10.1 Introduction

URS carried out an Air Quality Impact Assessment which is presented in full as **Appendix E**. The study of the likely impacts of the Biomass Power Plant covered:

- impact on local air quality; and
- plume rise in relation to aviation safety.

The assessment of plume rise is summarised in **Chapter 13**.

The air quality assessment involved an analysis of the operation of the Power Plant, including the combustion process.

The type of fuel being combusted can have a significant influence on the composition of the emissions generated. The facility will use around 57,700 tpa of wood waste. The proposed fuel is considered as a *Standard Fuel* (as defined in *The Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005*) for assessing air quality impacts.

10.1.1 Emissions Inventory

The primary source included in this assessment was emissions from the main (flue gas) stack. Emissions would comprise combustion air that has particulate matter removed through soot removers and an ESP. Ash and soot would also be generated from the combustion process and directed to a bottom ash transport system and conveyed to the Ash Silo. These sources would be covered and minimal particulate matter would be generated. Consequently, these sources were excluded. Particulate matter from the processing of wood was also excluded from the assessment, as these emissions are considered to be localised and not a significant contributor to particulate emissions from the proposed operation.

The air pollutants found to be of significance and considered in this assessment are presented below.

- Oxides of nitrogen (NO_X) - For the purposes of this assessment, it has been conservatively assumed that all NO_X emissions are emitted as NO_2.
- Ozone - The potential for smog generation in Eden and similar rural locations is considered to be low given that there are few major industrial sources of hydrocarbons in the area, and emissions of NO_X and non-methane hydrocarbons (NMHCs) from vehicles would be significantly lower than the levels experienced in major metropolitan air sheds such as Sydney and Melbourne. Photochemical smog is unlikely to occur due to operation of the Power Plant and consequently ozone has not been assessed.
- Particulate Matter (PM) - The major emission from wood boilers is PM. These emissions depend primarily on the composition of the residue fuel burned and the particulate control device installed. The majority of the particles generated from the wood fired boiler will be controlled using an ESP with the remainder and comprising PM less than 10 microns in diameter (PM_{10}). ESPs remove larger sized particles and collection efficiencies of 90 to 99 % for PM have been observed for ESPs operating on wood-fired boilers. As the emissions of PM from the main stack would comprise principally PM_{10}, other larger forms of PM, namely Total Suspended Particulates and Deposited Dust have been excluded from the assessment.

- Carbon monoxide (CO) - CO would be produced as a result of the combustion process and emitted within the exhaust flue gas stream. Nearly all of the fuel carbon (99%) in wood residue is converted to CO_2 during the combustion process. The majority of the fuel carbon not converted to CO_2 due to incomplete combustion, is entrained in the bottom ash. Consequently, CO is not a significant pollutant, although it was included in the assessment for thoroughness.
- Sulphur dioxide (SO_2) - When released into the atmosphere SO_2 can combine with water to generate acid rain. SO_2 is generated through the combustion of sulphur containing fuels such as coal, petrol and diesel. Given the low content of sulphur within the biomass fuel, SO_2 emissions are not expected in large quantities, however it has been included for thoroughness.
- Hazardous Air Pollutants (HAPs) - HAPs such as dioxins and furans can be formed in combustion environments under certain conditions. The formation of such compounds is often heavily dependent on combustion temperature and residence time. For the purposes of this assessment, HAPs have been further defined into Dioxins and Furans, Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs) - specifically formaldehyde, and metals - specifically cadmium.
- Hydrogen Fluoride (HF) - Whilst several HAPs are known to be generated by the combustion of wood, HF is not considered a significant pollutant and is associated more with coal combustion than with wood combustion. Compounds containing fluorine were not identified in the biomass analysis. This suggests the sources of fluorine and the process are not likely to generate appreciable concentrations of HF, consequently HF has not been further assessed.
- Lead - A range of metals are known to be present in wood waste combustion products, including lead and associated compounds. Lead has been considered along with other metallic HAPs in this assessment.

10.1.2 Emissions Standards

The NSW *Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005* (Clean Air Regulation) sets emission limits (as in-stack concentrations) for air impurities from stationary plant and equipment. The current standards, relevant to the proposed Power Plant are presented in **Table 10-1**.

Table 10-1 Emission Standards for Electricity Generation

Pollutant	Applicability	Limit (Group 6 sources)
NO_2 or NO or both as NO_2 equivalent [A]	Any boiler operating on a fuel other than gas, including a boiler used in connection with an electricity generator that forms part of an electricity generating system with a capacity of less than 30 MW	500 mg/m^3 as NO_2
Smoke	Any activity or plant using a liquid or solid standard fuel or a non-standard fuel	Ringelmann 1 or 20% opacity
Solid Particulates (Total)		50 mg/m^3
Fluorine (F_2) and any compounds containing fluorine, as total fluoride (HF) equivalent.		

Source: *Schedule 3, POEO (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005*

The DECCW Air Quality Impact Assessment Criteria specify a range of criteria for toxic and odorous air pollutants. The impact assessment criteria for those pollutants associated with the proposed Power Plant are shown in **Table 10-2**.

Table 10-2 DECC Impact Assessment Criteria for Modelled Pollutants

Pollutant	Averaging Period	Frequency	Cumulative / Incremental impact [A]	Concentration	
Criteria Pollutants				(ppm)	($\mu g/m^3$)
NO_2	1 hour	100%	cumulative	0.12	246
	Annual	100%	cumulative	0.03	62
PM_{10}	24 hour	100%	cumulative	-	50
	Annual	100%	cumulative	-	30
SO_2	10 minutes	100%	cumulative	0.25	712
	1 hour	100%	cumulative	0.20	570
	24 hours	100%	cumulative	0.08	228
	Annual	100%	cumulative	0.02	60
CO	15 minutes	100%	cumulative	87	100,000
	1 hour	100%	cumulative	25	30,000
	8 hours	100%	cumulative	9	10,000
Lead	Annual	100%	cumulative	-	0.5
Hazardous Air Pollutants				(ppm)	(mg/m^3)
Formaldehyde	1 hour	99.9 %	incremental	0.02	0.018
Cadmium	1 hour	99.9 %	Incremental	N/A	0.000018
Dioxins and Furans [B]	1 hour	99.9%	incremental	-	2.0×10^{-9}
PAH (as benzo[a]pyrene) [C]	1 hour	99.9%	incremental	-	0.0004

Notes:
- = not applicable
Gas volumes expressed at 250C and 101.3 kPa (DEC 2005);
A: Cumulative impact refers to the addition of an ambient air background concentration when assessing plant impact, whilst incremental refers only to predicted concentration derived from the plant.
B: Dioxins and furans reported as toxic equivalent using toxic equivalence factors listed in clause 29 of the Clean Air Regulation.
C: Polycyclic Aromatic Hydrocarbons (PAH) as benzo[a]pyrene (BaP) reported using potency equivalency factors, as defined in DEC (2005).

10.2 Existing Environment

10.2.1 Climate

The area experiences warm summers and mild winters as expected in coastal regions, where the water has a moderating influence on temperature. The mean daily maximum temperature is approximately 21°C during summer and 15°C during winter. The area receives moderate rainfall having a mean annual rainfall of 747 mm over an average of 109.5 rain days per year.

10.2.2 Meteorology

The nearest weather stations are the Merimbula Airport Automatic Weather Station (AWS) and the Green Cape Lighthouse AWS, both located approximately 20 km from the Site. Because of their distances from the Site, the meteorological data used in the assessment was generated using CSIRO's The Air Pollution Model (TAPM).

TAPM meteorological data show the dominance of winds from the south west and north east. Summer winds are primarily from the north east, and autumn winds are from the south west. Winds from the south west dominate in winter, and spring shows a more uniformly spread of wind direction with a slight dominance of winds from the north east and south west quadrants. An assessment of the meteorological data generated is provided in Appendix B of the Air Quality Assessment **(Appendix E).**

10.2.3 Ambient Air Quality

No DECCW monitoring stations or other monitoring data was available for the local region at the time of assessment. In order to quantify cumulative air quality impacts, URS adopted background concentrations obtained from a DECCW monitoring station at Wollongong in 2007 (DECC 2008). It is noted that this data would present higher concentrations than would be apparent at Eden, given the lack of emission sources in the area. The Eden local area consists of a more rural environment, with fewer combustion and industrial sources, while Wollongong is highly urbanised with numerous industrial sources which would contribute to increased pollutant concentrations in the local air shed.

Table 10-3 Summary of Background Data Used in Air Quality Modelling

Species	Averaging Time	Monitoring Station	Maximum Background Concentration ($\mu g/m^3$)[C]	Air Quality Criteria ($\mu g/m^3$)
NO_2	1 hour	Wollongong	81	246
	Annual	Wollongong	17	62
PM_{10}	24 hour	Wollongong	47.6[A]	50
	Annual	Wollongong	19.5	30
SO_2	10 minutes	Wollongong	[B]	712
	1 hour	Wollongong	84	570
	24 hour	Wollongong	21	228
	Annual	Wollongong	3	60
CO	15 minute	Wollongong	[B]	100,000
	1 hour	Wollongong	3	30,000
	8 hour	Wollongong	2	10,000
Lead [D]	Annual	Wallsend	0.09	0.5

Notes:

A: PM_{10} 24 hour average reported as 99th percentile. The maximum for the reported year (58.8 $\mu g/m^3$) is above air quality guidelines due to bushfires (DECC 2008) and thus the 99th percentile has been adopted.

B: Concentrations with an averaging time of less than 1 hour have been determined from 1 hour concentrations.

C: Values taken from DECC (2008).

D: Lead concentration conservatively assumed to be 0.09 $\mu g/m^3$, being the highest measured value in NSW over the past several years. The value of 0.09 $\mu g/m^3$, was measured in Wallsend in 2003 (DECC 2008).

10.3 Methodology

The assessment comprised of two primary components, namely a comparison of in-stack concentrations to the limits specified in the NSW *Protection of the Environment Operations (Clean Air) Amendment (Industrial and Commercial Activities and Plant) Regulation 2005* (Clean Air Regulation) and a comparison of ground level concentrations against criteria contained in the *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW* (DEC 2005).

To assess the likely impact of the proposed Power Plant on local and regional air quality, the study included:

- an assessment of existing local climate and meteorological characteristics;
- an analysis and summary of existing air quality in the region; and
- dispersion modelling of pollutants such as NO_2, CO, SO_2, PM_{10}, lead and HAPs.

10.3.1 Emission sources

A single point source was included in the modelling (flue gas stack). Stack parameters and emission rates are outlined below and presented with more detail in **Appendix E**).

10.3.2 Normal Plant Operation

The manufacturers' design specifications were obtained for the key pollutants of concern from the main stack, which are Nitrogen Oxides (NO_X, assumed to be present as NO_2), particulate matter (assumed to be PM_{10}) and CO. Emission rates for other pollutants assessed (sulphur dioxide, lead and HAPs) have been estimated using emission factors derived from other sources. It should be noted that emission factors were developed from a number of boilers potentially utilising wood waste including municipal landfill waste which would potentially be contaminated. Given that the proposed Power Plant would only use uncontaminated wood waste, these emission factors are deemed conservative. A summary of the stack emissions is provided in **Table 10-4**.

10.3.3 Plant Start Up and ESP Maintenance Emissions

SEFE would employ a range of measures to mitigate against varying pollutant emissions during plant start-up and maintenance scenarios. Emissions during 'start-up' would be controlled through an Air Quality Management Plan for the facility, and the Power Plant would not be operational during maintenance to the ESP. No further assessment of emissions during 'start-up' or shut-down periods was considered warranted for this investigation.

Table 10-4 Summary of Main Stack Parameters and Emissions

Stack Parameter	Units	Value
Stack Height (above ground level)	m	35
Stack Diameter	m	1.6
Exit Temperature	°C	180
Oxygen	Vol %	5.15
Exit Velocity	m/s	11.2
Mass Flow Rate	Nm^3/hr (wet)	49,000
Mass Flow Rate	Nm^3/hr (dry)	35,770
Stack Emissions	**Units**	
Criteria Pollutants		
NO_x (as NO_2)	g/s	5.62
CO	g/s	1.97
SO_2	g/s	1.38
PM_{10}	g/s	0.56
Lead	g/s	2.26×10^{-3}
Hazardous Air Pollutants		
Formaldehyde	g/s	0.57
Cadmium	g/s	7.02×10^{-5}
Dioxins and Furans		
Total Dioxins and Furans	g/s	4.95×10^{-9}
PAH		
Total PAH as Benzo[a]pyrene	g/s	2.82×10^{-7}

Notes:
The toxic equivalents (TEQs) used to estimate dioxin, furan and PAH concentrations and emission are detailed in **Appendix E**.
All NO_X has conservatively been assumed to be present as NO_2.

10.3.4 Receptor Locations

A 10 km by 10 km gridded receptor domain, with a 500 m grid spacing was modelled. A large domain range was used in order to predict any impacts within the Eden urban area, across the bay from the Site. Four discrete receptors were also represented in the modelling inputs, these being:

- Receptor 1 - Edrom Lodge (760398 mE, 5889072 mN, MGA);
- Receptor 2 - Boydtown (756273 mE, 5889474 mN, MGA);
- Receptor 3 - Eden (South) (758982 mE, 5892994 mN, MGA); and
- Receptor 4 - Eden (Town Centre) (758156 mE, 5894126 mN, MGA).

The locations of the sensitive receptors are shown below in **Figure 10-1** and **Figure 10-2**.

10.3.5 Building Wake Effects

Building wake effects were incorporated into CALPUFF using the Building Profile Input Program. The most significant building that would influence building wakes is considered to be the boiler housing, with a height of 21 m, a width of 16 m and a length of 30 m.

10.3.6 Potential Discharges to Air during Construction

A quantitative assessment of emissions such as dust during construction has not been included in this assessment however, mitigation measures to minimise adverse air quality impacts during the construction process have been included (**Section 10.5**). The assessment of air quality during construction is to be addressed in the Construction Environmental Management Plan.

10.3.7 Potential Discharges to Air during Operations

For the operational phase of the project, a quantitative review of air quality impacts was undertaken using dispersion modelling. The modelling investigated a range of air pollutants likely to be emitted from the plant including NO_X, PM_{10}, CO, SO_2, lead and HAPs.

10.3.8 Scenarios Assessed

A single dispersion modelling scenario has been completed for normal plant operation. The modelling scenario considered constant emissions over a single year (2007).

The assessment has used a conservative approach applied in accordance with the *Approved Methods* (DEC 2005). Where appropriate, the assessment of the cumulative impacts against regulatory criteria has used the aggregate of the worst case predicted plant impacts and peak background concentrations from DECCW and other relevant monitoring stations.

10.4 Impact Assessment

Incremental concentrations predicted at each discrete receptor have been tabulated against the maximum predicted concentration over the entire modelling domain. The results show that none of the modelled pollutants are present at concentrations that exceed the DEC (2005) guidelines.

The contour plots for the criteria pollutants NO_X and PM_{10} are presented in **Figure 10-1** and **Figure 10-2**. The full compliment of contour figures is presented in **Appendix E**.

The contour plots for all criteria pollutants over all modelled durations show that the peak ground level concentrations are generally restricted to regions within 1 km of the plant.

10.4.1 Comparison to Emissions Standards

As presented in **Table 10-5**, the ESP emissions proposed for the facility comply with the relevant emission limits specified in the Clean Air Regulation.

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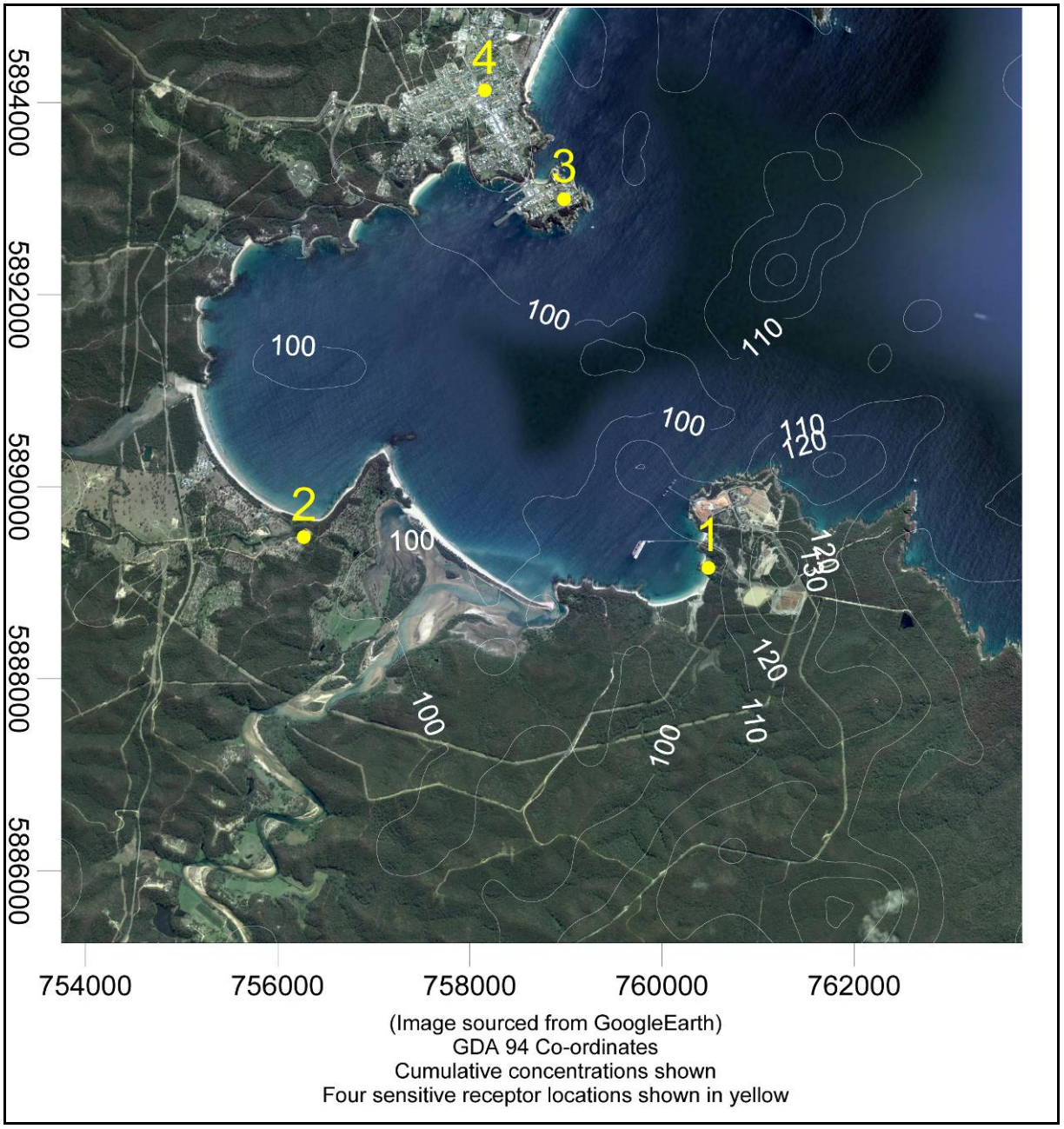

Figure 10-1 Nitrogen Oxides (NO_X) Concentration Annual average ($\mu g/m^3$)

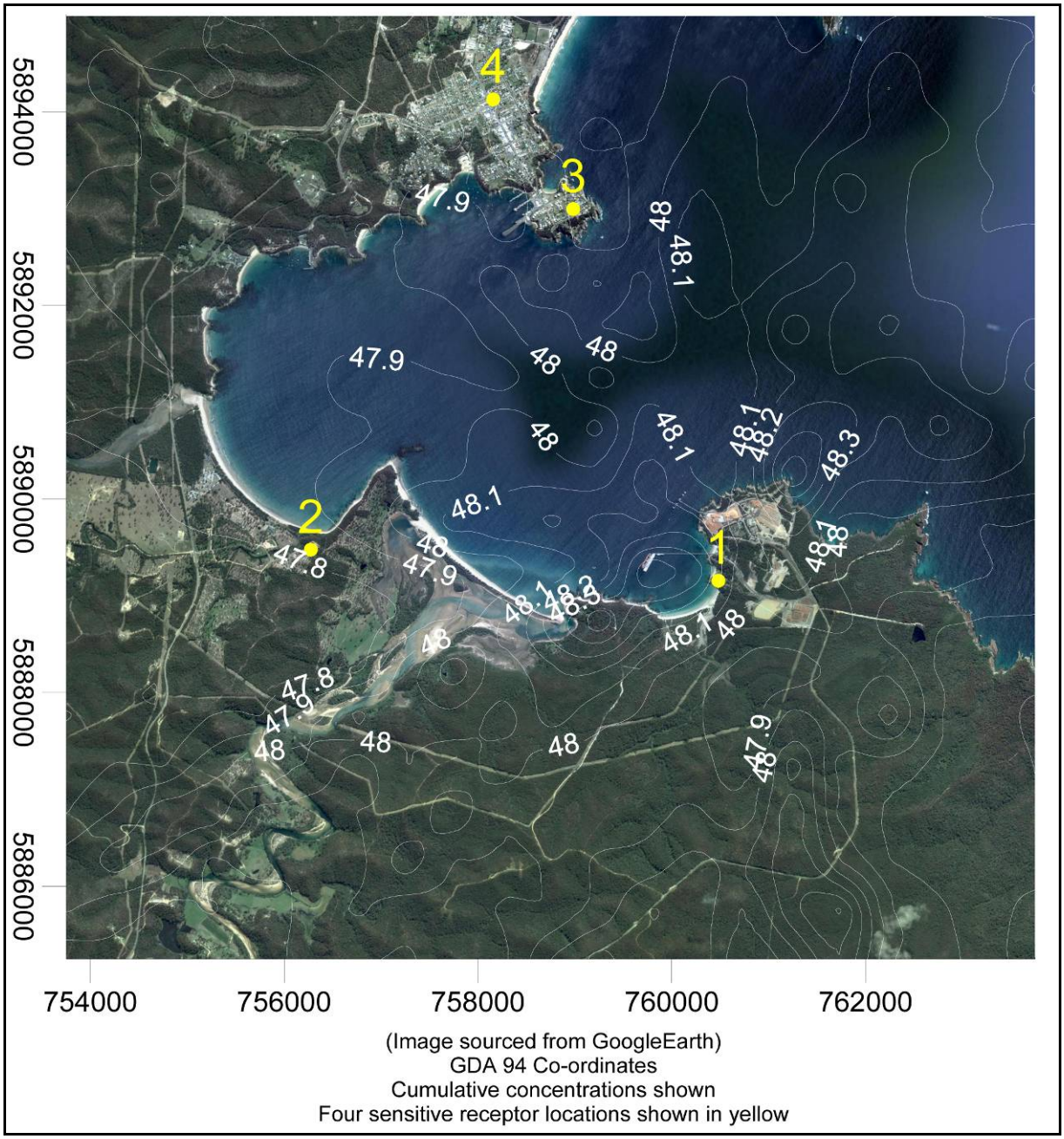

Figure 10-2 Particulate Matter (PM_{10}) Concentration 24 hour average ($\mu g/m^3$)

Table 10-5 Proposed In-stack Concentration Compared to Regulatory Criteria

Pollutant	Limit (Group 6 sources)	Proposed Concentration	Conformance to regulatory criteria
Solid Particulates (Total)	50 mg/m^3	50 mg/m^3	Yes
NO_2 or NO or both as NO_2 equivalent [A]	500 mg/m^3 as NO_2	500 mg/m^3	Yes
Fluorine (F_2) and any compounds containing fluorine, as total fluoride (HF) equivalent.	50 mg/m^3	< 50 mg/m^3	Yes
Smoke	Ringelmann 1 or 20% opacity	< 20% opacity [A]	Yes

Notes

[A]: Opacity of the emissions has not been provided, however, emissions from the Electrostatic Precipitator are expected to meet regulatory criteria.

10.4.2 Comparison to DECC Air Impact Assessment Criteria

Emissions NO_X (as NO_2), CO, SO_2, PM_{10} and lead emissions from the Power Plant, when added to background concentrations, were below regulatory criteria. Dioxins, furans, PAHs, VOCs and metals were also assessed for incremental impact and were below regulatory criteria. No adverse impacts on local air quality are expected as a result of these pollutants.

10.5 Mitigation Measures

Table 10-6 Mitigation Measures

Mitigation Measure	Project Stage		
	Pre construction	Construction	Operations
A Construction Environmental Management Plan will be prepared to addresses air monitoring and management.	✓	✓	
In dry, windy conditions, water sprays would be used to dampen down soils prior to excavation and handling. Exposed surfaces and stockpiles would also be watered, sprayed or covered where required.		✓	
Vehicles would only be loaded to less than the height of the side and tailboards and loads of fill would be covered during transport. Any soil adhering to the undercarriage and wheels of trucks would be removed prior to departure from the site.		✓	
Any long-term stockpiles would be stabilised using fast-seeding grass or synthetic cover spray.		✓	
All major access roads are sealed and vehicle speeds on unsealed site areas would be controlled to minimise dust.		✓	
The operation of the facility would not occur during maintenance on the ESP.			✓
Control of emissions during 'start-up' will be via an Air Quality Management Plan for the facility.			✓