	45	19	64	57	19	76
Mt Warrigal	45	5	50	93	5	98	69	5	74	93	5	98
Windang	50	1	51	68	1	69	67	1	68	71	2	73
Barrack Hts	40	6	46	46	10	56	42	10	52	52	10	63
Primbee	46	3	49	57	3	59	54	3	57	58	12	70
Pt Kembla	22	13	35	32	1	33	28	14	42	48	1	49
Average	50		56	71		78	62		70	72		79

- **Table 8-6 Highest Background Concentration and Contemporaneous Predicted NO_2 1-Hour Average Impacts (µg/m^3) for Tallawarra A CCGT (Gas Fired) and Tallawarra B CCGT**

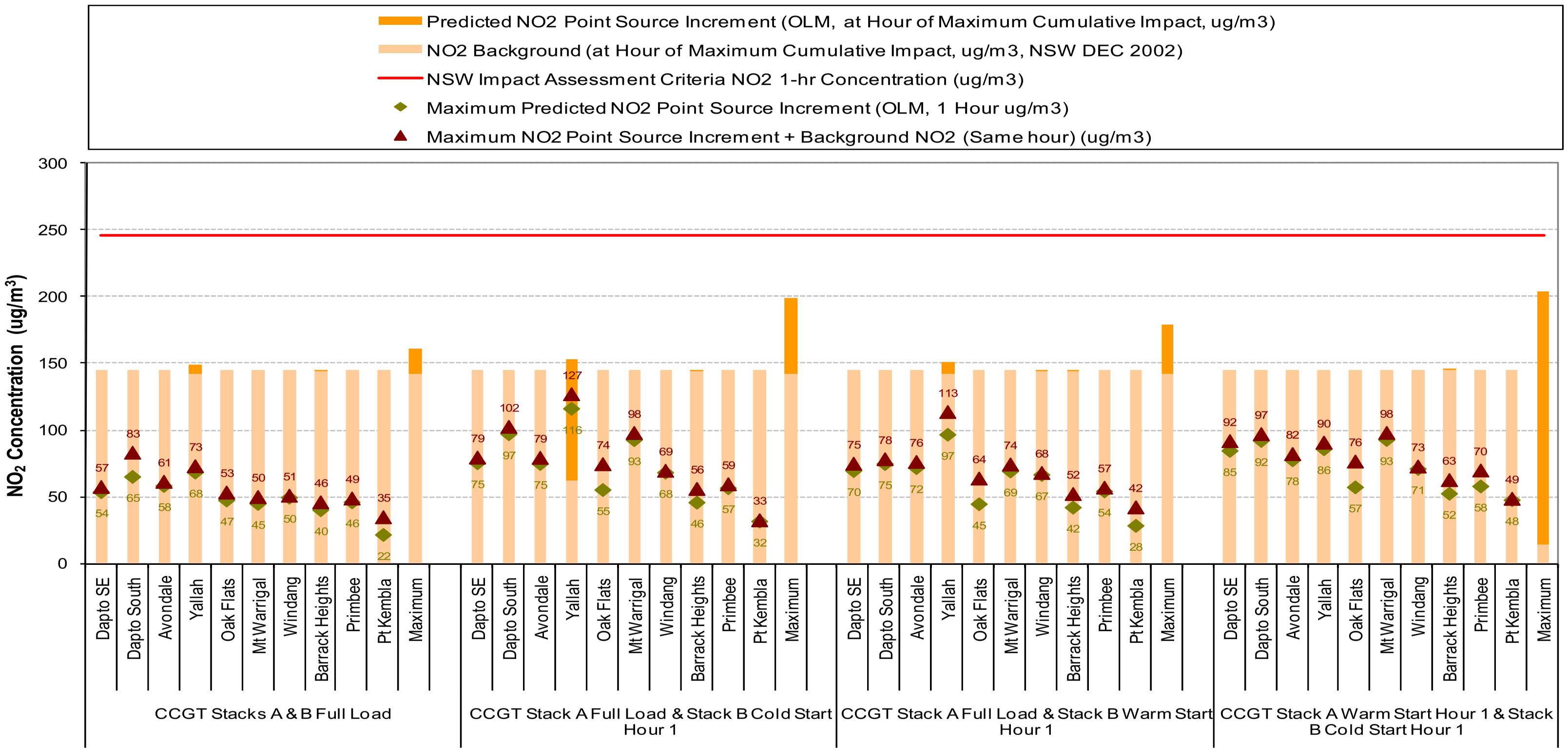
Scenario	Tallawarra A Full Load + Tallawarra B Full Load			Tallawarra A Full Load + Tallawarra B Cold Start Hour 1			Tallawarra A Full Load + Tallawarra B Warm Start Hour 1			Tallawarra A Warm Start Hour 1 + Tallawarra B Cold Start Hour 1		
Sensitive Receptor Location	Predicted Incremental NO2 by OLM	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
SE Dapto	0	145	145	0	145	145	0	145	145	0	145	145
South Dapto	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
Yallah	0	145	145	0	145	145	9	142	151	0	145	145
Oak Flats	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
Windang	0	145	145	0	145	145	0	145	145	0	145	145
Barrack Hts	0	145	145	0	145	145	0	145	145	1	145	146
Primbee	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
Grid Maximum	5	145	150	14	145	158	4	145	148	22	145	167

▪ Table 8-7 Example Highest Cumulative Concentrations for Tallawarra A and B CCGT Showing Contemporaneous Predicted NO_2 1-Hour Average Impacts and Background Concentration

Tallawarra A Warm Start Hour 1 + Tallawarra B1 Cold Start Hour 1	Total NO_2 Point Source Increment By OLM (µg/m^3)	NO_2 Background (DECC Kembla Grange same hour) (µg/m^3)	Total NO_2 Cumulative Impact (same hour) (µg/m^3)
Dapto South			
20021030	0	145	145
20021004	0	142	142
20021004	29	81	110
20021030	0	108	108
20021030	0	101	101
20020924	0	100	100
20020924	0	99	99
20021207	92	5	97
20020822	64	31	95
20020923	71	22	93
At Any Point Across the Grid			
20020104	191	14	205
20021004	57	142	199
20021222	172	24	196
20021216	167	24	190
20021222	155	25	181
20020104	160	19	179
20021216	149	28	177
20020104	162	11	173
20021004	85	84	169
20021030	22	145	167

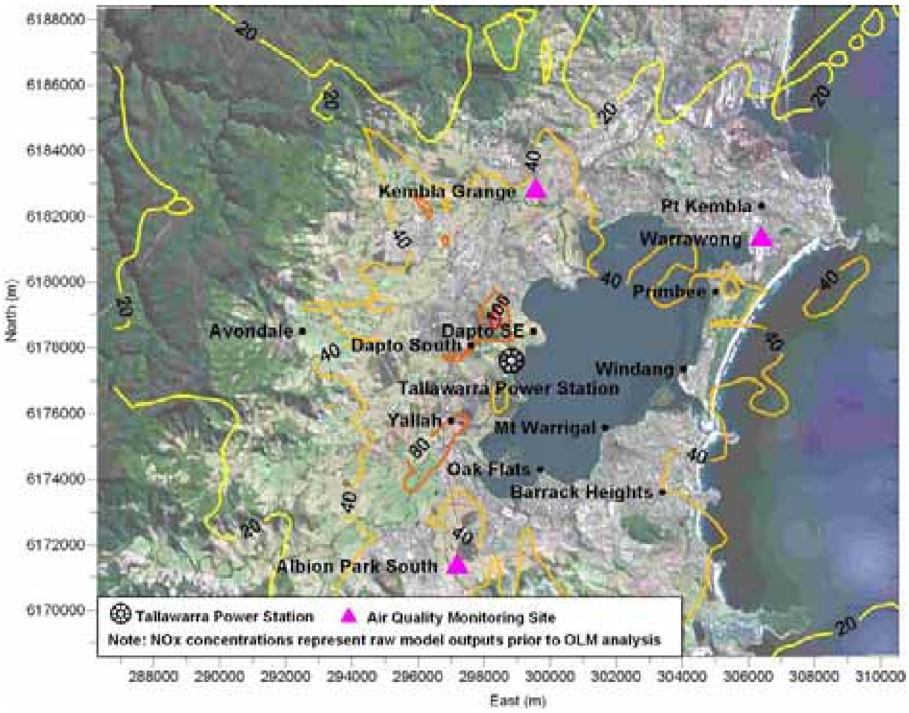
Note: In this example, the maximum cumulative concentration at the sensitive receiver resulted from the highest background concentration combined with a near –zero incremental impact. At any point across the grid, the maximum cumulative concentration resulted from the maximum incremental impact, due to the plume, combined with a relatively low background concentration.

■ Figure 8-1 Tallawarra A and B CCGT Local Scale Predicted Maximum NO_2 Impacts at Sensitive Receivers

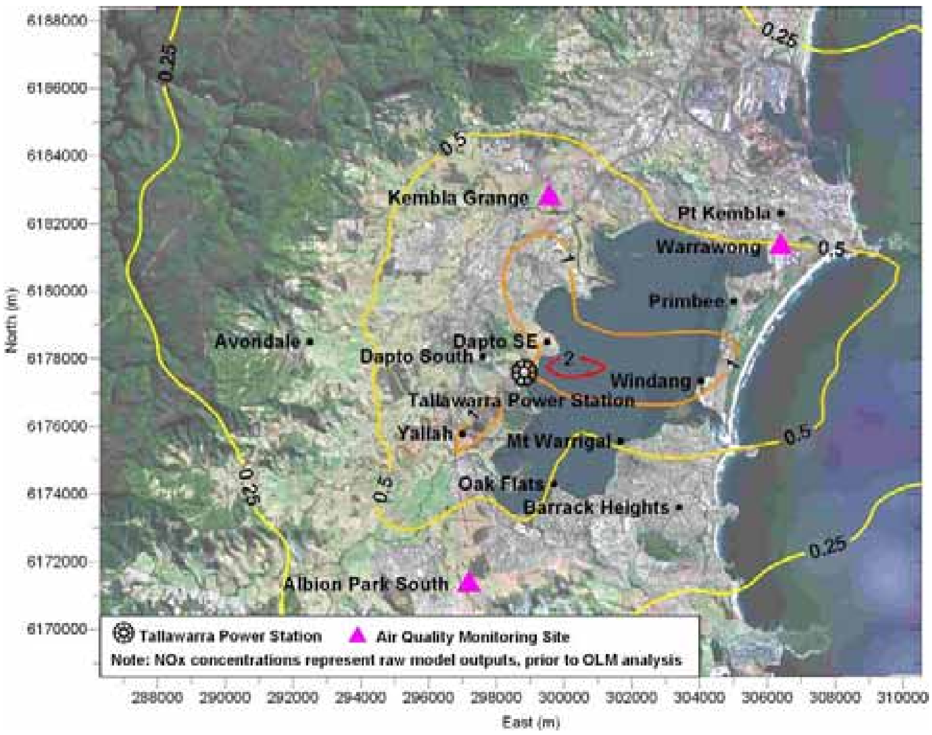


Note:
The shaded bars illustrate that the highest cumulative impacts generally resulted from the maximum 1-hr average background NO_2 concentration, 146 µg/m^3, combined with a relative low incremental impact of the plume from the power station, in the corresponding

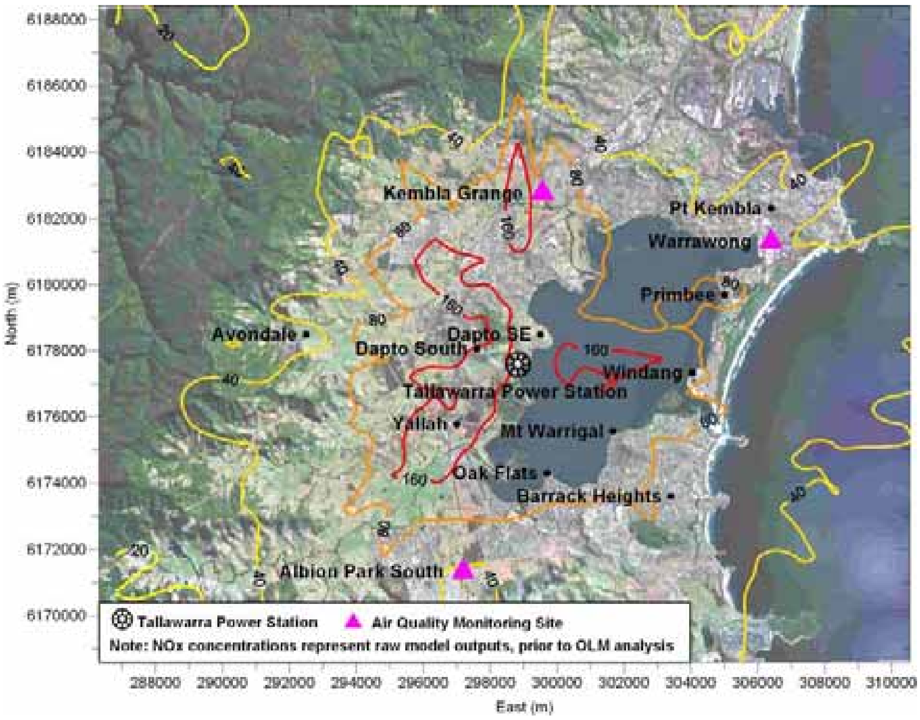
- **Figure 8-2: Tallawarra A and B CCGT Full Load Incremental NO_X Maximum 1 hr Concentrations (µg/m³)**



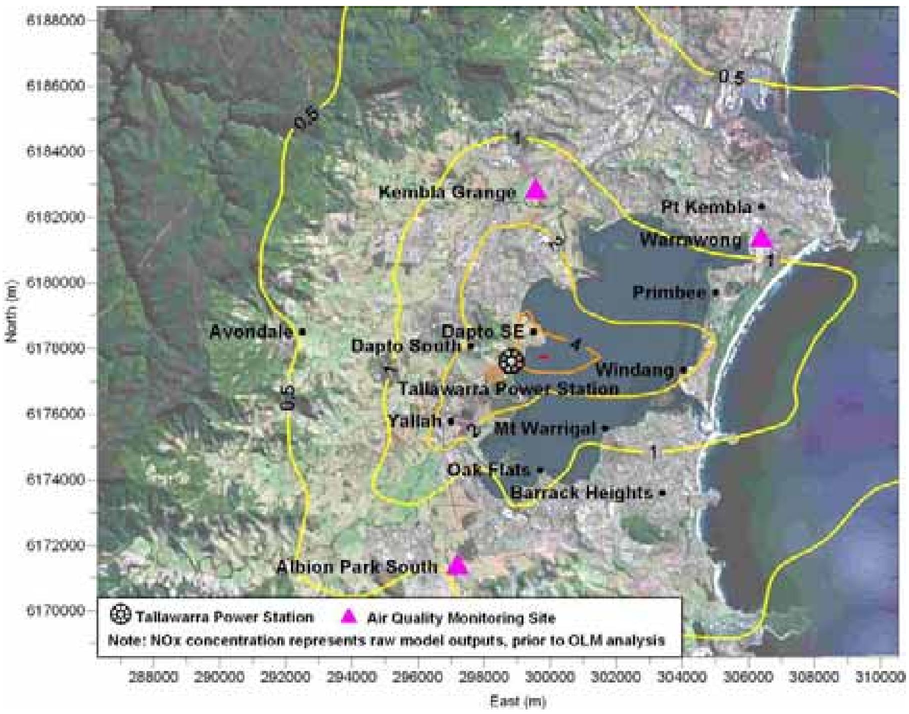
- **Figure 8-3: Tallawarra A and B CCGT Full Load Incremental NO_X Annual Average Concentrations (µg/m³)**



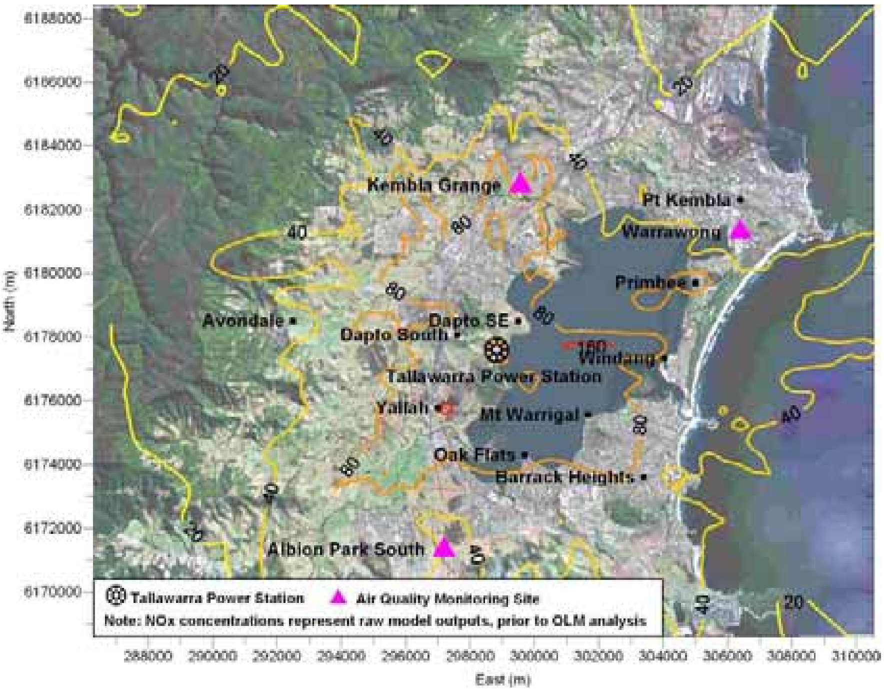
- **Figure 8-4: Tallawarra A Full Load and B CCGT Cold Start Hour 1 Incremental NO_X Maximum 1 hr Concentrations (µg/m^3)**



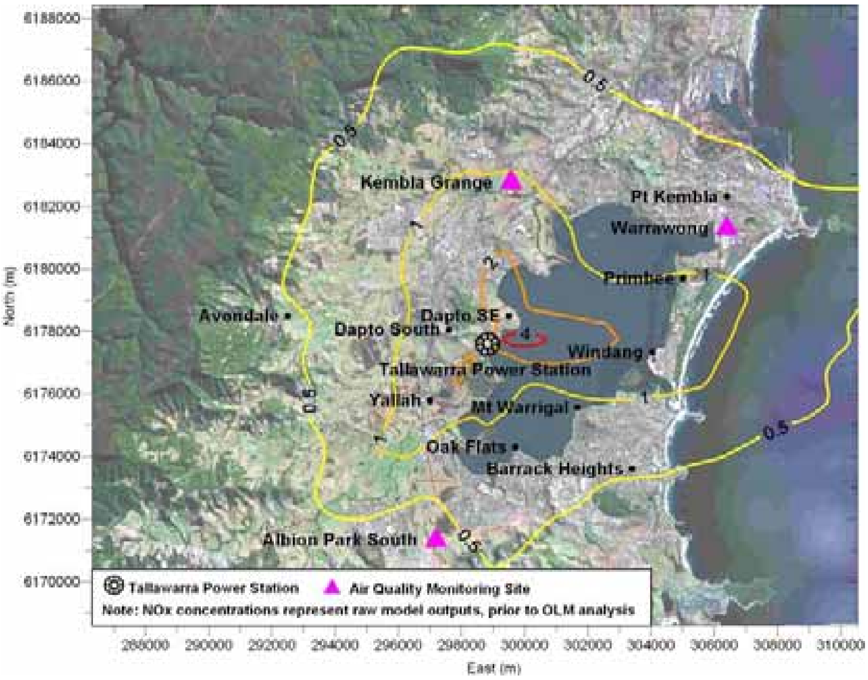
- **Figure 8-5: Tallawarra A Full Load and B CCGT Cold Start Hour 1 Incremental NO_X Annual Average Concentrations (µg/m^3)**



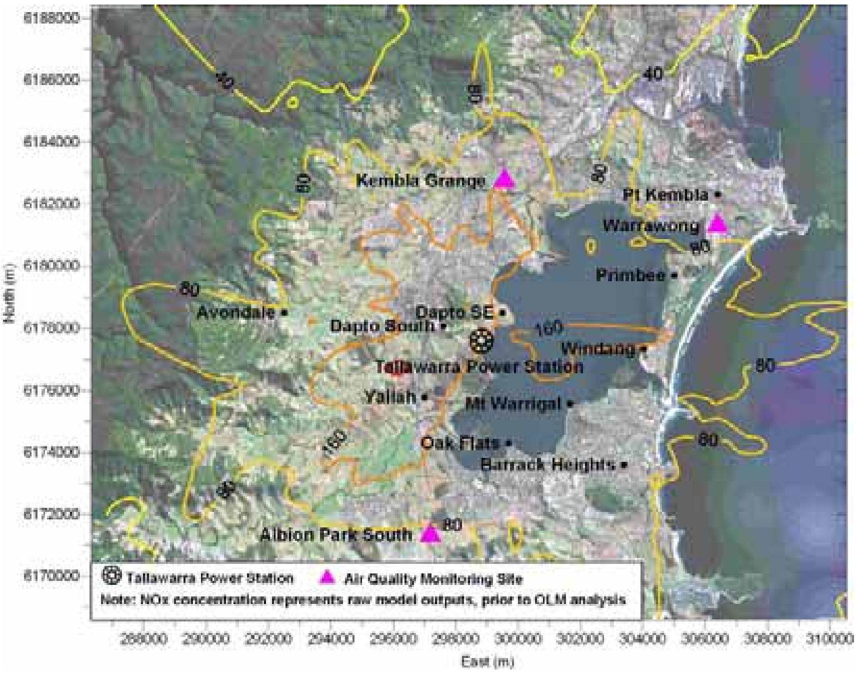
- **Figure 8-6: Tallawarra A Full Load and B CCGT Warm Start Hour 1 Incremental NO_X Maximum 1 hr Concentrations (µg/m³)**



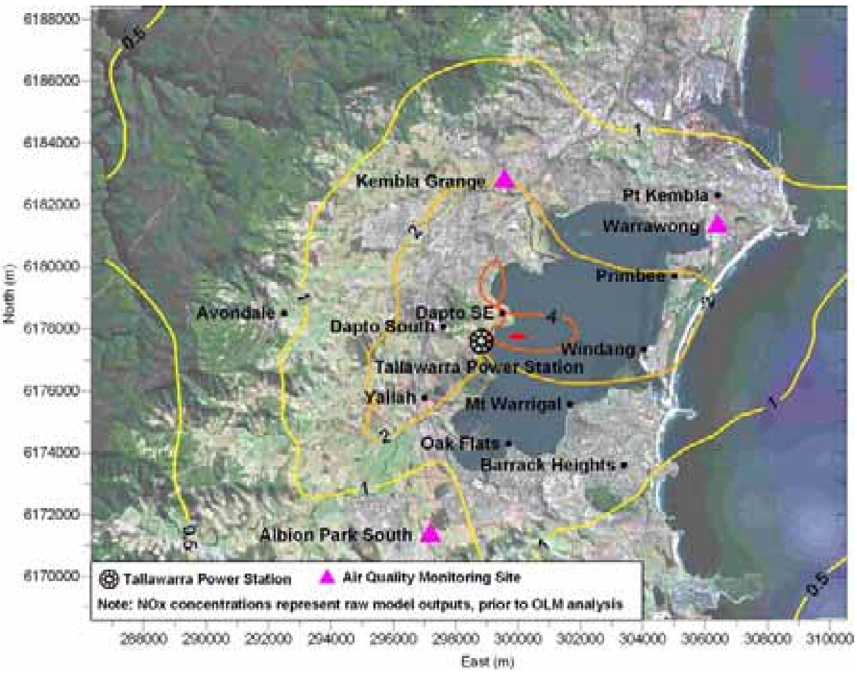
- **Figure 8-7: Tallawarra A Full Load and B CCGT Warm Start Hour 1 Incremental NO_X Annual Average Concentrations (µg/m³)**



- **Figure 8-8: Tallawarra A Warm Start Hour 1 and B CCGT Cold Start Hour 1 Incremental NO_X Maximum 1 hr Concentrations (µg/m^3)**



- **Figure 8-9: Tallawarra A Warm Start Hour 1 and B CCGT Cold Start Hour 1 Incremental NO_X Annual Average Concentrations (µg/m^3)**



Summary of Local Air Quality Assessment

The results show that the impacts of Tallawarra Stage A and Stage B plants, at any point across the study area, meet the DECC criteria for NO_2 1-hour average concentration (246 µg/m^3) and the annual average concentration (62 µg/m^3) for all hours during full load operations and hot, warm and cold start-up operations.

Considering Tallawarra Stage A and Stage B under full load operations, the maximum cumulative 1-hour NO_2 impacts within all sensitive receiver areas are predicted to be 83 µg/m^3, which represents approximately 34 percent of the DECC criterion (refer to **Table 8-8**). The maximum cumulative NO_2 1-hour average concentration at any point across the modelling domain was predicted to be 161 µg/m^3, which represents approximately 65 percent of the DECC criterion of 246 µg/m^3. The average annual impact was predicted to be 18 µg/m^3 representing less than 29 percent of the DECC criterion of 62 µg/m^3. Considering Tallawarra A operations during the first hour of a warm start, combined with Tallawarra B during the first hour of a cold start, the maximum cumulative NO_2 1-hour average concentration at any point across the modelling domain was predicted to be 205 µg/m^3, which represents approximately 83 percent of the DECC criterion.

Table 8-8 Tallawarra Stage A and Stage B CCGT 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	Units	% of Criteria
NO_2 (1-Hr)	Full Load	246	68 Avondale	28%	83 Dapto South	34%	161	65%
NO_2 (Annual)		62					18	29%
NO_2 (1-Hr)	A Full Load + B Cold Start Hr 1	246	116 Yallah	47%	127 Yallah	62%	199	81%
NO_2 (Annual)		62					23	37%
NO_2 (1-Hr)	A Warm Start Hr 1 + B Cold Start Hr 1	246	93 Mt Warrigal	40%	98 Mt Warrigal	40%	205	83%
NO_2 (Annual)		62					20	32%

Notes:
Cumulative concentrations for 1-hour impacts were derived by adding the highest NO2 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 NOx output is NO2) and the annual average concentration of 15 µg/m^3 recorded at Kembla Grange for the monitoring year 2002

8.1.5 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.

It is noted that given the significant resources required to undertake these photochemical smog assessments, the modelling has only been conducted for Tallawarra A CCGT and Tallawarra B operating in OCGT mode, as described in Chapter 7.

This is considered conservative when considering the impacts of Tallawarra B as an CCGT plant, noting that base load NO_X emissions for Tallawarra B OCGT diesel fired which were assessed in terms of photochemical smog impact in Chapter 7 are of the order of 270 kg/hour, whereas Tallawarra B as gas fired CCGT plant will have NO_X emissions of the order 105 kg/hour.

In Chapter 7 the ozone (photochemical smog) generation associated with Tallawarra A CCGT and Tallawarra B OCGT – diesel fired was shown to be acceptable. 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), although 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.

It can be reasonably deduced, therefore, that impacts would also be acceptable for Tallawarra B operating as a CCGT plant, where NO_X emissions are significantly lower.

8.1.6 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. The following 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:

- 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.
- 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 8-1** and **8-2** 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.

8.2 Plume rise assessment

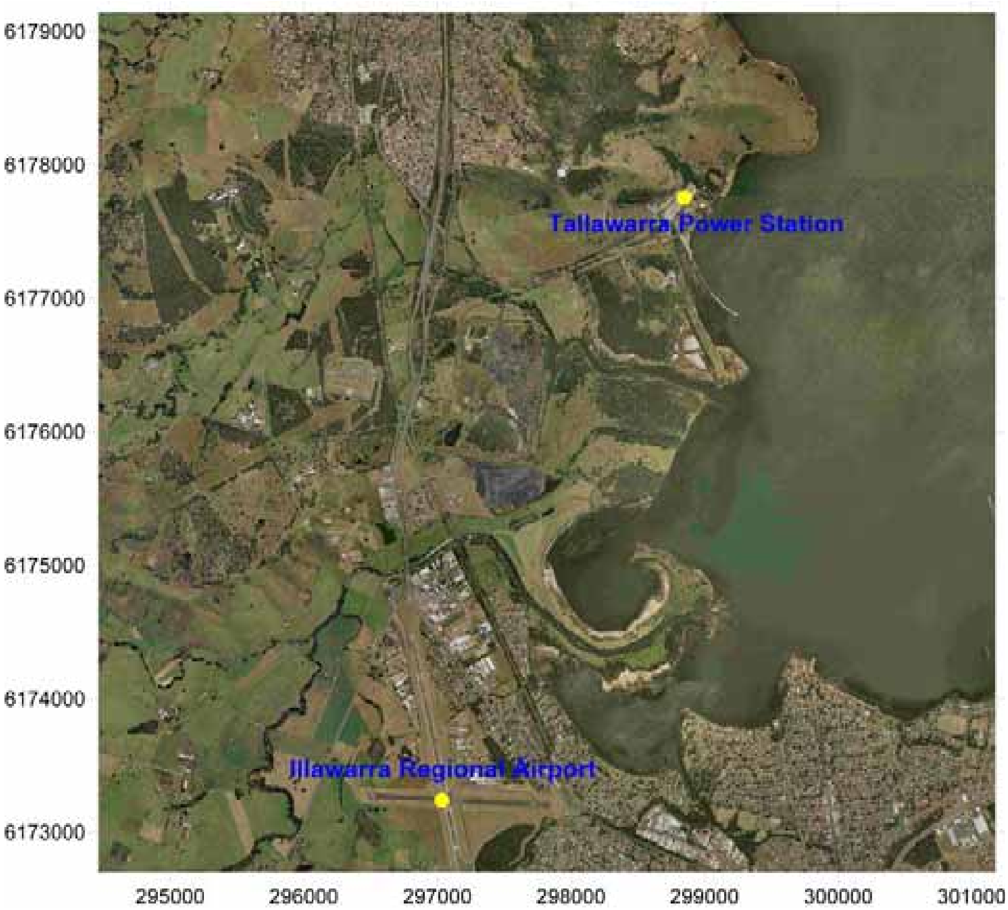
Due to the proximity of the proposed power station to the Illawarra Regional Airport (**Figure 8-10**), the Civil Aviation Safety Authority (CASA) identified the need to assess the potential hazards to aviation due to the vertical velocity from gas efflux that may cause airframe damage and/or affect 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 and fire fighting;
- 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 defines the airspace to be protected for aircraft operating visually during the initial and final stages of flight, or manoeuvring in the vicinity of an airport. The OLS for Illawarra Regional Airport is 52 metres. If the results of the assessment of plume rise from both the Stage A and Stage B CCGT plants determine plume rise heights above the OLS (which is likely as the stack heights of the CCGT plants 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 8-10 Proximity of Illawarra Regional Airport**



8.2.1 Assessment methodology

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 8-9** 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 8-9 CASA model requirements**

Requirement	Assessment
The entire horizontal grid domain should be a square region with 25 by 25 (or more) grid points, with 30km outer grid and two nested grids at 10km and 3km.	✓
A further sub-3km nested grid may be added at the user's discretion provided it is not less than 800m.	✓
The horizontal domain should be less than 1000km by 1000km.	✓
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 both CCGT plants with gas fuel at full load. The parameters used in the model are outlined in **Table 8-10**.

- **Table 8-10 Model Scenario**

Parameter	Stage A CCGT plant	Stage B CCGT
Number of stacks	1	1
Stack height (m)	60	60
Stack radius (m)	2.75	2.75
Temperature (^{o}C)	78	78
Exit velocity (m/s)	26	26
Buoyancy enhancement factor	1.82	1.82

8.2.2 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 8-11**.

- **Table 8-11 Critical Vertical Velocity Exceedance Summary**

Turbine	Maximum Height (m)	Minimum Height (m)	Average Height (m)
CCGT	506	60 (stack height)	98

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 8-12**.

- **Table 8-12 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%	72	7%	123
90%	82	6%	127
80%	86	5%	132
70%	88	4%	139
60%	91	3%	147
50%	94	2%	162
40%	97	1%	193
30%	100	0.5%	224
20%	105	0.3%	244
10%	117	0.2%	262
9%	118	0.1%	305
8%	121	0.05%	352

Horizontal plume displacement

Plume development, based on average plume characteristics, were analysed for the period 2000 to 2004. **Table 8-13** shows the development of the average plume through 8 vertical levels for the CCGT alternative. 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. **Figure 8-11** shows a schematic plot of the average plume horizontal dispersion for the proposed CCGT stacks.

Table 8-13 Average Plume Development (2000 – 2004)

Vertical Velocity (m/s)	Height (m)	Horizontal Plume Radius (m)
10.5	75	10.3
8.9	78	11.9
7.5	81	13.9
6.5	84	15.7
5.8	87	17.5
5.3	90	19.2
4.8	93	20.9
4.3	98	23.7

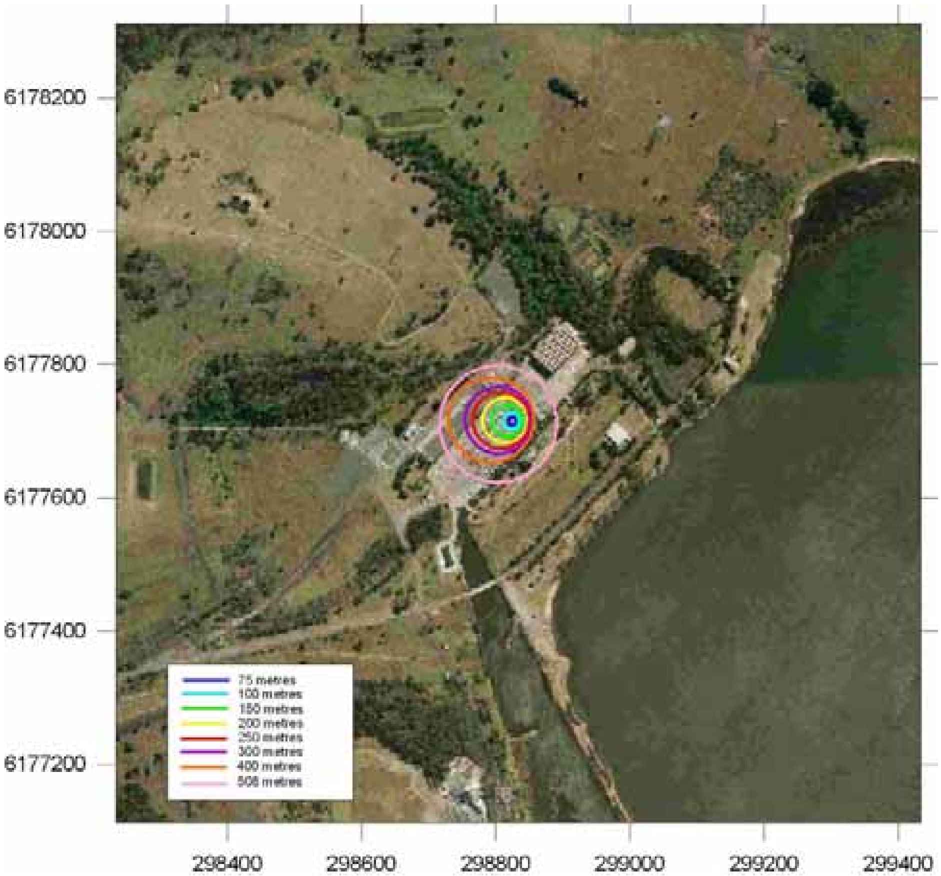
Figure 8-11 Average Plume Horizontal Dispersion (Small Extent)

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 CCGT stacks was the 13th hour of the 3 June 2002. **Table 8-14** 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 8-12** shows the spatial extent of the peak plume with respect to height.

- **Table 8-14 Peak Plume Development (13th hour – 03/06/02)**

Vertical Velocity (m/s)	Height (m)	Horizontal Plume Radius (m)
19.3	75	6
10.8	100	12.3
7	150	23.2
6	200	33.6
5.6	250	42.2
5.4	300	49.7
5.1	400	63.4
4.3	506	87.3

- **Figure 8-12 Peak Plume Horizontal Dispersion (Small Extent)**



8.2.3 Summary

Examination of average plume vertical velocity and extent found that the average plume would decrease to below the critical vertical velocity by 98 metres above ground level. The maximum height reached by the plume before decreasing in vertical velocity to 4.3 m/s was 506 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 (refer to **Section 8.2**) and the Illawarra Regional Airport has an OLS of 52 AHD, an application will be made to CASA for an Aircraft Operational Assessment.

8.3 Greenhouse gas generation

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

8.3.1 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, bulldozers, 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 will be relatively short term and would be minimal compared to the operational phase. For these reasons, the greenhouse gas emissions of the construction phase were not quantified.

8.3.2 Operational greenhouse gas emissions

The following activities are sources of greenhouse gas emissions associated with the operation of the Tallawarra Stage A and Stage B CCGT power stations:

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

8.3.3 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.

8.3.4 GHG emission estimates

The estimation of greenhouse gas emissions for Tallawarra Stage B CCGT power station has been undertaken using forecast operating capacities, plant efficiency and fuel usage. At this stage TRUenergy has not determine the exact operating regime of either of the CCGT plants, although for the purpose of this assessment the CCGT plants are expected to have an annual capacity in the range of 30 to 95 percent on an annual basis.

Greenhouse gas emission estimates for the Stage B proposal have been calculated and summarised in **Table 8-15**. The summary provided is based on full fuel cycle (i.e. Scopes 1 and 3 combined). Full emission calculations are presented in **Appendix D**.

- **Table 8-15 Full fuel cycle CO_2 Equivalent Emissions**

	CCGT (30%)	CCGT (95%)
Generating capacity (MW)	402	402
Expected operating hours (hours/annum)	2,628	8,322
Total annual emissions (kt CO_2-e/year)	492	1,557
Total generating capacity (GWh)	1,056	3,345
Emissions intensity (tonnes CO_2-e/GWh)	465	465

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:

- CCGT – 364 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 combined cycle industrial gas turbine plant.

Assuming a 30 year project lifetime this would equate to a total greenhouse gas emissions of between 14.8 and 46.7 Mt CO_2-e.

From **Table 8-16** it can be seen that the total greenhouse gas emissions in NSW in 2005 was 158.2 million tonnes CO2-e. Stationary energy emissions were 75.7 million tonnes CO2-e, which includes 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 8-16: 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

State	2005 Emissions (Mt CO_2-e)
Tasmania	11
ACT	1.1
Total	**557.4**

If the proposed Tallawarra Stage B CCGT power station was to operate at 30 percent capacity the greenhouse gas emissions produced would be approximately equal to 0.31 and 0.09 percent respectively for NSW and national emissions in 2005. Greenhouse gas emissions from the proposed Tallawarra Stage B CCGT power station operating at a 95 percent capacity factor will be equivalent to approximately 0.98 percent of the NSW emissions (2005) and 0.28 percent of the national emissions (2005).

Through the burning of natural gas to produce electricity the Tallawarra Stage B CCGT power station (operating with a 95 percent capacity factor) will emit approximately 1,557 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 465 tonnes CO_2/GWh.

This emission intensity is low when compared to coal fired power stations around the country which produce up to about 1,400 tonnes CO_2-e/GWh. It is also low when compared to other CCGT units across Australia. 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.

8.3.5 Proposed management measures

Greenhouse gas emissions from the Tallawarra Stage B CCGT 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, where appropriate, 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 gas produced.

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 in the Annual Environmental Report. 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 distillate fuel use.

8.4 Noise

The assessment of noise emissions was undertaken for the proposed Tallawarra Stage B CCGT 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**, and 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, which indicate where the likelihood of an unacceptable noise emission may occur. Where impacts are expected to be above the guideline noise levels, mitigation measures are identified to be incorporated as part of the project design.

8.4.1 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 criterion is designed to account for shorter duration noise impacts and is 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. Where there is an existing industrial noise influence, the amenity criterion is 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; or
- The subject noise does not contain tonal, impulsive, or other modifying factors as detailed in Chapter 4 of the INP.

From **Table 8-17** 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 8-17**. 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 a $L_{Aeq (Period)}$ of 60, 50 and 45 dB(A) for the day, evening and night periods respectively. For residences located in a suburban area, acceptable criteria would be a $L_{Aeq (Period)}$ of 55, 45 and 40 dB(A) for the day, evening and night periods respectively.

The INP aims to control cumulative noise impacts resulting 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 40dB(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 -4dB(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 8-17**. The Wyndarra Way site is shown in bold to indicate the modified night time criteria. The lower of the Amenity or Intrusive criteria has been selected as the project specific level for each location.

- **Table 8-17 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*

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 of 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.

8.4.2 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 CCGT plant 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 8-18**.

- **Table 8-18 Modelled noise levels**

CCGT Plant Item	Sound Power Level dB(A)	Emission Height Range (m)
Cooling Tower	105	12
Air intake	101	14-25
Main Transformer	97	0-3
Stack Mouth	94	60
Lube Oil Cooler	94	2-4
Diffuser	93	0-7
HVAC System	93	0-3
Feed Water Pump	90	0-3
Turbine building	90	0-23

The assessment scenarios are as follows:

- Scenario 1 – Tallawarra Stage A CCGT and Tallawarra Stage B CCGT 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 CCGT 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 8-13** and **Figure 8-14** present the predicted noise levels for the combined operations of the Tallawarra Stage A CCGT and the proposed Tallawarra Stage B CCGT power stations for Scenario 1 and Scenario 2, respectively. **Table 8-19** presents the point calculations of the cumulative noise impact assessment for the Tallawarra Stage A CCGT and Tallawarra Stage B CCGT combined operations, which includes the 5 dB(A) penalty.

- **Table 8-19 Predicted noise levels Tallawarra Stage A and Stage B CCGT plants**

Description	Predicted Noise Level Neutral Conditions	Predicted Noise Level Adverse Conditions	Noise goal
Carlyle Street, Koonawarra (T2)	28 dB(A)	30 dB(A)	43 dB(A)
Wyndarra Way, Koonawarra (T4)	29 dB(A)	31 dB(A)	36 dB(A)
Central Park, Mongurah Pt	31 dB(A)	35 dB(A)	38 dB(A)
Boonarah Pt	32 dB(A)	35 dB(A)	37 dB(A)
Haywards Bay Estate, Yallah	26 dB(A)	31 dB(A)	44 dB(A)

The modelling indicates that under neutral conditions, at all receiver locations external to the Tallawarra Land boundary, noise levels are predicted to be lower than the identified noise criteria. When a 5dB(A) low frequency noise penalty is added to the predicted results, noise levels at these locations would still remain lower than the criteria in **Table 8-17**. However, the predicted noise levels are equal to the criteria in one location. This is due to the operation of the fan cooled wet cooling tower for the Tallawarra Stage B CCGT plant. The noise level assumed for this operation is based on limited data for this type of equipment and therefore has the potential to be reduced during the equipment tendering process.

The locations west and north of the site will benefit from a significant amount of topographical 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 8-13** and **Figure 8-14**.

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.

Legend

- Site boundary

Tallawarra Lands Structure Plan

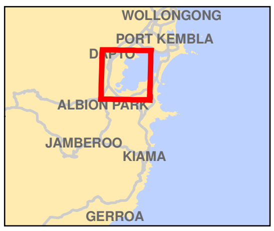
- Large Lot Residential
- Low Density Residential

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



SKM
SINCLAIR KNIGHT MERZ

Figure 8-13: Noise Contours - Stage A and B CCGT

Scenario 1 - Neutral Meteorological Conditions

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

April 24, 2009
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Legend

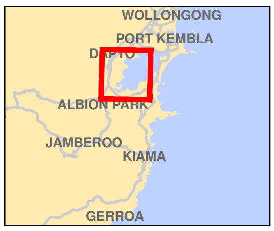
- Site boundary
- Tallawarra Lands Structure Plan
  - Large Lot Residential
  - Low Density Residential

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



SKM

Figure 8-14: Noise Contours - Stage A and B CCGT

Scenario 2 - Adverse Meteorological Conditions

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

April 24, 2009
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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 8-13** and **Figure 8-14** 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. To the north of the site residential areas are likely to experience only marginally higher noise levels from both the Tallawarra A and Tallawarra B configuration.

8.4.3 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.

8.4.4 Mitigation and management of noise impacts

To minimise operational noise impacts, the project noise goals listed in **Table 8-17**, developed in accordance with the Industrial Noise Policy (INP), will be adhered to during the operation of the plant. For external receiver locations a combination of the distance and shielding from local topography would provide a high level of attenuation with no identified residual impacts. For noise sensitive locations within the Tallawarra Lands, TRUenergy will undertake consultation with Wollongong City Council. TRUenergy will provide council with the noise monitoring results and would assist in the development of development controls for the site, such as a site-specific development control plan (DCP). The preparation of a DCP will ensure that any future development application within Tallawarra Lands would be aware of and ensure compliance with the relevant noise goals.

The noise emissions data used for modelling noise impacts for Tallawarra Stage B has been taken from the Tallawarra Stage A CCGT plant, although a specific supplier or design has not yet been finalised. The Sound Power Levels were taken from manufacturer's data for a design that incorporates significant attenuation measures in the construction of the plant. It is therefore necessary that similar attenuation controls identified for the Stage A plant be implemented for the proposed Stage B CCGT in order to meet the project specific noise goals.

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 can 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 8-20**. Impacts from a CCGT plant would occur at similar levels.

- **Table 8-20 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;
- 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.

8.5 Water quality and the ecology of Lake Illawarra

The water demands for the Tallawarra Stage B CCGT plant include cooling towers with lake water makeup for the cooling process, as well as potable water for drinking and general power station use. The water demands are outlined in **Section 5.4.4**, although in summary, the lake water demand and potable water demand is shown in **Tables 8-21** and **8-22** respectively. A description of the existing aquatic environment is provided in **Section 6.1.6**.

- **Table 8-21 Water requirements for a lake-water cooling tower**

	Ambient Temperature	Ambient Relative Humidity	Evaporation	Blowdown and drift	Total
Units	^{o}C	%	L/s	L/s	L/s
Design	25	70	87	217	304
Cold day	1	70	67	168	235
Hot day	40	20	108	271	379

**-+Note: Assumes 1.4 cycles of concentration*

- **Table 8-22 Annual Potable Water Demand for Tallawarra Stage B CCGT plant**

Capacity Factor	Units	95%	65%
Potable [1]	ML	90-100	65-75
Demineralised	ML	40-50	30-35

Note: 1. Includes feed to demineralised water plant.

8.5.1 Effects of cooling water on water chemistry

Fouling potential in cooling water systems

Closed cooling water systems in which part of the circulating fluid is lost by evaporation require chemicals or other treatment to control corrosion, scaling and fouling. This is due to evaporation resulting in increased concentration of impurities in the remaining water. The presence of light on the cooling tower surfaces or cooling pond also encourages the build-up of organic matter and micro-organisms.

It is essential as part of the cooling tower operation to apply a correct and efficient cooling water chemistry regime that minimises the risk of corrosion, scaling, biofilm formation and deposit fouling within the system, effects that would otherwise have a potentially ruinous impact on the integrity and efficiency of the plant. Potential fouling within the cooling water system includes:

- Corrosion;
- Scale;
- Biofilm; and
- Deposition.

Some measure of control is achieved by draining some of the water in the system to waste. This is called blowdown. The quantity of water introduced to compensate for the evaporation and blowdown losses is called make up water. This make up water assists in reducing the rate of build-up of impurities. Wherever possible, material selection and careful system design will be used to manage corrosion control, scaling and bio-fouling. It is not normally possible, however, to control the water quality by this means alone. Supplementary control is achieved by means of addition of chemicals or by the use of ozone. Chemical controls may be necessary, at times, to prevent corrosion, scaling and bio-fouling. The recommended water treatment and system chemistry conditions are detailed in **Table 8-23** below. The determination of necessary process and operational chemistry criteria for cooling tower system operation has been based on a worst-case water chemistry profile (e.g. simultaneous conditions of high salinity, calcium and suspended solids).

Table 8-23 Chemistry Treatment Conditions for the Cooling Tower System

Issue	Chemical	Concentration	Dose Frequency	Dose Point	Shock Dose
Scale control	1-Hydroxy Ethylidene-1,1-Diphosphonic Acid (HEDP)	1 mg/L as active	Continuous	Immediately upstream of main cooling water pumps	2.5 mg/L as active (only if cooling water flow rate is reduced by >25%
Biofilm control	Stabilised Peracetic Acid	60 mg/L as product	15 minutes per dose, 3 times/day	Make-up water intake channel	100mg/L as product, 3 times/week
Deposit control	Polyacrylate	0.5 mg/L as active	Continuous	Immediately upstream of main cooling water pumps	4 mg/L as active (only if TSS >100 mg/L for more than 24hr)
Corrosion control	Not required on the assumption of prudent design				

Antiscalents and biocides were selected to minimise the potential to cause acute toxicity and bioaccumulation.

Periodic chemical control may be required in the form of a peracetic acid-based oxidising biocide for biofilm control in the condenser and cooling tower. In addition, an inhibitor product may be used to minimise the risk of scale and deposit fouling. If required, the inhibitor concentration would be varied according to the actual concentration of calcium in the lake water.

The peracetic acid biocide exhibits excellent control of macro-organisms and biofilm. Due to the oxidising power of the chemical, bacteria have no resistance to the active agent and so biofilm growth can be efficiently controlled. Nuisance macro-organism species such as mussels are deactivated at the larval stage, preventing system infestation.

Peracetic acid is widely used as an industrial cooling water biocide. Chemicals for the treatment of industrial cooling water systems fall under the control of the Australian Pesticides and Veterinary Medicines Authority (APVMA), although an exemption from registration for industrial biocides exists for the control of organisms in water used in cooling systems.

The antiscalent HEDP has found widespread use in water treatment as a particularly useful calcium-scale control agent. The popularity of the chemical is based both on its technical efficiency as an excellent scale inhibitor and the relatively low concentrations required to provide that inhibition.

Given the low-cycles nature of any proposed Tallawarra B cooling tower system and the concentration of incoming suspended solids it is not expected to be a limitation on plant operation. Even under high-solids conditions in Lake Illawarra, the peak suspended solids loading in the cooling tower system should be below 100 mg/L at all times. Condenser-tube ball-cleaning systems help provide good protection of steam condensers (and other heat exchange equipment) against suspended solids deposition fouling.

Selection of high-efficiency, low-fouling packing material for the cooling tower adds a high degree of protection to cooling tower operation even under sustained conditions of high-solids loading. The cooling tower design specification should include the requirement for cooling tower packing to be provided that tolerates a continuous suspended solids concentration of 80 mg/L and a peak solids concentration of 150 mg/L.

Discharge Water Quality

Discharge modelling was undertaken to estimate the water quality of the discharge from Stage B for three operating scenarios once it has been mixed with the cooling water from Stage A in the mixing basin prior to discharge into Lake Illawarra. The modelling under the alternative operating conditions used a mass balance equation, which weights the concentration of chemicals based upon the proportion of flow contributed (**Appendix G**). The estimated discharge of peracetic acid and HEDP was calculated as the final concentration leaving the mixing chamber (**Appendix G**). The estimated combined discharge water quality of Stage A and B once it has left the mixing basin is presented in **Table 8-24.** This provides the:

- Mean Lake Illawarra water quality used in the study (based on available literature obtained from Scanes *et al* .2007, EPA unpublished reports*,* the Lake Illawarra Authority and Monitoring Evaluation and Report data (MER) from June 07 to June 08 (see **Appendix G** for raw data);
- Estimated water quality based on the preliminary design and anticipated chemical treatment regimes;
- Lake Illawarra Authority Estuary Management and Strategic Plan Guidelines (LIA 2006); and
- ANZECC guideline for slightly disturbed estuarine ecosystems in south-east Australia (ANZECC/ARMCANZ 2000).

- **Table 8-24 Input Lake and Modelling of Combined Discharges from Tallawarra A and B compaired with ANZECC Guidelines (2000) and Lake Illawarra Authority Estuary Management and Strategic Plan Guidelines (LIA 2006).**

Parameter	Mean Water Quality	Combined Design Output	Combined Hot Day Output	Designed Cold Day Output	ANZECC (2000) Guidelines	LIA Estuary Management and Strategic Plan Guidelines (LIA 2006)
NOx (ug/L)	5.04	5.08	5.09	5.07	15	-
NH3 Ammonia (ug/L)	8.97	9.04	9.05	9.02	-	-
Total Nitrogen (ug/L)	377.43	380.21	380.89	379.59	300	500
FRP (Filterable Reactive Phosphorus) (ug/L)	10.25	16.62	16.62	16.62	5	20
Total Phosphorus (ug/L)	78.00	86.15	86.15	86.15	30	50
Salinity	28.60	28.81	28.86	28.76	20-30	-
Dissolved Oxygen (%sat)	98.10	98.82	99.00	98.66	-	-
Temperature (°C)	21.20	21.36	21.39	21.32	-	-
Turbidity	6.19	6.23	6.24	6.22	1–20	-
Chlorophyll-a (ug/L)	8.38	8.44	8.45	8.42	15	4
Peracetic Acid (ug/L)	-	0.000849	0.000845	0.000853	-	-
HEDP (mg/L)	-	0.013	0.016	0.010	-	-

*Mean water quality data obtained from Scanes *et al.* (2007); DECC Unpublished Data & LIA (2006).

The Tallawarra B cooling water process adds additional concentrations of phosphorus and peracetic acid (PAA) to Lake Illawarra due to the addition of antiscalents and biocides detailed in **Table 8-22**.

No other chemicals are added to the water, although the 1.4 cycles of evaporation associated with Stage B create higher concentrations of constituents rather than increasing the quantity. Concentrations of all other constituents increased by a maximum of 1.009 percent under the various operating scenarios when discharge is combined with Tallawarra A. This indicates a very slight increase in the concentration of those constituents.

Effects of the 1.4 cycles of concentration associated with Tallawarra B once combined with Tallawarra A result in a slight increase in the concentration of nitrogen (approximately 3ug/L), although there has been no change in the nitrogen load as there has been no nitrogen added to the blow down. Lake Illawarra is strongly nitrogen limited, with essentially no free nitrogen in the lake available for biological update (LIA 2006). The mean total nitrogen concentration of both the input lake water (377ug/L) and the combined discharges of Tallawarra A and B (379-380 ug/l) exceed the ANZECC guidelines (300ug/L), although neither exceeds the LIA Guidelines (500ug/L).

Total phosphorus and Filterable Reactive Phosphorus (FRP) concentrations will increase due to the addition of the antiscalent HEDP. Modelled Total Phosphorus discharge increased by 8.15 ug/L whilst FRP increased by 6.37ug/L. Phosphate is not considered a limiting factor in estuarine waters and the expected concentrations fall within the natural variation of nutrient concentrations monitored by Manly Hydraulics (2007), LIA (2006), and Scanes *et al* (2007) around the lake, with lake concentrations already exceeding the ANZECC (2000) recommended guidelines.

The predicted exceedances arise primarily due to levels associated with the incoming lake water quality and are within natural variation. The notable exceptions to these natural variations are the concentrations of FRP (increases by a factor of 1.6), total phosphate (increases by a factor of 1.1) and peracetic acid (not present in the lake water), which would be added to the system to protect against scale and bio-fouling.

The proposed cooling tower system will not result in any additional faecal, enterococci or nuisance organisms entering the Lake Illawarra estuary.

Toxicity of the Treatment Chemicals

Periodic chemical control may be required in the form of a peracetic acid-based oxidising biocide for biofilm control in the condenser and cooling tower and HEDP as a calcium control agent. At the discharge mixing zone or canal, the blowdown would contain concentrated levels of cations and anions compared to the intake water (no additional loads have been created) and blowdown may have an additional concentration of phosphate (due to chemical addition for scale control) and a low residual of peracetic acid (due to chemical addition for biofilm control) (refer to **Table 8-24**).

The discharge concentration of HEDP once mixed with Stage A and discharged from the mixing basin was modelled under worst case operating scenarios and found that approximately 0.016 mg/L of HEDP would be present in the discharge. Under typical operating scenarios this concentration would be lower.

The potential consequence of HEDP use (and that of any phosphonate or polyphosphate chemical) is the addition of phosphate to the process water and hence to the discharge water and receiving environment. Algae are particularly sensitive to HEDP, with quoted LC50 doses in the range 10—50 mg/L. This is considerably above the concentration of 0.016 mg/L that would be expected to be applied to a low-cycles cooling tower system. The toxicity data of HEDP from various sources of literature is presented in **Table 8-25**.

Due to the limited environmental toxicity data available, as required by the ANZECC (2000) water quality guidelines, an assessment factor of 100 for the lowest EC50 value was applied to account for other potentially more sensitive organisms. The lowest EC50 value for HEDP is for the green algae, with an EC50 of 3mg/L (chronic). When the assessment factor is applied, the lowest acceptable EC50 value is 0.03 mg/L. At the modelled worst-case scenario the combined concentration of HEDP reaches 0.016 mg HEDP/L, thus it is not anticipated that HEDP will have an effect on any organisms.

HEDP biodegrades into carbon dioxide, water and simple orthophosphate. It degrades photochemically in sunlight water, whilst some species of algae can slowly utilise the phosphorus as a nutrient. HEDP has been found not to pose a bioaccumulation risk (Steber & Hater 1997; Gulbrandsen Technologies 2002). Since HEDP can also function as a corrosion inhibitor it can be found as part of a protective film on cooling system surfaces. However, the concentration of HEDP in this form relative to both the dosed concentration and the residual concentration will be extremely low and does not post a toxicity risk.

- **Table 8-25 Environmental Toxicity Data for HEDP (Jaworska *et al.* 2002; HERA (2004), Gulbrandsen Technologies (2002).**

HEDP (1-Hydroxyethylidene-1, 1-Diphosphoninc Acid)			
Species	**Description**	**Endpoint**	**mg/L**
Lepomis macrochirus	Bluegill Sunfish (FW)	96 hour LC_{50}	868
Oncorhynchus mykiss	Rainbow Trout	96 hour LC_{50}	360
Oncorhychus mykiss	Rainbow Trout	14 day NOEC	60-180
Cyprinodon variegatus	Sheepshead Minnow	96 hour LC_{50}	2180
Ictalurus punctatus	Channel Catfish	96 hour LC_{50}	695
Leuciscus idus melanatus	Ide (FW)	48 Hour LC_{50}	207-350
Daphnia magna	Water flea	24-48 Hour EC_{50}	65-500
Daphnia magna	Waterflea	28 day NOEC	10 -12.5
Palaemonetes pugio	Grass Shrimp	96 hour EC_{50}	1770
Crassostrea virginica	Eastern Oyster	96 hour EC_{50}	89

HEDP (1-Hydroxyethylidene-1, 1-Diphosphoninc Acid)			
Species	**Description**	**Endpoint**	**mg/L**
Selenastrum capricornutum	Green Algae	96 hour EC_{50}	3
Selenastrum capricornutum	Green Algae	96 Hour NOEC	1.3
Algae	Algae	14 day NOEC	13
Chlorella vulgaris	Green Algae	48 Hour NOEC	>100
Where the LC50 is statistically derived concentration of a substance that can be expected to cause death in 50% of test animals. The median effects concentration (EC50) is statistically derived concentration of a substance that can be expected to cause a specified effect in 50% of test animals. No Effect Concentration (NOEC) is the maximum concentration of a substance prior to any effect to the organism to be observed. FW indicates the species is freshwater not estuarine/marine.			

The peracetic acid biocide exhibits excellent control of macro-organisms and biofilm. Due to the oxidising power of the chemical, bacteria have no resistance to the active agent and so biofilm growth can be efficiently controlled. Nuisance macro-organism species such as mussels are deactivated at the larval stage, preventing system infestation. The product demonstrates low toxicity and is readily biodegradable in receiving environments, to the extent that it is sold as an environmentally-friendly biocide. The peracetic acid biocide does not bioaccumulate (NIWA, 2006). An advantage of PAA in high saline/seawater systems is that its half-life is very short, in the order of minutes. It is expected that the PAA residual in the blowdown water would decay to non-detectable (<0.1 mg/l) in a maximum of 60 minutes.

The biocide is normally applied as a shock-dose (60 – 100 mg/l as product) of short duration, i.e. not more than 15 minutes. Shock-dose frequency for low-cycles recirculating cooling tower systems would be around 3—5 times daily. Every 60mg/L of the biocide product contains 9mg/L of peracetic acid. Once discharged from Stage A and B mixing chamber the concentration of peracetic acid will be 0.000000853mg PAA/L at worst case operating scenarios (**Table 8-24**). **Table 8-26** shows the environmental toxicity information for peracetic acid (NIWA 2006).

- **Table 8-26 Environmental Toxicity Data for Peracetic Acid (NIWA 2006).**

Peracetic acid (PAA)				
Test Organism	**Test Type**	**Test Duration (hours)**	**NOEC (mg PAA/L)**	**EC50 (mg PAA/L)**
Marine Algae	Chronic	48	0.59	0.89
Blue Mussel Embryo	Chronic	48	0.3	0.69
Juvenile Shellfish	Acute	96	1.17	4.37
Marine Flounder	Acute	96	2.87	4.3
The median effects concentration (EC50) is statistically derived concentration of a substance that can be expected to cause a specified effect in 50% of test animals. No Effect Concentration (NOEC) is the maximum concentration of a substance prior to any effect to the organism to be observed.				

Due to the limited amount of environmental toxicity data available, as required by the ANZECC water quality guidelines , an assessment factor of 100 for the lowest EC50 value was applied to account for potentially more sensitive organisms. The lowest EC50 value for PAA is for the marine algae, with an EC50 of 0.89mg/L (chronic). When the assessment factor is applied, the lowest acceptable EC50 value is 0.0089 mg/L. The highest calculated worst-case concentration of PAA discharged from the mixing basin is 0.00853ug/L(**Table 8-23**). This is significantly below the lowest acceptable EC50 value (ANZECC assessment factor). At these concentrations discharges of peracetic acid will have no effect on the aquatic ecology of Lake Illawarra with the discharge concentration well below the lowest ANZECC EC50 value of 0.0089mg/L.

8.5.2 Effects of blowdown flow rate, water temperature and relative density

Changes in flow rate, temperature and density were determined based on ambient weather conditions for three alternatives: design, cold day and hot day. The ambient weather conditions used in the mass balance and heat balance calculations are summarised in **Table 8-27**. The anticipated discharge rates, temperatures and relative density are summarised in **Table 8-28**. The temperatures and densities under the alternative operating conditions were calculated using a mass balance equation, which weights the concentration of chemicals based upon the proportion of flow contributed (**Appendix G**). The blowdown temperature will be approximately 8°C higher than the wet bulb air temperature. The discharge rate will vary with ambient conditions.

- **Table 8-27 Ambient weather conditions**

	Ambient Dry Bulb Temperature °C	Ambient Wet Bulb Temperature °C	Ambient Relative Humidity %	Lake Temperature °C
Design	25	21	70	20
Cold day	1	-1	70	8
Hot day	40	22	20	28

Note – based on Bureau of Meteorology data (2008) and water quality data from the Lake Illawarra Authority (2008)

- **Table 8-28 Blowdown flow rate and water temperature**

	Flow Rate L/s			Outlet Temperature °C			Change in Relative Density %	
	Stage A	Stage B	Combined	Stage A	Stage B	Combined	Low lake salinity	High lake salinity
Design	11550	217	11767	25.1	29.4	25.2	0.00	0.02
Cold day	11550	168	11718	13.3	18.5	13.4	0.00	0.01
Hot day	11550	271	11821	33.1	29.9	33.0	0.00	0.02

The blowdown from the tower will be returned to the lake via the existing Tallawarra Stage A outlet canal, adding a nominal 9MW thermal load to the lake. This is less than 4 percent of the 240MW load discharged via the approved once-through cooling system employed by Tallawarra Stage A.

The Tallawarra Stage B discharge would be mixed with that of Tallawarra Stage A prior to discharge into Lake Illawarra. The Tallawarra B discharge would result in:

- At most, 2.3 percent of the total combined flow rate to the lake;
- Less than a 0.1°C increase in temperature of the combined discharge for design and cold day scenarios;
- Less than a 0.1°C decrease in temperature of the combined discharge for a hot day (as the blowdown will be at a lower temperature than that of the heated water from Tallawarra Stage A);
- Less than a 1 percent increase in salt concentration of the combined discharge;
- No change in the relative density of the combined discharge under low lake salinity conditions; and
- Less than 0.02 percent increase in relative density of the combined discharge under high lake salinity conditions.

8.6 Hazards and risk

As part of the 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.

8.6.1 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.

Hazard analysis

As part of the power station development, it is likely that the dangerous goods listed in **Table 8-29** will be stored, handled and used.

Table 8-29 Possible dangerous goods storage

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	Lubricating Oil*	Combustible Liquid	C2	-	$20m^3$
3	Transformer Oil#	Combustible Liquid	C2	-	$65m^3$

*Per oil tank
#Per transformer

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**.

8.6.2 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;
- 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; 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.

8.6.3 Risk analysis

Both of the hazards subject to frequency analysis were considered at 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:

$FDT = \frac{1}{2} \lambda t$ where: λ = component failure rate (p.a.)

t = test period (1/no.tests per annum), assumed 1 in this case

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

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.

8.6.4 Mitigation and management

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 would be implemented to ensure that risks are minimised:

- The distance between the marker signs located along the pipeline route 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).

In addition to the above mitigation measures, it was 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.

8.7 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 easement 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 8-30** and **Table 8-31** below.

8.7.1 Significance assessment

Threatened Species Conservation Act (TSC Act)

Assessment steps have been identified by the Draft Guidelines for Threatened Species Assessment (The Department of Environment and Conservation and The Department of Primary Industries 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 to occur in the project area 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 areas 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.

Table 8-30 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 5 km north of the site.	Not required. No potential impact on the species or its habitat.
Zieria granulata 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 8-31 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*),	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	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
			Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. Dependent on large hollow-bearing eucalypts for nest sites (DECC, 2005)	hollows for this species, therefore no nesting habitat is considered to be available.	
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 to compound supports Typha (Cumbungi) reedland, considered to be potential habitat for this species. The proposed peaking 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 to the compound 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 bissects the main access road in between the two access gates to the compound 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 Peaking 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.

Scientific Name / Common Name	TSC	EPBC	Habitat	Likelihood of occurrence on project site	Further assessment required
Pandion haliaetus Osprey	V	-	Coastal areas, lower reaches of rivers, estuaries. Nests in tall, dead trees	Low likelihood of occurrence. No suitable habitat recorded. No potential nest trees recorded during the present study	Not required. No 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 bissects the main access road in between the two access gates to the compound supports Typha reedland, considered to be potential habitat for this species. The proposed Peaking 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: TSC – Threatened Species Conservation Act 1995; EPBC – Environment Protect and Biodiversity Conservation Act 1999; E – Endangered; V - Vulnerable

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 reedland 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, the nearest being at Coomonderry Swamp in Berry, which is 30 kilometres 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 the creek, it is unlikely for run-off to make its way into the creek. 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 affected by such edge-effects, particularly through weed invasion, which is already threatening the fragmented remnants adjoining the project site. All works will be conducted to council standards, 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 is at the known limit of its 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 CCGT 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 Mt Brown, linking with Lake Illawarra and includes much of the Tallawarra Lands and the project site. Development already fragments this corridor and as the location of works is 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 (EPBC Act)

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 8-32**.

Table 8-32 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 any tree of 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:
	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 Tallawarra Lands support 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 study 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.

Matter of NES	Comments
	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
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), 1994

This section addresses information required to satisfy an assessment of potential impacts under the *Fisheries Management Act 1994*, 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 or impact on the known or potential habitat of a threatened species as listed in the *Fisheries Management Act* 1994, no assessment of impact (under Section 5A of the EP&A Act) is required under Schedules 4 and 5 of the FM Act. Further, the study area does not contain 'critical habitat' as listed in the FM Act, 1994.

Schedule 6 of the *Fisheries Management 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 New South Wales watercourses.

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

8.7.2 Summary

The proposed Tallawarra Stage B CCGT power station is located within the footprint of a previous 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 (EECs) which are known from the area will be affected by the proposal.

Yallah Creek is upslope of the proposal and directly to the north-east. The existing footprint includes a road which abuts the creek line vegetation, identified as containing Illawarra Subtropical Rainforest EEC (Eco Logical, 2006) in the upper sections. No threatened fauna species are likely to be affected by the proposal. However, there is the potential for increased edge-effects from the development and future operation of the station.

8.7.3 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.

8.7.4 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 include:

- Lake Illawarra Flood Study (Cardno Lawson & Treloar Pty Ltd, 2001);
- Lake Illawarra Floodplain Risk Management Study and Plan, version 6 (Cardno Lawson & Treloar Pty Ltd, 2005); and
- Duck Creek Flood Study (Cardno Forbes Rigby, 2007).

The Lake Illawarra Flood Study investigates flooding from the Lake itself and the Floodplain Risk Management Study provides more detailed assessment of flooding from the lake and foreshores, while the Duck Creek Flood Study looks specifically at Duck Creek. Flooding directly from Yallah Creek was not investigated in any of the studies, and specifically there are no publicly available flood studies for Yallah Creek.

The flood study of Duck Creek (Cardno Forbes Rigby, 2007) was undertaken as part of the Local Environmental Plan (LEP) for the Tallawarra site. The report focused on flood risk to the site imposed by Duck Creek. Flooding from Duck Creek is limited to the south side of the Tallawarra Lands area. The report also considered the flood risk from the smaller tributaries within the Tallawarra Lands area; this included Wollingurry Creek, Barrons Gully and Pithungar Gully. Hydraulic calculations of flood extents for Pithungar Gully and Barrons Gully were undertaken and it was noted in the report that the top widths of flooding are considerably less than the riparian corridor widths for the watercourses examined. Hence the flooding from these tributaries is considered to be minimal.

The Tallawarra Lands Local Environmental Study was prepared by Willana Associates in December 2006. It draws upon work undertaken by Northrop Engineers and identifies a risk of flooding from two sources, Lake Illawarra and Duck Creek. Localised flooding was shown to affect the site in the vicinity of Yallah and Wollingurry Creek. Northrop carried out preliminary calculations and estimated a 1% AEP flood width of 20 metres (approximately) for Yallah Creek. This flood extent is shown in **Figure 6-5** with respect to the Tallawarra Stage B site. The boundary of the flood extent is approximately 35m away from the proposed power station development. Although the calculation of 'top width' is based on assumptions such as uniform channel shape and steady-state flow, it provides an indication of the flood envelope in the absence of detailed data. No data on flood levels were provided for Yallah Creek in the study.

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 an ephermal 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. The development site is not included within this inundated 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.

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 20m. 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

8.8 Aboriginal heritage

8.8.1 Assessment of impacts

The proposed Tallawarra Stage B CCGT 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 located. 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 that unrecorded items exist in the area.

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.

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 potential impacts of the proposed works on Aboriginal heritage would be localised and limited to the construction period. The proposed works could affect areas if appropriate mitigation strategies were not implemented during the construction phase.

8.8.2 Mitigation and management

As the area has been subject to previous heritage assessments (Kelleher Nightingale Consulting, 2006 and Salmon, 1998), 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.

8.8.3 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.

8.9 Visual

This section provides an assessment of the potential visual impacts of the Tallawarra Stage B CCGT 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.

8.9.1 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, and 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 CCGT power station by considering the visual modification and visual sensitivity of the surrounding areas.

8.9.2 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 8-33**. The degree of visual modification generally decreases as the distance between the proposed development and the viewer increases.

Table 8-33 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.

8.9.3 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 CCGT power station. The levels of visual sensitivity are shown in **Table 8-34**.

Table 8-34 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 to gain views of the plant.

8.9.4 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 8-35**).

- **Table 8-35 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 CCGT 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 CCGT 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 CCGT 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.

8.9.5 Visual impact assessment

Visual characteristics of the project

The proposed works would involve the installation of the Tallawarra Stage B CCGT 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 are described in **Section 5-5**. These include gas turbine generators and ancillary plant, high voltage switchyard, gas receiving station, distillate tanks and unloading station, emergency diesel generator and two above ground diesel storage tanks. The proposed exhaust stack would be approximately 60 metres in height (approximately 35 metres taller than the proposed turbine building) and 7 metres in diameter. 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 – The site showing location of the proposed Tallawarra Stage B CCGT plant and Tallawarra Stage A CCGT plant

Visual modification

There would be a moderate level of visual modification as a result of the proposal. Views of the Tallawarra Stage B CCGT plant would be obscured from the south by the Tallawarra Stage A CCGT plant. 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 Mt 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 stack which will be about 25 and 60 metres above ground level respectively.

Future industrial development within the Tallawarra Lands project, which would have a direct line 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 stack which is approximately 60 metres high 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.

8.9.6 Visual impact

A viewshed analysis was conducted to determine the locations from which the proposed power station may be visible (**Figure 8-15**). The model assumes no existing vegetation coverage or screening from other objects and structures and has been modelled on a maximum height of 60 metres, which would be associated with the stack. Hence the zone of influence is a 'worst case' and the power station may not actually be visible from all locations shown.

The extent of visual impacts can be more easily identified from the 3D visual simulations provided in **Figures 8-16** to **8-17** and the photomontage (refer to **Figure 8-18**), which show the unaffected and filtered view lines from three assessment points to the north, south and east of the site, respectively.

As shown in **Figure 8-16** the vast majority of existing residences to the north of the site are screened from views of the proposed power station by Mount Brown. Long distance views may be possible from residences along Gilba Road, although these would be at a distance of over 1km and a dense stand of vegetation exists in between the residences and the power plant.

Figure 8-16 also 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 south of the site and to residences along Mount Warrigal on the eastern shores of Lake Illawarra. However, the Tallawarra Stage B CCGT plant is to be constructed in a consistent style to the Tallawarra Stage A CCGT plant, 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.

8.9.7 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.

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 provision of 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.

Figure 8-15: Viewshed generated from CCGT Stacks (60m high)

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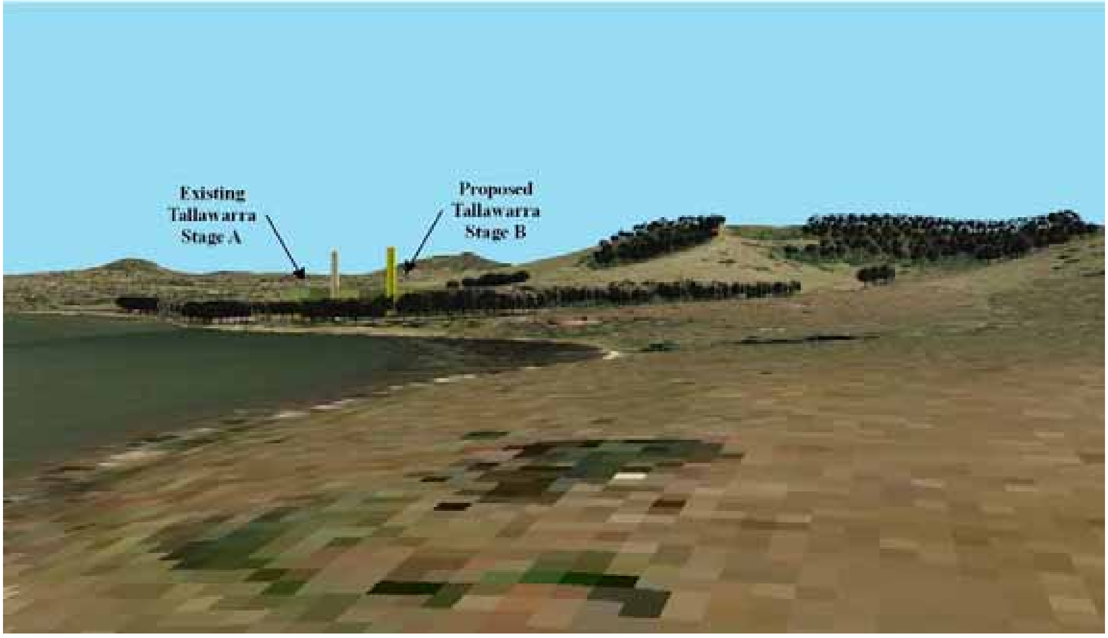
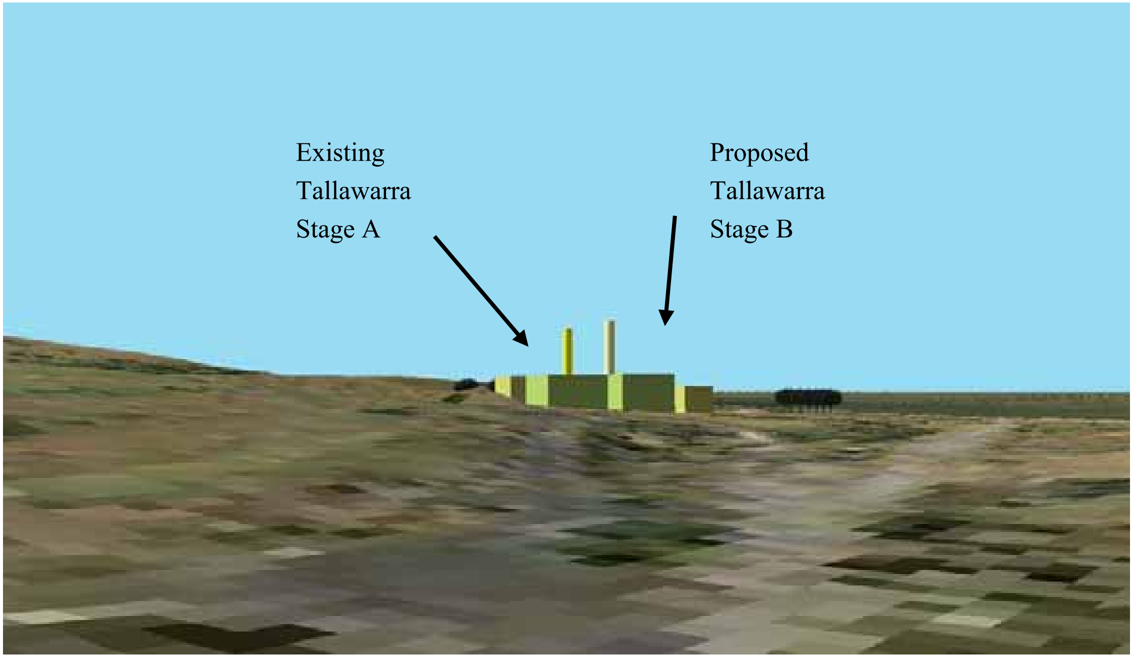
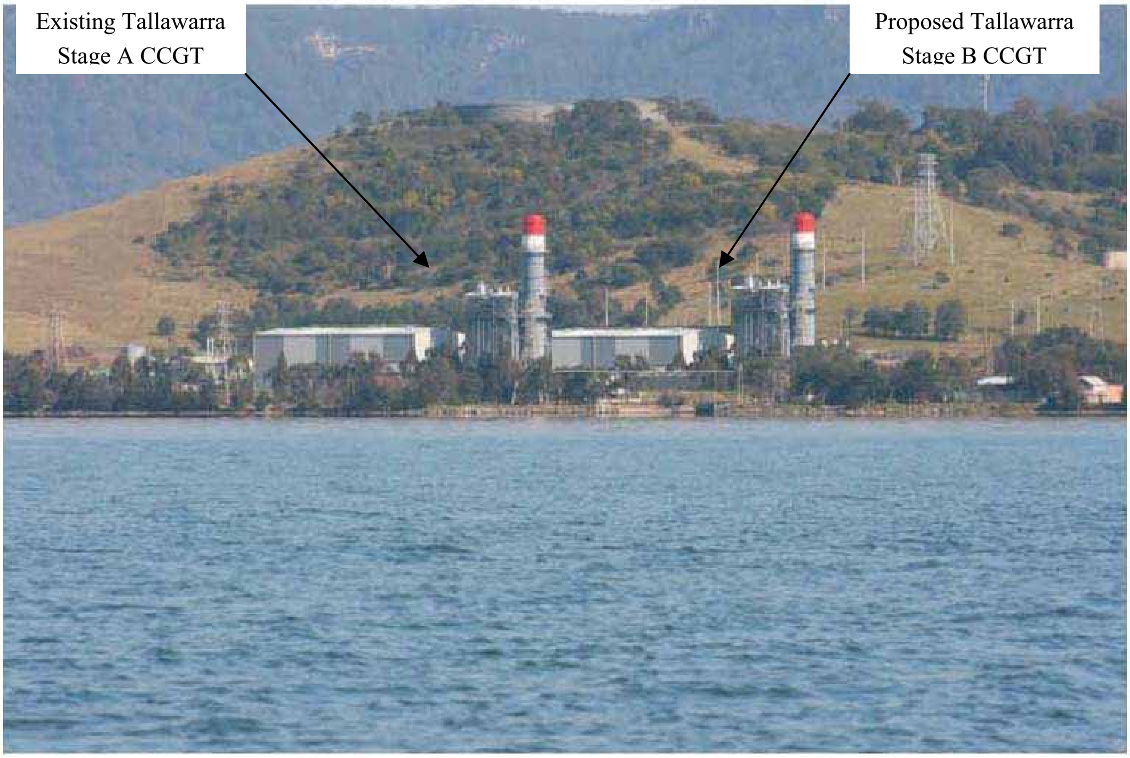
■ **Figure 8-16 3D visual simulation – looking south**



■ **Figure 8-17 3D visual simulation – looking north**



- **Figure 8-18 Photomontage of the proposed Tallawarra Stage B CCGT Power Station – looking west**



8.9.8 Summary

The visual impact of the proposed Tallawarra Stage B CCGT 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 35 metres above the power station building. 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.

8.10 Traffic and transport

8.10.1 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 power station, the Tallawarra Stage A plant will be fully operational. Hence, the operational traffic from the Tallawarra Stage A plant must be taken into account when determining traffic volumes during the Tallawarra Stage B plant construction. 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 the Tallawarra Stage A power station 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

An additional 15 to 20 personnel will be required to operate the Tallawarra Stage B CCGT plant, resulting in additional vehicle movements to and from the site. Operational traffic will also comprise a small number of delivery, maintenance and waste removal trucks. The existing road network in the vicinity of the Tallawarra site is considered to have sufficient capacity to cater for the additional vehicle movements.

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.

8.10.2 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.

8.11 Waste

The development of the Tallawarra Stage B CCGT 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); and
- General waste from operation of the facility (waste water, packaging materials and office wastes).

Detail on each of these waste streams is provided below.

8.11.1 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 stages of the project, in accordance with the following legislation and policies that provide the statutory framework for waste management in NSW.

8.11.2 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.

Spoil generation

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.

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. 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 recycle. 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 B CCGT 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.

8.11.3 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.

8.11.4 Mitigation measures

Mitigation measures for wastes generated by the proposal are discussed below.

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; and
- 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 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.

8.11.5 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.