GREENHOUSE GAS AND AIR QUALITY 13

13.1 INTRODUCTION

The proposed expansion would increase ore throughput and introduce a new open pit mine. As a result, the operation would consume more energy and the number of potential emission sources would increase. This chapter describes the effect of the proposed expansion on air quality and public amenity values, and quantifies the emissions of greenhouse gases, particulates and other gaseous emissions and their impacts on ambient air quality. Greenhouse gases are described separately to other emissions in Section 13.2.

The potential effects of airborne emissions from the proposed expansion on wildlife and on human health and safety are addressed in Chapter 15, Terrestrial Ecology, and Chapter 22, Health and Safety, respectively. Climate change is discussed in Chapter 8, Meteorological Environment and Climate, and provides a context to the assessment of greenhouse gas emissions and air quality in this chapter. The assessment of existing and predicted radon and radionuclide concentrations is in Chapter 22, Health and Safety.

13.2 GREENHOUSE GAS ASSESSMENT

13.2.1 INTRODUCTION

As a result of the expansion, energy consumption would increase, particularly electricity and diesel. This would increase greenhouse gas emissions and necessitate additional greenhouse gas management. The overall approach to greenhouse gas management for the proposed expansion would be to:

- apply a goal of reducing greenhouse gas emissions (reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008) to an amount equivalent to at least a 60% reduction (to an amount equal to or less than 40%) of 1990 emissions, by 2050
- constructing an on-site cogeneration power station (250 MW capacity) for recovering waste heat
- sourcing renewable energy (35 MW capacity) via the national electricity market for the seawater desalination plant
- producing an annual ‘road map’ that quantifies emission reduction opportunities and achievements.

This chapter reviews the current legislative environment as it applies to greenhouse gases and assesses the greenhouse gas emissions for the proposed expansion in the context of emissions from the existing operation, and compares them to projected emissions from South Australia, Australia and the rest of the world. Potential mitigation measures are also identified.

13.2.2 ASSESSMENT METHODS

The emissions generated from the following sources were used to assess the potential greenhouse gas footprint of the expanded operation:

- stationary energy emissions (i.e. from fuel burning equipment like furnaces)
- transport fuel emissions
- emissions associated with using electricity
- emissions associated with changes to land use (such as land clearing)
- emissions associated with oxidation reactions within the metallurgical process, the rock storage facility (RSF) and the tailings storage facility (TSF).

The scope of the greenhouse gas assessment was the entire expansion project including the export of concentrate via the Port of Darwin as outlined in Chapter 5, Description of the Proposed Expansion. The assessment estimated emissions from electricity purchased through the national electricity market (NEM) as a worst case. The addition of an on-site combined cycle gas turbine (CCGT) power station would reduce the emissions estimated in Section 13.2.5.

Greenhouse gases

Greenhouse gases include gases such as water vapour, carbon dioxide, methane, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) that absorb and re-emit infra-red radiation (heat), which warm Earth's surface and contribute to climate change. The greenhouse effect, which is synonymous with climate change and global warming, has recently been defined as 'any change in climate over time, whether due to natural variability or as a result of human activity' (IPCC 2007).

The impact of greenhouse gas emissions on the atmosphere is the combined effect of the radiative properties of the gases (that is, their ability to absorb solar and infra-red radiation) and the time that it takes for those gases to be removed from the atmosphere by natural processes. In order to compare the relative effects of different gases over a particular time period, Global Warming Potentials (GWP) are used, referenced in units of carbon dioxide equivalents (CO_2-e); carbon dioxide is used as the base reference, and has a GWP of 1. There are six major groups of greenhouse gases, which are listed in Table 13.1. The table also shows the GWP for each of the gases, calculated over a 100-year time scale. The table indicates, for example, that an emission of 1 kg of methane has the same global warming potential as an emission of 21 kg of carbon dioxide: if 1 kg of carbon dioxide is emitted together with 1 kg of methane, the total emission would be valued at 22 kg of CO_2-e (see Figure 13.1).

Table 13.1 Greenhouse gas categories and indicative global warming potentials[1]

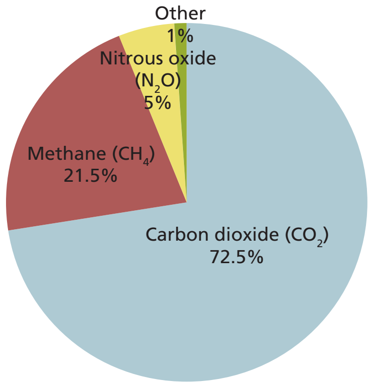
Greenhouse gas	GWP range
Carbon dioxide	1
Methane	21
Nitrous oxide	310
Hydrofluorocarbons (HFC)	150–11,700
Hydrofluoroethers (HFE)	100–500
Perfluorocarbons (PFC)	6,500–23,900

[1] Sourced from National Greenhouse Accounts Factors (Department of Climate Change 2008).

Emission factors

The emissions for the existing Olympic Dam operation were calculated by multiplying the volume or mass of a greenhouse gas emitting fuel or process by an emission factor, to generate a value for the likely amount of CO_2-e emitted. The CO_2-e value accounts for the various greenhouse gases emitted, taking into account their respective GWP and the amount emitted.

The emission factors used in this study were sourced from the National Greenhouse and Energy Reporting (Measurement) Determination 2008 or, where NGER factors were not available, the National Greenhouse Accounts Factors (Department of Climate Change 2008). NGAF factors were also used to determine scope 2 and 3 (indirect) emissions. A list of the emission factors used is provided in Appendix L1.



Source: UNFCCC Synthesis and Assessment Report on the Greenhouse Gas Inventories 2008

Figure 13.1 Contribution of various greenhouses gases to Australia's overall greenhouse gas emissions

The electricity emission factor declines slightly over time (i.e. the CO_2-e per MWh of electricity consumed decreases), reflecting the de-carbonisation of the South Australian electricity mix as the proportion of coal used to generate electricity declines and the proportion of fuels such as natural gas and renewables increases (ABARE 2006). This is shown in Table 13.2.

Table 13.2 Electricity emission factor over time

Development phase	Emission factor (kg CO_2-e per MWh)
Existing	840
Initial development (to 20 Mtpa ore)	840
Intermediate development (to 40 Mtpa ore)	840
Full capacity of expansion (to 60 Mtpa ore)	803
At closure (Year 40)	734

The de-carbonisation of the electricity mix referred to above does not include the de-carbonisation that may occur as a result of compliance with the South Australian *Climate Change and Greenhouse Emissions Reduction Act 2007* targets, under which the state has committed to producing 20% of electricity from renewable sources by 2014.

Other emission sources

Metallurgical process

CO_2 is emitted from the metallurgical process when flotation tailings containing carbonate minerals are leached with sulphuric acid to facilitate the extraction of copper and uranium. The primary carbonate is siderite ($FeCO_3$) and the proportion of other carbonates (including dolomite) is relatively small. Siderite displays around 80% solubility during leaching (i.e. around 20% remains unreacted after the leaching process has finished, releasing no CO_2). Emissions from the proposed metallurgical plant were estimated using ore feed geochemical data (further information is presented in Appendix L1).

Tailings storage facility

The emission of CO_2 from the tailings storage facility (TSF) occurs as acidic seepage is neutralised by the underlying limestone in the following series of reactions:

$$H^+ + CaCO_3 \rightarrow Ca^{2+} + HCO_3^-$$

The bicarbonate that forms reacts further as follows:

$$HCO_3^- + H^+ \rightarrow H_2CO_3 \rightarrow H_2O + CO_2$$

For the purpose of this assessment, a seepage rate from the TSF of 3,200 m^3/d, at an acidity of 43 g $CaCO_3$ eq/L, has been used to estimate potential CO_2 generation. This equates to about 22,230 tonnes of CO_2 per cell per annum while the tailings are actively deposited in the cell. Thereafter the rate of generation would decrease as percolation decreases. See Appendix L1 for further details.

Rock storage facility

In a process similar to that occurring within the metallurgical plant, acidic liquor generated within the rock storage facility (RSF) (as a result of reactions between rainfall and reactive mine rock) would react with carbonates in the mine rock, and release CO_2. The CO_2 would permeate the RSF and be emitted to atmosphere. The volume of CO_2 emitted would depend on a number of factors including the volume of rainfall entering the RSF, the reaction kinetics that generate acid and subsequently the potential of the acidic leachate to contact carbonate materials. It would be many years before the RSF begins emitting CO_2 and the process would continue for at least one or two hundred years after closure as the water within the pores of the RSF percolates through the facility. Emission estimates from the RSF were provided by ENSR Australia Pty Ltd (ENSR) based on geochemical information from the RSF geochemical studies (see Chapter 12, Groundwater, and Appendices K4 and K5 for details).

Land use change

In addition to the above-mentioned sources, land use change associated with land clearing for infrastructure results in one-off greenhouse gas emissions. Emissions from changes to land use were estimated by applying the FullCam model from the National Greenhouse Accounting Toolkit to the areas of land that would be cleared over the life of the expanded operation, as discussed in Chapter 15, Terrestrial Ecology. The assumptions used in the model are outlined in greater detail in Appendix L1.

Scope 1, 2 and 3 emissions

Emissions are reported in terms of scope, which defines how and where the greenhouse gases are generated within an organisation. Scope 1, 2 and 3 emissions are included in this assessment, and are defined in Table 13.3 and detailed further in Appendix L1.

The exact boundaries of scope 3 emissions are subjective. However, for the purpose of this greenhouse gas assessment, scope 3 is considered to include all transport-related emissions generated within Australia, but does not include emissions from the end use of products produced at Olympic Dam, or overseas transport.

Greenhouse gas regulation and policy

The regulation of greenhouse gases and associated policy can be broadly divided into five areas:

- international
- national
- state
- the BHP Billiton Group
- BHP Billiton (i.e. the Olympic Dam operation).

Each of these is summarised below and discussed in greater detail in the Appendix L1.

International

The major international agreement is the Kyoto Protocol, which Australia ratified in 2007. The protocol caps Australian greenhouse gas emissions to 108% of 1990 levels during the first commitment period (2008–2012). Australia was one of only three countries – the other two being Norway and Iceland – granted an increase to its emission levels over its 1990 base year. In contrast, other developed countries collectively agreed to reduce their aggregate greenhouse gas emissions by at least 5% from 1990 levels in the first commitment period (2008–2012).

The 'Bali Roadmap' was an outcome of the 2007 United Nations Framework Convention on Climate Change conference, and outlines actions to be undertaken after the first commitment period of the Kyoto Protocol ends. For developed countries, this is likely to necessitate quantitative commitments to cap greenhouse gas emissions.

Table 13.3 Greenhouse gas emission scopes

Scope	Description
1	Direct emissions from sources within the boundary of an organisation (e.g. fuel used on-site)
2	Indirect emissions from the consumption of purchased electricity
3	All other indirect emissions associated with the activities of an organisation

National

The National Greenhouse Strategy was developed in 1998 as Australia's response to climate change, providing a strategic framework without specifying state or project-specific targets. The Australian Greenhouse Office (now the Department of Climate Change) was established to coordinate Commonwealth action on climate change matters.

Greenhouse Challenge was initiated as a voluntary program between the Australian Government and industry to abate greenhouse gas emissions and increase energy efficiency. Greenhouse Challenge Plus builds on the Greenhouse Challenge program, integrating other initiatives (such as Generator Efficiency Standards and the Greenhouse Friendly program) into a single industry program. The aim of the voluntary Greenhouse Challenge Plus program is to:

- reduce greenhouse gas emissions (including promotion of awareness of greenhouse gas abatement opportunities in industry)
- accelerate the uptake of energy efficiency opportunities
- integrate greenhouse issues into business decision making
- provide more consistent reporting of greenhouse gas emissions.

Mandatory reporting requirements for sizable emitters was introduced in the *National Greenhouse and Energy Reporting Act 2007* (NGER Act) from July 2008. The NGER Act has been designed to provide robust data as a foundation for an Australian Emissions Trading Scheme, and to thereby facilitate the reporting of abatement and offsets before an emissions trading scheme commences. A timeline for introducing the emissions trading scheme, released in March 2008, indicates a national emissions trading scheme is likely to commence in 2010.

The NGER system will provide company-level information on greenhouse and energy efficiency performance to the public and create a single online entry point for reporting. Reporting will be administered by the Australian Government Department of Climate Change.

The *Energy Efficiency Opportunities Act 2006* was developed to improve the method of identifying and evaluating energy efficiency opportunities. The Act requires organisations to submit five-year plans that set out proposals for assessing their energy usage and to identify efficiency projects.

South Australian

The South Australian Government has developed a South Australian greenhouse strategy for tackling climate change based heavily on the *Climate Change and Greenhouse Emissions Reductions Act 2007*.

The key objectives of the legislation are:

- to reduce greenhouse emission levels by 60% (to 40% of 1990 levels) by 2050
- to increase the proportion of renewable electricity generated so that it comprises at least 20% of electricity generated in South Australia by 2014
- to increase the proportion of renewable electricity consumed so that it comprises at least 20% of electricity consumed in South Australia by 2014.

The legislation also aims to promote action within South Australia by developing specific targets for various sectors of the state's economy, and developing policies and programs to reduce greenhouse gas emissions.

BHP Billiton is currently negotiating a Sector Agreement with the South Australian Government, specifically for the Olympic Dam expansion. Sector Agreements are voluntary agreements between the Minister for Sustainability and Climate Change and a business or industry grouping. They may set out the objectives and strategies for greenhouse emission abatement, as well as covering intended research, development and innovation in technologies or industry practices. The Agreement would be entered into on a voluntary basis for the purposes of facilitating strategies to meet targets set under the *Climate Change and Greenhouse Emissions Reductions Act 2007*.

Northern Territory

The Northern Territory Strategy for Greenhouse Action 2006 (Northern Territory EPA 2006) was prepared in line with the goals and principles of the NT Government's Greenhouse Policy Framework released in 2002. The strategy describes the following objectives:

- provide leadership to the community by demonstrating how the NT Government is addressing greenhouse gas emissions generated by its own activities
- minimise greenhouse gas emissions by managing savanna burning
- minimise greenhouse gas emissions from agriculture and land use changes and encourage the enhancement of carbon sinks
- minimise greenhouse gas emissions by improving management of transport and urban land use
- minimise greenhouse gas emissions from the supply and use of electricity
- minimise greenhouse gas emissions from industry and waste
- support efforts to increase our understanding of likely climate change and the actions needed to adapt to the changing climate.

The BHP Billiton Group

In June 2007, the BHP Billiton Group released its Climate Change Position. The position is a multifaceted approach to tackling climate change. It aims to:

- understand emissions from the full life cycle of the products the BHP Billiton Group produces
- improve the management of energy and greenhouse gas emissions across the BHP Billiton Group businesses

- commit US$300m over five years to support the development of low emissions technology, energy excellence projects within the company and encourage emissions abatement by employees and local communities
- use technical capacity and experience of the BHP Billiton Group to assist governments and other stakeholders to design effective and equitable climate change policies, including market-based mechanisms such as emissions trading.

Olympic Dam expansion

The Olympic Dam expansion is implementing the BHP Billiton-wide position goals as part of its Greenhouse Gas and Energy Management Plan. To date, a number of studies have been conducted that review the potential greenhouse gas footprint of the proposed expansion and analyse potential mitigation measures. These are summarised in Sections 13.2.3 and 13.2.5 of this chapter.

As well as complying with BHP Billiton's Climate Change Position, BHP Billiton has set additional goals and targets specific to the proposed expansion in order to minimise potential impacts. These are to:

- apply a goal of reducing greenhouse gas emissions (reportable under the National Greenhouse and Energy Reporting (Measurement) Determination 2008) to an amount equivalent to at least a 60% reduction (to an amount equal to or less than 40%) of 1990 emissions, by 2050
- constructing an on-site cogeneration power station (250 MW capacity) for recovering waste heat
- sourcing renewable energy (35 MW capacity) via the national electricity market for the seawater desalination plant
- producing an annual 'road map' that quantifies emission reduction opportunities and achievements.

The company would establish specific short-term targets to reduce greenhouse gas emissions in its Environmental Management Programs (EM Programs) at Olympic Dam in accordance with the International Standard AS/NZS 14001: 2004 Environmental Management Systems guidelines. BHP Billiton would also develop a detailed Greenhouse Gas and Energy Management Plan for Olympic Dam that would:

- establish modelling to project the likely emissions from the expanded Olympic Dam operation from commencement to 2050
- establish targets and timelines for greenhouse gas reduction
- identify greenhouse gas reduction strategies and projects.

The Greenhouse Gas and Energy Management Plan would be reviewed annually.

13.2.3 EXISTING ENVIRONMENT

The most significant emissions from both the existing and proposed Olympic Dam operation are carbon dioxide, related to the indirect combustion of hydrocarbons to produce electricity, and the direct combustion of hydrocarbons in vehicles and furnaces. Minor emissions of methane and nitrous oxide are generated as a result of some chemical processes and the decomposition of putrescible wastes in the on-site waste management facility.

Some HFCs and PFCs are currently used on-site, and this would continue; HFCs are used for on-site refrigeration and PFCs (in particular sulphur hexafluoride, SF_6) are used in electrical switchyards and transformers.

Fuel and electricity consumption data for the existing Olympic Dam operation are summarised in Table 13.4.

Table 13.5 summarises the annual emissions that would be reported under the NGER Act. Table 13.6 summarises the estimated total of all greenhouse gas emissions from the existing operation, including those not covered within the NGER reporting method (such as indirect and process-related emissions) derived from NGAF and other emissions estimation methods (see Appendix L1). Table 13.7 summarises the estimated total greenhouse gas emissions for the existing operation by scope.

Table 13.4 Typical fuel and electricity consumption by type

Energy type and units	Volume/mass consumed per annum
On-site diesel (kL)	24,250
Electricity (MWh)	870,000
Explosives – ANFO (t)	3,000
Explosives – Emulsion (t)	2,000
LPG (GJ)	780,000
Natural gas (GJ)	0
Fuel oil (kL)	8,000
Soda ash (t)	1,000
Coke (t)	13,000
Electrical switchyard gases[1] (t)	0.33
Material transport diesel (kL)	1,825

[1] Refers to volumes stored within electrical switchgear expressed in CO_2-e tonnes.

Table 13.5 Existing annual greenhouse gas emissions by greenhouse gas (NGER Act methodology)

Greenhouse Gas	Existing operation (t CO_2-e)
CO_2	898,853
CH_4	296
N_2O	667
SF_6	12
Total	**899,828**

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Total greenhouse gas emissions from all sources for the existing Olympic Dam operation are around 1.14 Mtpa of CO_2-e, including 0.9 Mtpa reportable under the NGER reporting requirements. This is broken down by source as shown in Figure 13.2, and by scope as illustrated in Figure 13.3.

Table 13.6 Existing total annual greenhouse gas emissions by source (all sources)

Source	Existing operation (t CO_2-e)
LPG	44,200
Fuel oil	24,900
On-site diesel	75,500
Material transport diesel	5,300
Soda ash	400
Coke	43,300
Sulphur hexafluoride	12
Electricity	852,600
Metallurgical process	69,000
TSF	22,200
Explosives	850
Total	**1,138,300**

Table 13.7 Existing total annual greenhouse gas emissions by scope (all sources)

Scope	Existing operation (t CO_2-e)
Scope 1	261,100
Scope 2	730,900
Scope 3	146,300
Total	**1,138,300**

13.2.4 PROJECT MODIFICATIONS TO PROTECT ENVIRONMENTAL VALUES

The greenhouse gas assessment for the proposed expansion is based on the project configuration described in Chapter 5, Description of the Proposed Expansion, and includes the positive effects of generating electricity from waste heat (i.e. cogeneration) and using renewable electricity for the desalination plant.

Other potential greenhouse gas reduction measures are discussed further in Section 13.2.5.

13.2.5 IMPACT ASSESSMENT AND MANAGEMENT

The estimate of greenhouse gas emissions used the following assumptions and limitations:

- electricity was assessed as purchased from the NEM
- electricity demand reflects the operation of the 250 MW cogeneration plant and the use of renewable electricity (purchased under contract from the NEM) for the desalination plant (35 MW)
- natural gas was not used to replace other liquid fuels (i.e. diesel and/or fuel oil) to estimate worst-case emissions
- material transport emissions were limited to transport within Australia.

Hydrocarbon and electricity emissions

Fuel and electricity consumption data for the various development phases of the expanded operation are described in Table 13.8.

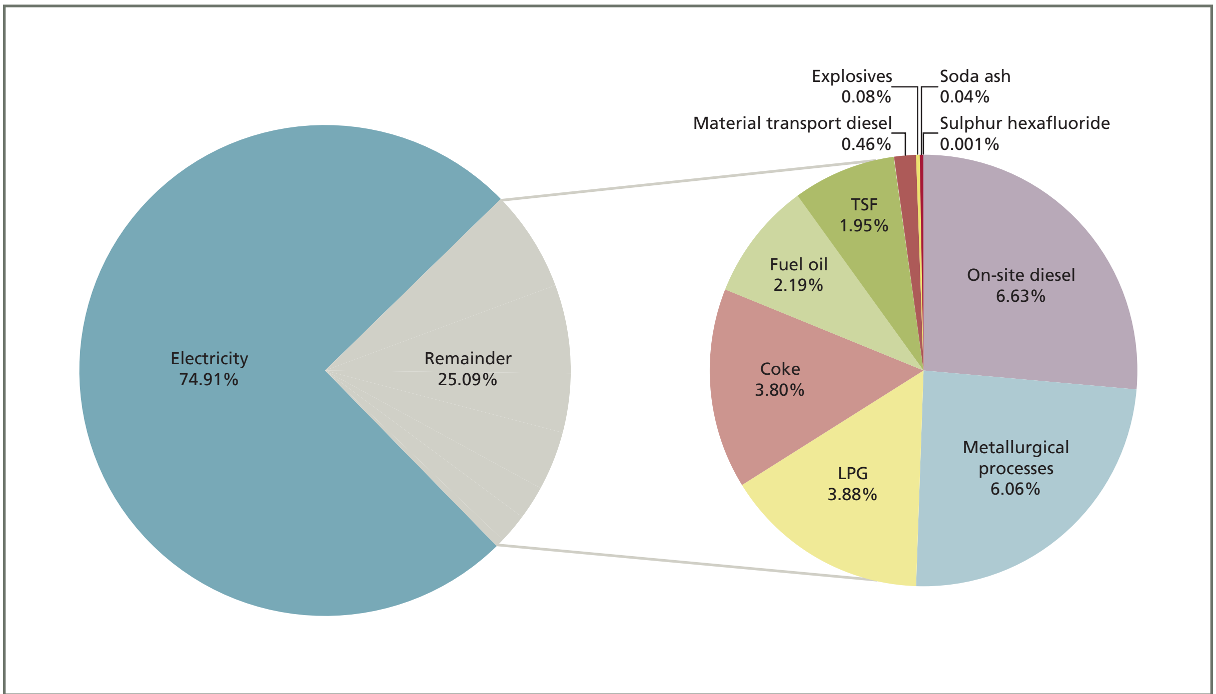

Figure 13.2 Greenhouse gas emission sources from the existing operation

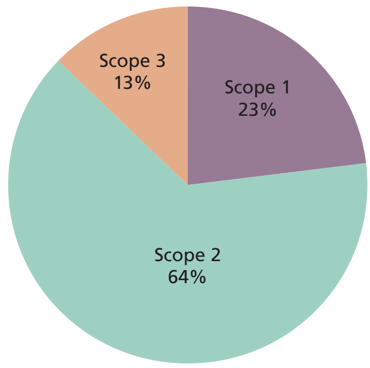

Figure 13.3 Greenhouse gas emissions from the existing operation by scope

The amounts shown in Table 13.8 are converted into gigajoules (GJ) (where necessary) through the use of energy content factors and subsequently converted to CO_2-e emissions through the use of emissions factors, as detailed in Appendix L1.

Estimation of emissions

Annual emissions

Table 13.9 summarises the expected annual emissions that would be reported under the NGER Act. Table 13.10 summarises the estimated total of all greenhouse gas emissions for the proposed expansion, including those not covered within the NGER reporting method (such as indirect and process-related emissions) derived from NGAF and other emissions estimation methods (see Appendix L1). Table 13.11 summarises the estimated total greenhouse gas emissions for the proposed expansion by scope.

The breakdown of emission source varies with each phase of development. Scope 1 emissions (largely on-site diesel consumption and on-site process-related CO_2 emissions) and Scope 2 emissions (being off-site electricity production) both account for approximately 42–46% of all greenhouse gas emissions for the proposed expansion (i.e. total of 84–92%). Scope 3 emissions provide the balance (see Figures 13.4 and 13.5).

The proposed expansion would result in an increase in the proportion of Scope 1 emissions compared with the existing operation because of the significant increase in diesel (required by the new open pit mining fleet) and the positive influence of using cogenerated electricity. The proportion of Scope 3 emissions would also increase as a result of the increased transport volumes and distances associated with transporting concentrate to the Port of Darwin for export.

Land use change

In addition to the above-mentioned sources, land use change associated with land clearing for infrastructure associated with the expansion would result in one-off greenhouse gas emissions totalling approximately 1 Mt of CO_2-e over the life of the expansion (see Appendix L1 for details).

Expanded operation greenhouse gas emissions in context

Over the next five decades, Australian and global greenhouse gas emissions are predicted to rise from the current levels of 506 Mtpa and 36,200 Mtpa, respectively. No specific emission projections for South Australia exist, however assuming the proportion of South Australia's greenhouse gas emissions (relative to Australia) remain constant (at around 7.5%), South Australian greenhouse gas emissions can be inferred, as shown in Table 13.12.

The peak greenhouse gas emissions from the proposed expansion (4.7 Mtpa of CO_2-e) were compared against the projected future state, national and international emissions. The additional greenhouse gas emissions associated with the proposed expansion would constitute a relatively small proportion of overall emissions as shown in Table 13.13 and shown in Figure 13.6.

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Table 13.8 Fuel and electricity consumption for the proposed expansion

Energy type and units	Volume/mass consumed			
	Initial development to 20 Mtpa	Intermediate development to 40 Mtpa	Full operating capacity of 60 Mtpa	At closure (Year 40)
On-site diesel (kL)	330,000	367,000	454,000	454,000
Electricity (MWh)	1,465,000	2,050,000	2,573,000	2,573,000
Explosives – ANFO (t)	110,000	110,000	110,000	110,000
Explosives – Emulsion (t)	4,500	4,500	4,500	4,500
LPG (GJ)	0	816,000	816,000	816,000
Natural gas (GJ)	0	0	0	0
Fuel oil (kL)	0	14,000	14,000	14,000
Soda ash (t)	0	6,700	6,700	6,700
Coke (t)	0	18,300	18,300	18,300
Electrical switchgear gases[1]	4,800	9,700	14,500	14,500
Material transport diesel (kL)	16,000	27,000	36,500	36,500

[1] Refers to volumes stored within electrical switchgear expressed in CO_2-e tonnes.

Table 13.9 Estimated annual greenhouse gas emissions by greenhouse gas (NGER Act methodology)

Greenhouse Gas	GHG emissions (t CO_2-e)			
	Initial development to 20 Mtpa	Intermediate development to 40 Mtpa	Full operating capacity of 60 Mtpa	At closure (Year 40)
CO_2	2,112,070	2,836,789	3,277,068	3,099,531
CH_4	2,548	2,942	3,220	3,220
N_2O	6,369	7,329	8,023	8,023
SF_6	24	49	73	73
Total	**2,121,010**	**2,847,108**	**3,288,384**	**3,110,847**

Table 13.10 Estimated total annual greenhouse gas emissions by source (all sources)

Source	GHG emissions (t CO_2-e)			
	Initial development to 20 Mtpa	Intermediate development to 40 Mtpa	Full operating capacity of 60 Mtpa	At closure (Year 40)
LPG	0	46,210	46,210	46,210
Fuel oil	0	43,591	43,591	43,591
On-site diesel	957,898	1,065,298	1,169,796	1,169,796
Material transport diesel	46,196	77,957	105,386	105,386
Soda ash	2,781	2,781	2,781	2,781
Coke	0	60,895	60,895	60,895
Sulphur hexafluoride	24	49	73	73
Electricity	1,435,700	2,009,000	2,426,339	2,248,802
Metallurgical process	153,200	306,400	459,600	459,600
TSF	66,700	133,400	200,080	200,080
RSF	0	0	160,000	160,000
Explosives	19,465	19,465	19,465	19,465
Total	**2,681,963**	**3,765,045**	**4,694,215**	**4,516,678**

Table 13.11 Estimated total annual greenhouse gas emissions by scope (all sources)

Scope	GHG emissions (t CO_2-e)			
	Initial development to 20 Mtpa	Intermediate development to 40 Mtpa	Full operating capacity of 60 Mtpa	At closure (Year 40)
Scope 1	1,129,775	1,584,373	2,061,410	2,061,410
Scope 2	1,230,600	1,722,000	2,066,119	1,888,582
Scope 3	318,808	458,672	566,686	566,686
Total	**2,681,963**	**3,765,045**	**4,694,215**	**4,516,678**

Table 13.12 Projected Australian and global greenhouse gas emissions in Mtpa of CO_2-e (excluding land use change)

Source	2010	2020	2030	2040	2050
South Australia[1]	41.2	47.8	52.1	56.4	60.5
Australia	549	638	695	752	806
Global	42,300	53,800	63,600	75,800	89,600

Source: ABARE 2007
[1] South Australian data inferred from Department of Climate Change 2008.

Table 13.13 Proposed expansion emissions represented as a proportion (in per cent) of projected state, national and international emissions (excluding land use change)

Source	2010	2020	2030	2040	2050
South Australia	0	9.8	9.0	8.3	7.4
Australia	0	0.74	0.68	0.63	0.56
Global	0	0.009	0.007	0.006	0.005

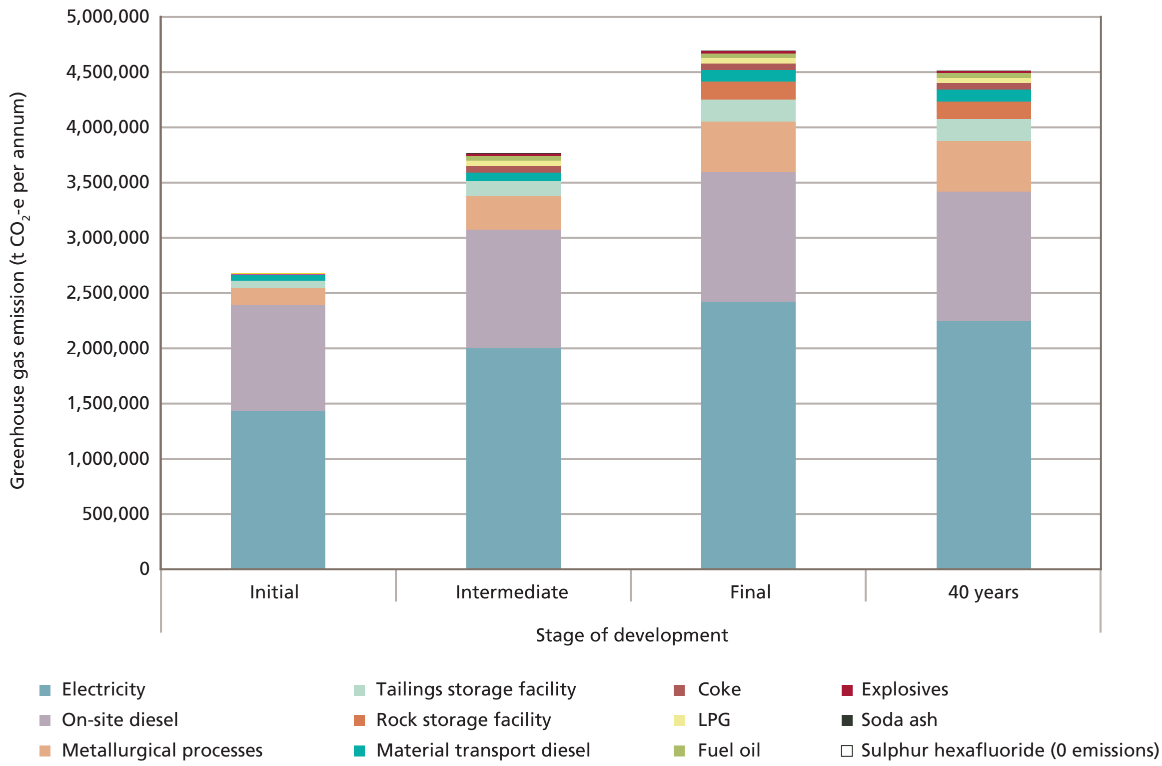

Figure 13.4 Predicted greenhouse gas emission sources for the proposed expanded operation

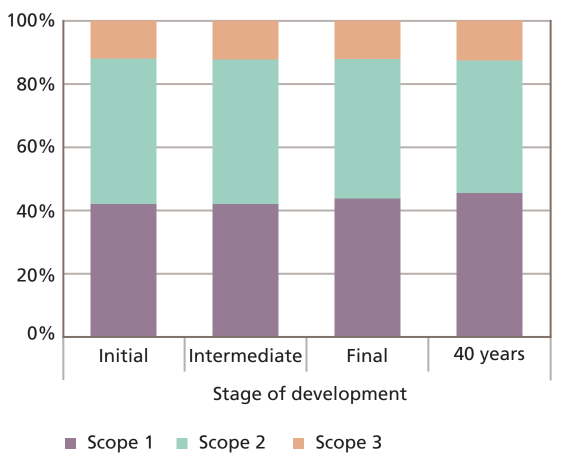

Figure 13.5 Greenhouse gas emissions from the proposed expanded operation by scope

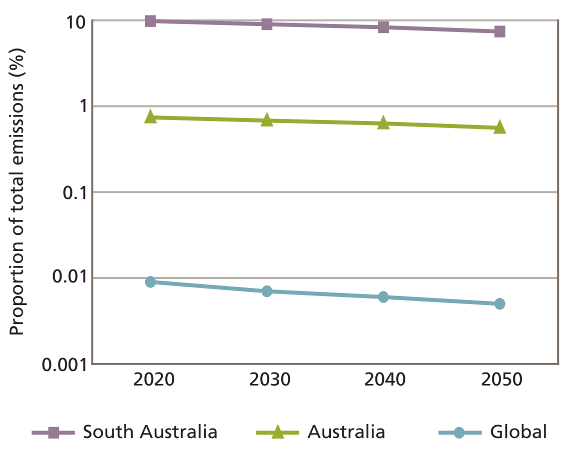

Figure 13.6 Greenhouse gas emissions in an Australian and global context

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Quantifying the impact of the additional greenhouse gas emissions associated with the proposed expansion on the state, Australian and global climate is difficult to estimate with any degree of certainty. The data presented in Table 13.13 shows that on a national and international scale, greenhouse gas emissions from the proposed expansion are relatively minor, however, for the purpose of the EIS and future management focus the impact has been categorised as high, representing a long-term state-wide impact.

For the purpose of providing context to global emissions, the abatement potential of the uranium oxide produced at Olympic Dam has been estimated. At full operating capacity, the expanded operation would produce up to 19,000 tpa of uranium oxide, which when used in nuclear power plants by customer countries would produce about 756,000 GWh of electricity. If, for example, this was used to substitute electricity supplied by typical fuel mixes in Australia, China and the United States of America, it would reduce direct greenhouse gas emissions by 615 Mtpa, 687 Mtpa and 438 Mtpa of carbon dioxide equivalents, respectively. This compares to Australia's current greenhouse gas emissions of 506 Mtpa of carbon dioxide equivalents (excluding land use change).

The greenhouse gas intensity (emissions of CO_2-e per tonne of ore milled) of Olympic Dam has decreased over the life of the current operation, reflecting increased efficiencies associated with previous optimisation and expansion projects. The proposed expansion would result in an initial increase in the greenhouse gas intensity to around 119 kg of CO_2-e per tonne of ore milled, from the current level of 105 kg of CO_2-e per tonne of ore milled, as a result of the ramp-up in mining and the energy usage associated with the movement of mine rock during the initial development phase. This would decrease as the development progresses, with greenhouse gas intensity reducing to around 79 kg of CO_2-e per tonne of ore milled (see Figure 13.7) as the ore extraction rate increases and the mine rock extraction rate decreases.

Greenhouse gas mitigation and management

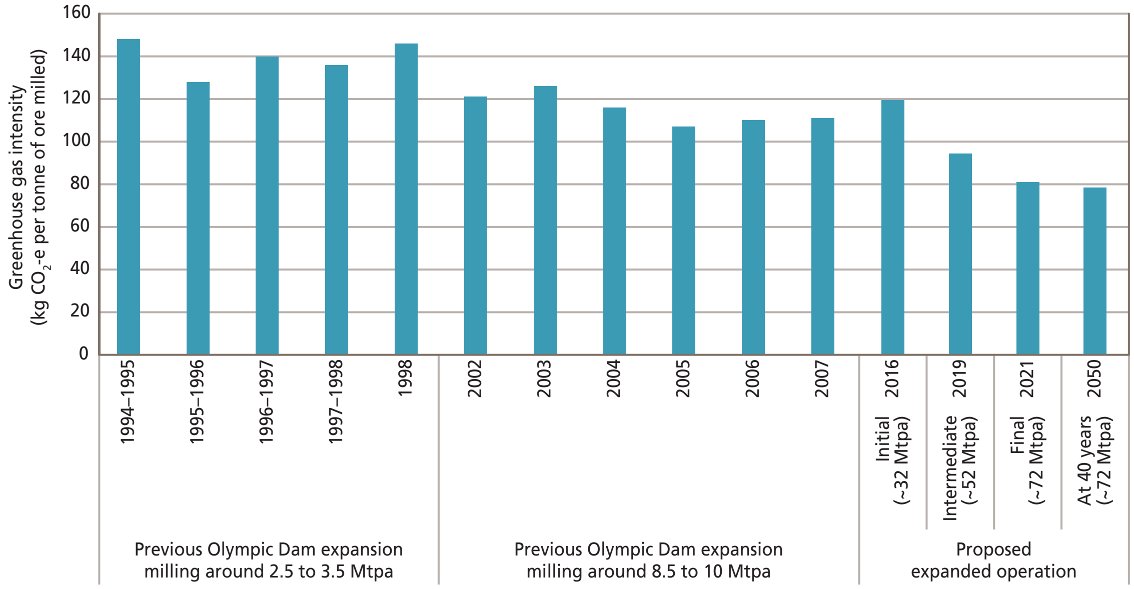
As discussed in Section 13.2.2, the expanded operation has committed to a goal of reducing emissions significantly by the Year 2050. BHP Billiton has used modelling based on McKinsey & Company's Australian carbon reduction methodology (McKinsey & Company 2008) to understand the path to achieve this goal. This involves evaluating the cost and carbon-reduction potential of specific projects using a three-step process:

- a project baseline was established
- a range of emission-reduction opportunities was identified through project workshops and fact-based estimates were made of the costs and potential abatement volume presented by each opportunity. A range of assumptions was made, including power capacity forecasts, expected learning curves, and initial generation costs
- these costs and volumes were combined to form the Olympic Dam expansion carbon reduction cost curves.

The carbon reduction cost curves from this process indicate that significant greenhouse gas reduction is possible. Appendix L1 details this process further, and includes figures for an indicative pathway from project inception to the year 2050.

Potential greenhouse gas reduction projects are divided into those that reduce energy demand, and those that provide a cleaner energy supply. Demand-side projects used in the modelling for the expanded Olympic Dam operation were:

- using waste engine oil in mine blasting
- in-pit ore crushing and conveying to the surface
- conveying mine rock to the surface
- trolley assist haulage
- alternative power/fuel supply for haul trucks (LNG)
- hybrid light vehicles
- more efficient crushing/grinding
- reducing water usage through increased recycling of TSF liquor
- low intensity leaching
- energy efficient design for town, construction camp and administration buildings.



Sources:
Previous Olympic Dam GHG emissions and intensity from WMC Greenhouse Challenge Agreement Annual Report August 2000 and from site data obtained from the Environment and Radiation Department

Figure 13.7 Greenhouse gas intensity of the existing and proposed expanded operation

Supply-side projects identified during the modelling were:

- on-site CCGT
- off-site CCGT
- on-shore wind power
- geothermal power
- concentrated solar thermal power (with waste heat recovery plant)
- concentrated solar thermal power (stand-alone)
- solar photovoltaic
- biodiesel
- coal carbon capture and storage (CCS)
- biomass power.

The current status of investigations into the technologies is provided in Appendix L1.

The carbon abatement curve for the projects listed above is presented in Figure 13.8. It shows the likely cost of mitigation (on the vertical scale) and the potential greenhouse gas reduction (on the horizontal scale) for the year 2050. As discussed in Section 13.2.2, a Greenhouse Gas and Energy Management Plan for the expanded operation would set interim goals and targets for emission reductions based on identified emissions reduction projects that may or may not include the above-mentioned projects. These have only been provided as examples of how the stated goal may be achieved and would be subject to annual updates as the costs of mitigation technologies, and carbon permits and offsets, change over time.

The implementation of demand and supply-side greenhouse gas mitigation measures alone would not necessarily achieve the 2050 goal described previously. Fixed greenhouse gas emissions, such as those from land use change, the metallurgical plant and the RSF and TSF, may require additional mitigation projects, offsets or permits. Options for offsetting these emissions would be investigated during the detailed design phase, but would include either Australian or internationally-purchased offsets, or a combination of both.

13.3 AIR QUALITY IMPACT ASSESSMENT

13.3.1 INTRODUCTION

The metallurgical plant of the existing Olympic Dam operation is the primary source of airborne emissions in the Olympic Dam region. Minor sources of emissions from the existing operation and the nearby township of Roxby Downs include heavy vehicles, passenger vehicles, air-conditioners, gas heaters and light industry. The current underground mining operation generates minimal dust although some dust is emitted from associated activities including the extraction of limestone from the on-site quarry.

There are extensive gas treatment facilities in the existing metallurgical plant that ensure that the substances emitted from the plant are below applicable compliance limits. On occasions, such as interruptions to power supply, substances are emitted via bypass stacks at elevated concentrations and these events are reported to the Environment Protection Authority (EPA) in South Australia.

Emissions from the existing operation are monitored to record the occurrence of bypass events, the effectiveness of controls and compliance with applicable limits. They are audited and annually reported publicly. The gas treatment systems are also maintained and monitored regularly, and these processes are used to identify opportunities for improving treatment efficiencies.

The remaining sections of this chapter provide an overview of the current airborne emissions associated with the Olympic Dam operation and discuss the additional airborne emission sources introduced by the proposed expansion, including the new open pit mine, the storage of mine rock, the expansion of the existing metallurgical plant and the construction and operation of a natural gas-fired power station. The construction and operation of off-site infrastructure may also result in additional air quality impacts.

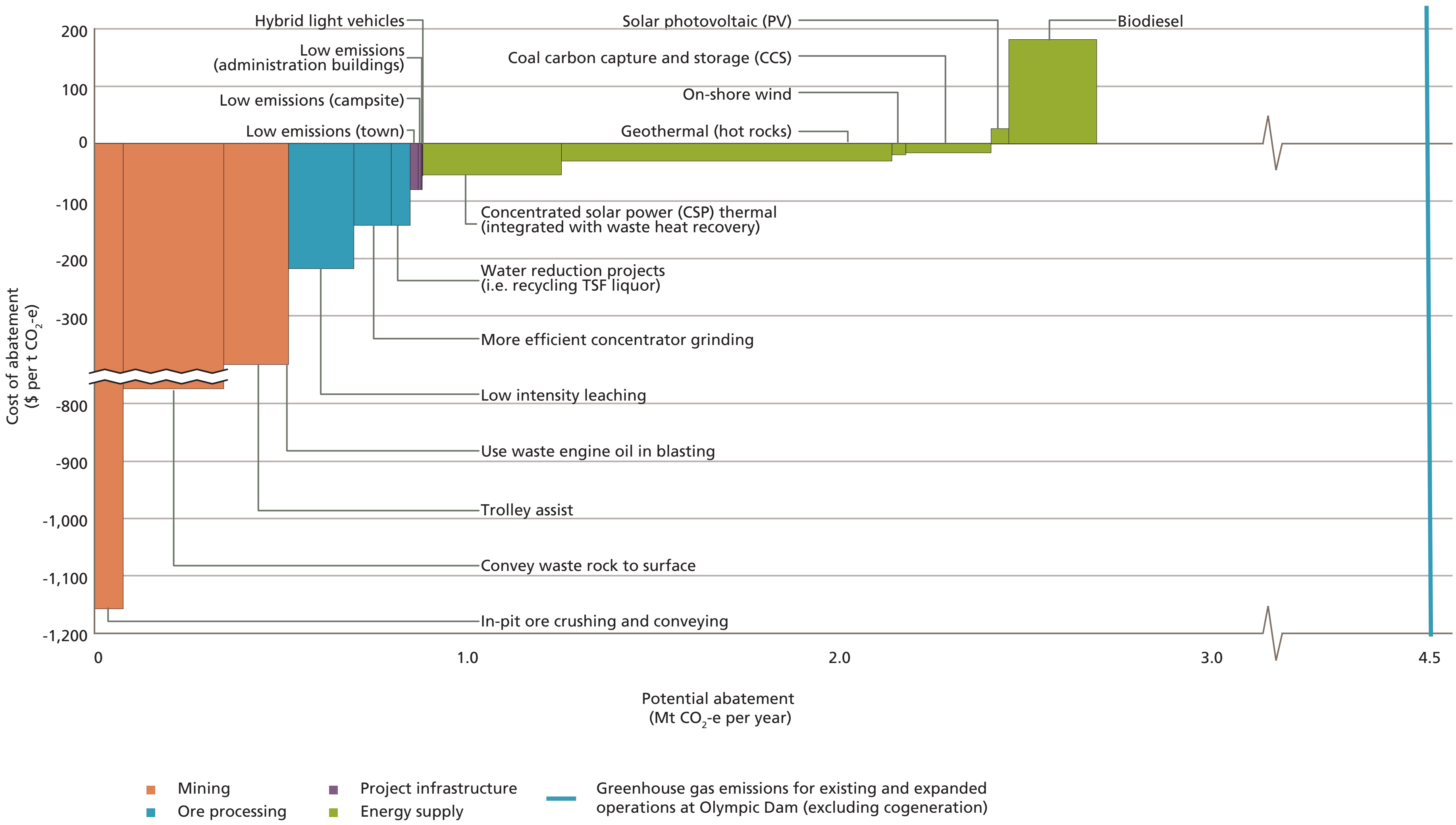
The remaining sections of this chapter also explain how the additional project components affect the existing air quality, and provides comparisons between the predicted concentration levels and applicable limits. Where necessary, design modifications and management measures are identified that would reduce predicted levels to within applicable limits.

13.3.2 ASSESSMENT METHODS

Several specialist air quality consultants conducted components of the detailed assessment for the Draft EIS. These were Holmes Air Sciences (peer review of the modelling process), Pacific Air and Environment (computational fluid dynamics (CFD) modelling of the open pit) and ENSR (Calpuff modelling and emissions inventory review). The assessments, which are detailed in Appendix L2, entailed:

- identifying sources of airborne emissions for the existing and expanded operation and modelling the point source and ground level concentrations for the combined existing and proposed expansion (i.e. the expanded operation)
- identifying sensitive receivers
- establishing existing ambient air quality at these receivers
- comparing the predicted emission levels with applicable limits and, if required, modifying the design and developing management measures to reduce the predicted levels to below the applicable limits.

Potential off-site infrastructure emissions were not modelled; instead specific analysis of the likely emissions from the infrastructure elements was considered relative to the nearby receivers and available mitigation measures. These are discussed further in the off-site infrastructure component of Section 13.3.5.



Sources: A cost curve for carbon abatement, McKinsey & Company; BHP Billiton analysis

Figure 13.8 Indicative greenhouse gas carbon abatement cost curve for the expanded operation at 40 years

Sensitive receivers

Sensitive receivers are those members of the population most likely to be affected by the proposed expansion. In terms of air quality, these are the communities closest to the expansion infrastructure construction and operations (see Figures 13.9a to 13.9d).

The population centres nearest to the expansion – Roxby Downs (about 14 km from the current operation) and the proposed Hiltaba Village (about 16 km from the existing operation) – were identified as sensitive receivers. These receivers would be about five and six kilometres respectively from the nearest airborne emission source of the proposed expansion, namely the southern and south-eastern boundary of the RSF.

Olympic Dam Village would continue to provide heavy industrial support to the operation until such time as the new heavy industrial area was established, about 3 km south from the existing area. The workforce currently accommodated at Olympic Village would be relocated to Hiltaba Village and/or accommodation at Roxby Village during the pre-mine phase, and the pre-mining operation would be managed to comply with the air quality criteria at Olympic Village while the workforce remains in that location.

The township of Andamooka is some 30 km from the existing operation and would be about 20–25 km from the nearest proposed airborne emission source. This was found to be at a distance beyond which the predicted impacts from the proposed expansion were so low as to be considered negligible, with an annual average PM_{10} particulate concentration of less than 2 $\mu g/m^3$.

As noted in the introduction to this chapter, the potential impacts from airborne emissions on ecologically sensitive receivers (e.g. plants and animals) are discussed in Chapter 15, Terrestrial Ecology. The potential impact of air quality on human receivers is discussed further in Chapter 22, Health and Safety.

Roxby Downs

Roxby Downs is located approximately 12 km south of the centre of the new open pit mining operation and about 5 km from the south-east edge of the proposed RSF. The nearest sensitive receiver, representing the worst-case scenario for ground level concentrations, is at the northern edge of Roxby Downs (Plate 13.1).

Hiltaba Village

Hiltaba Village would be located approximately 17 km north-east of Roxby Downs, along Andamooka Road. The site would be about 12 km from the centre of the open pit operation and about 5 km from the south-east edge of the proposed RSF. The nearest sensitive receiver, again representing the worst-case scenario for ground level concentrations, is at the north-western edge of Hiltaba Village.

Modelling of predicted levels

An air quality model was developed to predict ground level concentrations of pollutants from the expanded mining and processing activities.

Air quality model

Ground level concentrations of emissions for the proposed expansion were predicted using the Calpuff computer dispersion model. Other plume dispersion models have limitations associated with reaching steady-state dispersion conditions instantaneously, which leads to a potentially significant overestimation of pollutant concentrations at distant receivers under low wind-speed conditions. This is a particularly important constraint given the scale of the proposed expansion. Calpuff overcomes this constraint by representing each emission as a puff, which is effectively carried by the wind. The model's CALMET meteorology and topography pre-processing software is also more accurate when modelling complex terrains, such as those that may exist around the RSF and the open pit mining operation.

South Australia's EPA has approved Calpuff as a regulatory air quality model for the existing Olympic Dam operation.

Emission factors derived from the National Pollutant Inventory (NPI 1999, 2001, 2005) and the United States Environmental Protection Agency's Compilation of Air Pollutant Emission Factors, AP42 (US EPA AP42), were used with site geological data to estimate emissions from the proposed mining and processing operations.

The air quality model used several inputs, which are described in the following sections.

Topography

Local topographic data was used in the air quality model, although its effect is likely to be minimal given the relatively flat terrain of the Olympic Dam region. The maximum vertical relief is 40 m over the region modelled (i.e. 400 km^2).

Plate 13.1 Roxby Downs viewed from the existing operation

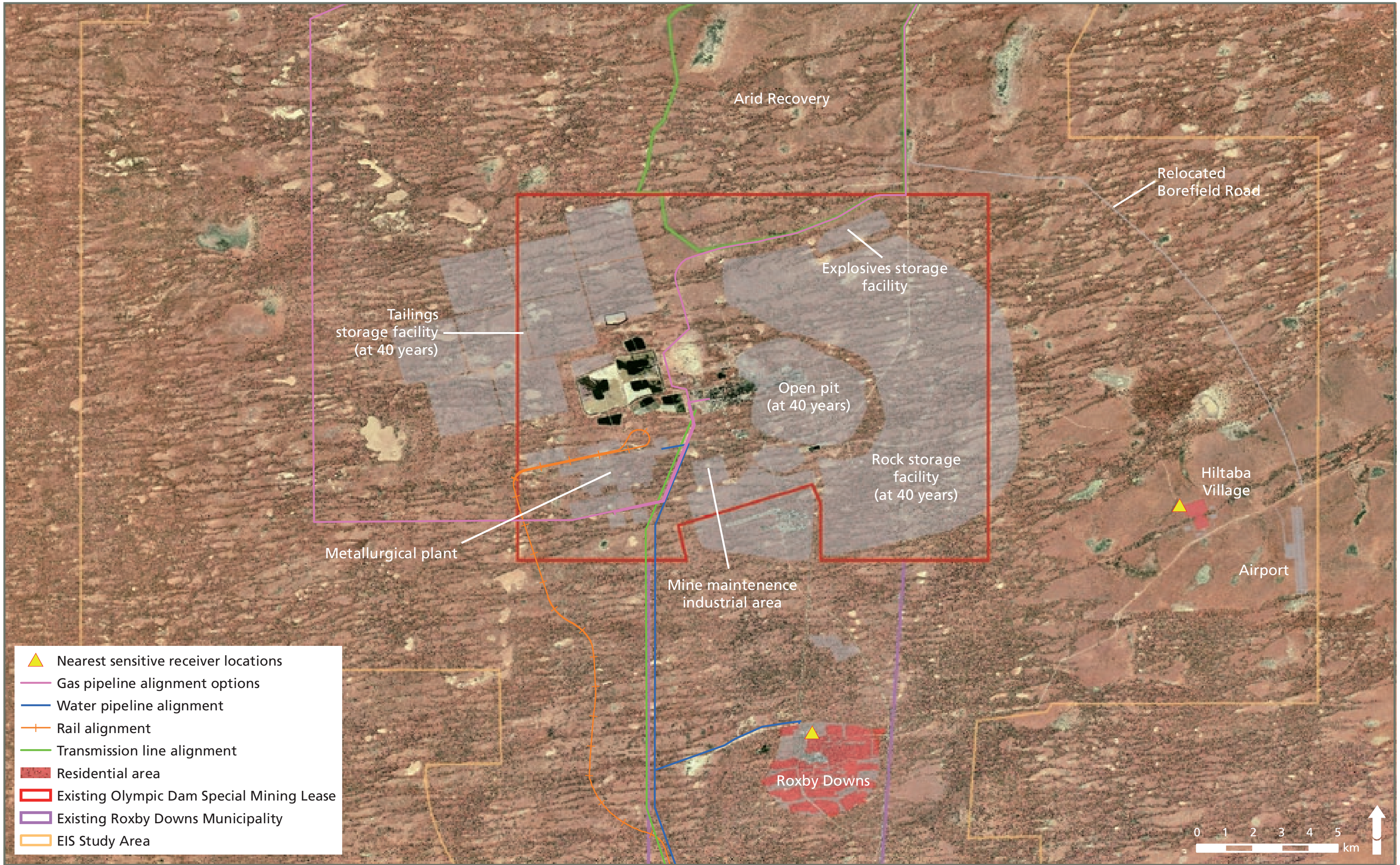


Figure 13.9a Location of sensitive receivers in the vicinity of Olympic Dam

Figure 13.9b Location of sensitive receivers in the southern corridor

Figure 13.9c Location of sensitive receivers for the Port of Darwin, East Arm

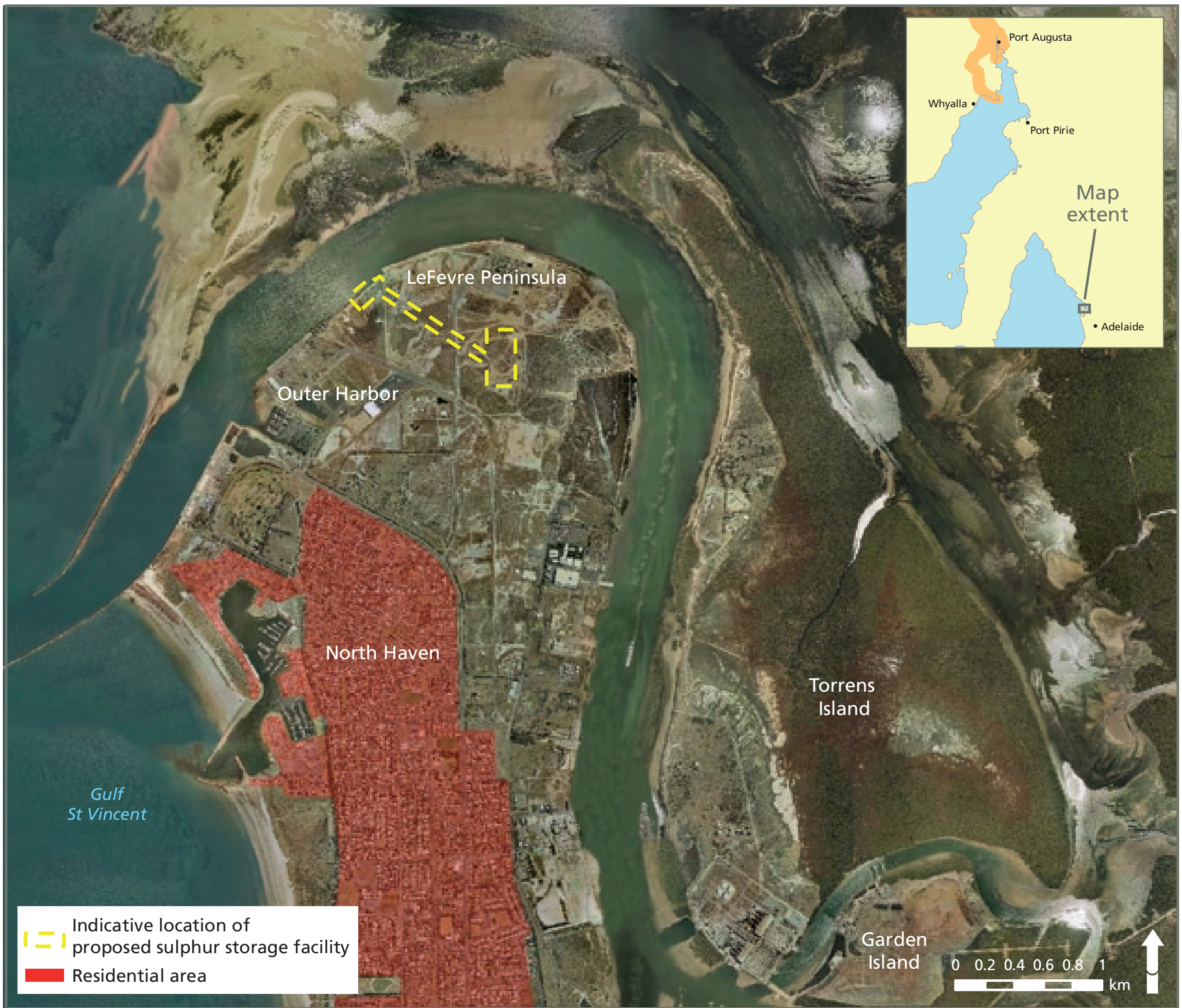


Figure 13.9d Location of sensitive receivers in the Outer Harbor region at Port Adelaide

The new landforms (i.e. the RSF and TSF) were incorporated into the model (see Chapter 5, Description of the Expansion Project and Figures 5.6a and 5.6b for the growth of the RSF and TSF over time). Such locally complex terrain is not generally handled well by traditional Gaussian plume models, which may overestimate ground level concentrations, as the additional mixing and turbulence caused by these complex terrain features is likely to result in greater dispersion of pollutants than predicted. This limitation is overcome to an extent by the Calpuff model, providing the terrain features are not severe (i.e. generally restricted to less than 30 degrees in gradient), which is the case with the proposed RSF and TSF.

The open pit's topography is too dramatic to model using traditional air quality models so computational fluid dynamics (CFD) modelling was used to predict the likely retention of emissions in the pit (see Appendix L2 for further details). Subsequently, the pit area was modelled as a ground level source of emissions within the Calpuff model.

Building-wake effects were not considered in the air quality modelling due to the height and location of the emission sources relative to the considerably lower buildings in the area, and the distance to the off-site sensitive receivers.

Meteorology

Twelve years of meteorological data are available from the automatic weather station located at the corner of Olympic Way and Eagle Way in the existing SML (see Plate 13.2 and see Chapter 8, Meteorological Environment and Climate, for climate details).

A statistical analysis by Professor A. Esterman (University of South Australia) indicated that the data fell within statistical upper and lower control limits, which means all years could be considered 'normal'. Air quality modelling of several pollutants across all years consistently indicated that the Year 2000 had the greatest ground level concentrations of pollutants at Roxby Downs. Therefore conditions for Year 2000 were adopted for modelling air quality for the proposed expansion to represent a realistic worst-case meteorological scenario. On average, the ground level concentration of pollutants would be expected to be lower than that predicted.

Plate 13.2 Site Automatic Weather Station (AWS)

In addition, a study was done to determine the likely impacts of climate change and topographical changes (as a result of the influence of the open pit and RSF) on the regional meteorology using a regional meteorological model (PAE 2007). The effects of these elements on wind speed and direction (the factors most relevant to modelling air quality) were found to be relatively insignificant on a regional scale and so were not included in the modelling.

Mixing height

Mixing height is a term used to describe the maximum height above the ground surface below which vertical diffusion or mixing of a plume occurs (i.e. the depth of the atmospheric surface layer beneath a temperature inversion). The air above this layer tends to be stable, with restricted vertical motion.

Mixing heights for Year 2000 meteorological data for Olympic Dam (sourced from the Calmet model) were about 200–500 m during the night and up to around 9 am, increasing after sunrise to a maximum of 3,000 m by mid-afternoon. This diurnal cycle is consistent with an inland site heavily influenced by the sun during the day, cool conditions at night and with no coastal influences.

Emitted elements and compounds

The emitted elements and compounds studied in this assessment were based on those listed as Class 1 substances in the SA EPA Guideline, Air quality impact assessment using design ground level pollutant concentrations (DGLCs) (EPA 2006) and the materials specified in the National Environment Protection (Ambient Air Quality) Measure. Some additional compounds considered particularly relevant to the proposed expanded operation were also included. The relevant emissions are:

- particulate matter – as total suspended particulate (TSP), particulate of less than 10 micron diameter (PM_{10}) and particulate of less than 2.5 micron diameter ($PM_{2.5}$)
- sulphur dioxide (SO_2)
- oxides of nitrogen (as nitrogen dioxide, NO_2)
- carbon monoxide (CO)
- lead (Pb)
- fluorides (as hydrogen fluoride, HF)
- carbon disulphide (CS_2, as a major component of likely site odour).

The determination of radionuclides in dust is important for estimating the radiation dose to members of the public and the workforce. These have been inferred from the particulate matter results and the relationship between ore and mine rock defined in the inventory of particulate matter emissions. This inventory, described in Section 13.3.5, lists the significant sources of dust from the expanded operation. A discussion of radiation dose levels (including contributions from radionuclides in dust and radon) and how this influences human health is provided in Chapter 22, Health and Safety.

National Pollutant Inventory

A review of the existing substances reported under the National Pollutant Inventory (NPI) scheme was undertaken with a view to identifying potential additional substances that may need to be reported under the expanded operation.

Applicable air quality criteria

The South Australian and Australian governments have established the performance criteria for airborne emissions. The criteria are determined at the source of emission through the South Australian Environment Protection (Air Quality) Policy 1994 and at the receiver through the ambient air quality goals outlined in the SA EPA Guideline for air quality impact assessment, 2006, and the National Environment Protection Council's (NEPC's) National Environment Protection (Ambient Air Quality) Measure. The assessment also considers the rescinded National Health and Medical Research Council (NHMRC) Goals for maximum permissible levels of pollutants in ambient air, 1996.

Ground level concentration criteria

Three sources of ambient air quality criteria were investigated for this air quality assessment, as outlined in Table 13.14. The criteria adopted for the expanded operation are considered to be the most stringent for each of the pollutants.

Radon has no specific ground level concentration limit, although the dose to members of the public is limited to one millisievert (mSv) per year. Further discussion regarding radon and radiation dose is presented in Chapter 22, Health and Safety.

Point-source emission criteria

In addition to the ground level concentration limits for emissions, South Australia's Environment Protection (Air Quality) Policy 1994 also specifies point-source emission limits for a variety of pollutants (SA EPA 1994), to be complied with at the point where the elements and compounds are emitted to the atmosphere, but before mixture with diluting gases. These are summarised in Table 13.15.

Table 13.14 Legislative goals for ambient air quality at sensitive receivers

Pollutant	Averaging period	Goals (µg/m³)			Allowable exceedances (days per year)
		SA EPA[1]	NEPC[2]	NHMRC[3]	
TSP	Annual	–	–	90	Nil
PM_{10}	24 hour	–	50	–	5
	Annual	–	30	–	Nil
$PM_{2.5}$[4]	24 hour	–	25	–	n.a.
	Annual	–	8	–	n.a.
Sulphur dioxide	1 hour	450	570	570	1
	24 hour	–	228	–	1
	Annual	–	57	60	Nil
Nitrogen dioxide	1 hour	158	240	320	1
	Annual	–	60	–	Nil
Carbon monoxide	1 hour	29	–	–	Nil
	8 hour	–	10,000	10,000	1
Lead	Annual	–	0.5	1.5	Nil
Fluoride	24 hour	2.9	–	–	Nil
Carbon disulphide	3 minute	130	–	–	Nil

1 Sourced from SA EPA Guidelines, Air quality impact assessment using DGLCs 2006.
2 Sourced from NEPC, National Environment Protection (Ambient Air Quality) Measure 2003.
3 Sourced from NHMRC, Ambient air quality goals recommended by NHMRC 1996 (since rescinded).
4 The $PM_{2.5}$ NEPC goal is an advisory reporting standard.

Impact and risk assessment

The assessment of impacts and risks for the proposed expansion has been undertaken as two separate, but related, processes (see Section 1.6.2 of Chapter 1, Introduction, and Figure 1.11).

Impacts and benefits are the consequence of a known event. They are described in this chapter and categorised as high, moderate, low or negligible in accordance with the criteria presented in Table 1.3 (Chapter 1, Introduction).

A risk assessment describes and categorises the likelihood and consequence of an unplanned event. These are presented in Chapter 26, Hazard and Risk Reduction.

13.3.3 EXISTING ENVIRONMENT

This section of the assessment describes the current air quality environment in the Olympic Dam region with reference to existing emissions sources, locations and monitoring results.

Existing emissions sources

The Olympic Dam operation is the only major source of emissions with the potential to affect air quality in the region. Other local emission sources such as heavy vehicles, passenger vehicles, air-conditioners, gas heaters and minor industrial emissions are relatively insignificant.

Existing metallurgical plant

Emissions from the existing metallurgical operations are generally low in concentration compared to the point source criteria, shown in Table 13.15, as a result of the extensive gas treatment facilities installed on most emission-generating plant. Emergency or abnormal events where the gas treatment facilities are bypassed, such as power supply failures, have previously resulted in short-term, high-emission concentrations being discharged from stacks. Such bypass events are necessary to protect the health and safety of personnel, and are recorded and reported to the SA EPA in accordance with the site EPA licence (see Chapter 2, Existing Operation, for details of environmental reporting).

The major sources of emission from the existing metallurgical plant shown in Figure 13.10a and are listed below:

- main smelter stack
- acid plant tails gas stack
- calciner stacks
- shaft furnace stack
- slimes treatment plant stacks
- feed preparation concentrate dryer stack.

There are also several bypass stacks used in emergency or abnormal situations. These are the:

- acid plant bypass stack
- electric furnace bypass stack
- anode furnace bypass stacks
- flash furnace bypass stack.

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Table 13.15 Point source emission criteria

Pollutant	Application	Limit (mg/Nm³)	Notes
Particulate (TSP)	All operations except those for heating metal or metal ores	250	
	Operations for heating metal or metal ores	100	
Lead (Pb)	All operations	10	
Antimony (Sb)	All operations	10	
Arsenic (As)	All operations	10	
Cadmium (Cd)	All operations	10	
Mercury (Hg)	All operations	3	
Oxides of nitrogen (NO_x)	All operations except those for the manufacture of nitric acid, sulphuric acid, glass or cement	500	For liquid or solid fuel burning equipment (other than internal combustion engines) with a maximum heat input rate greater than 150,000 MJ/h gross
		350	For gaseous fuel burning equipment (other than internal combustion engines) with a maximum heat input rate greater than 150,000 MJ/hr gross
		700	For power stations for electricity generation of rated output equal to or greater than 250 MW
		70	For gas turbines for electricity generation with a rated output equal to or greater than 10 MW using gaseous fuels
		150	For gas turbines for electricity generation with a rated output equal to or greater than 10 MW using other fuels
		90	For gas turbines for electricity generation with a rated output less than 10 MW using gaseous fuels
	All operations for the manufacture of nitric or sulphuric acid	2,000	Emitted gas must be colourless
Sulphur trioxide (SO_3) and/or sulphuric acid (H_2SO_4) aerosols	All operations	100	Expressed as sulphur trioxide equivalent
Acid gases	All operations for the manufacture of sulphuric acid	3,000	Expressed as sulphur trioxide equivalent. Off-gas must be free of persistent mist
Hydrogen sulphide (H_2S)	All operations	5	
Fluorine compounds (as HF)	All operations except primary aluminium smelters	50	Expressed as hydrofluoric acid equivalent
Chlorine (Cl)	All operations	200	
Carbon monoxide (CO)	All operations	1,000	

Plates 13.3 and 13.4 show the main smelter stack complex and the bypass stacks associated with the existing smelter.

The main pollutant generated (measured by concentration) in the metallurgical plant is sulphur dioxide, significant volumes of which are generated during the smelting of copper sulphide ore. About 99% of the sulphur dioxide is recovered and converted into sulphuric acid. The remaining 1% is emitted to the atmosphere as a result of conversion inefficiencies in the acid plant, gas treatment system bypasses or other fugitive emissions that occur in the smelter building.

Particulate matter is also released during metal smelting operations and although the majority is captured and recycled in the gas treatment areas, some is emitted to the atmosphere.

Figure 13.10b shows the location and source of major particulate matter emissions for the existing and proposed operation.

Odorous emissions are released from the flotation and reagents area of the metallurgical facility, where sodium ethyl xanthate decomposes to form the odorous carbon disulphide. The estimated emission rate from this (derived from the NPI Emission Estimation Technique Manual for Copper Concentrating, Smelting and Refining) is about 0.01 g/s. Acidic mist is also odorous, although less so than carbon disulphide, and is released from all open-topped process vessels containing acidic materials, including process tanks, storage ponds and the TSF.

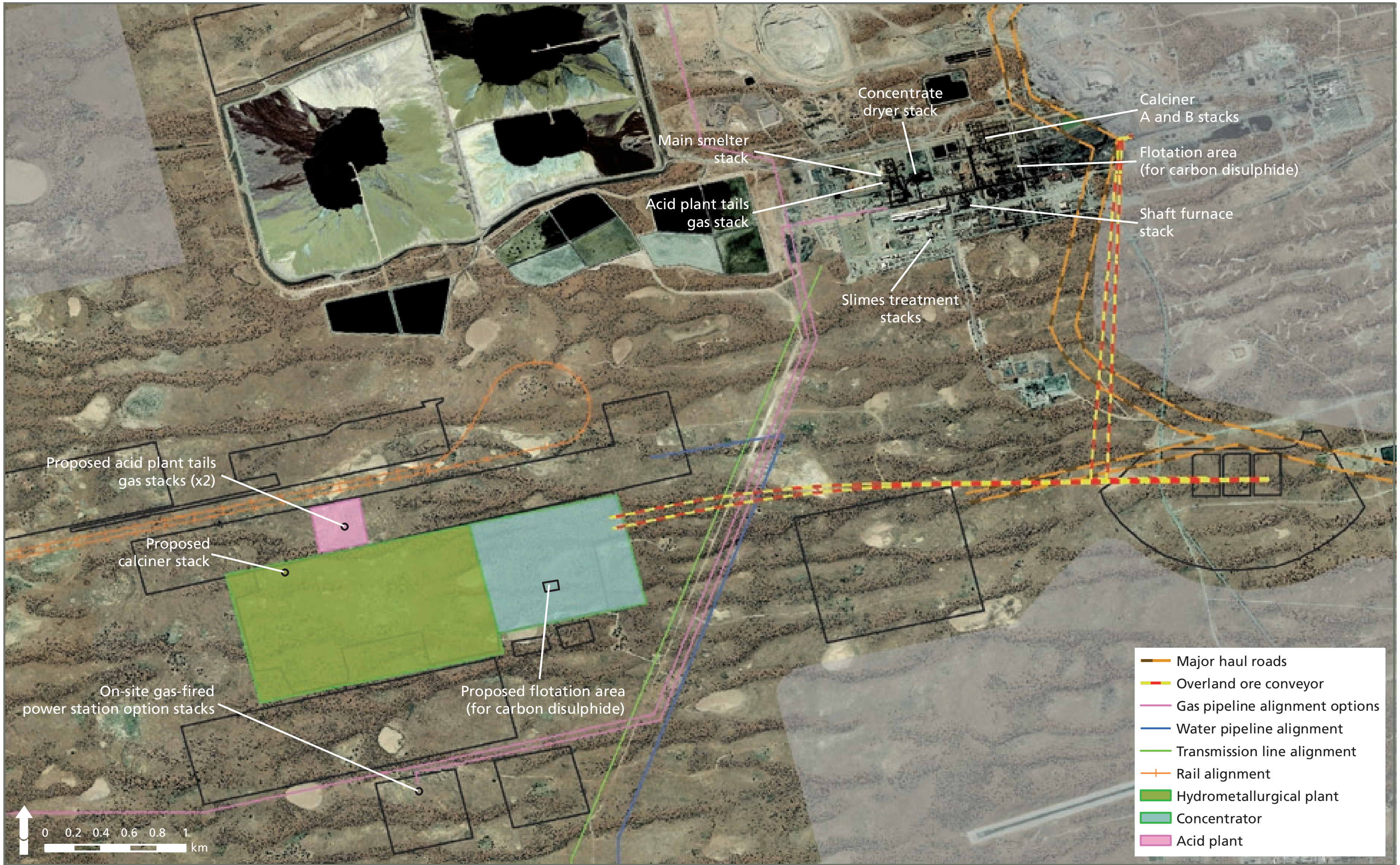

Figure 13.10a Location of gaseous emission sources for the existing and proposed operation

Figure 13.10b Location of particulate emission sources for the existing and proposed operation

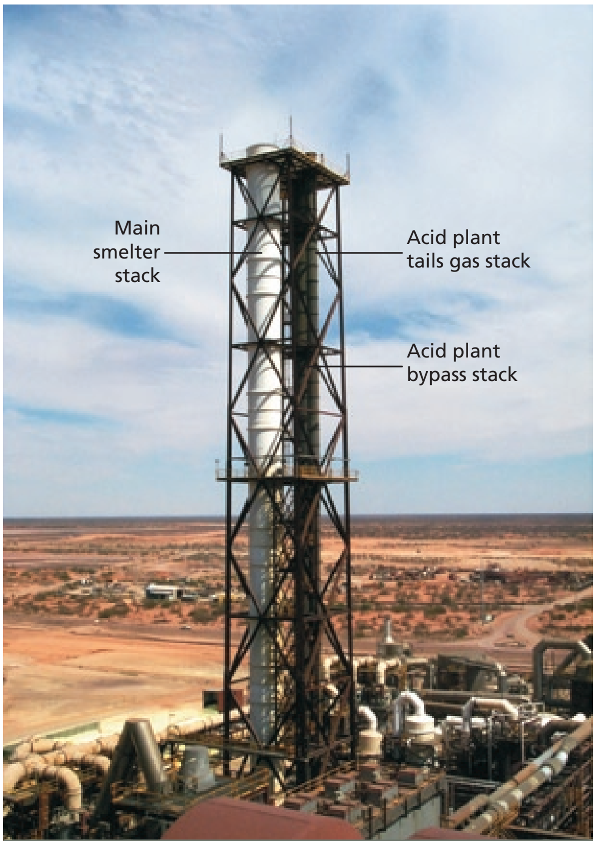

Plate 13.3 The smelter, showing emission stacks

Plate 13.4 The smelter, showing bypass stacks

The details of the main existing point sources are shown in Table 13.16, and the emission rates associated with the existing point sources are listed in Table 13.1. These were derived from on-site sampling data.

Existing mining activities including limestone quarry

Particulate matter, including saline aerosols, and gaseous pollutants (such as CO and NO_x from blasting) are released from both the mine ventilation raise bores (see Plate 13.5) and from the existing quarrying operation (see Plate 13.6). Radon generated through the exposure of ore in the underground workings is also ventilated to the surface via the raise bores.

Table 13.16 Existing point emission sources and indicative operating data

Stack	Flow rate (m^3/h)	Height (m AGL[1])	Velocity (m/s)	Inner diameter (m)	Temperature (°C)
Smelter 2 main smelter stack	475,000	90	17.0	3.80	55
Acid plant tails gas stack	100,000	90	6.5	2.90	70
Smelter 1 shaft furnace stack	45,000	40	15.5	1.30	38
Calciner A stack	2,500	29	9.0	0.50	45
Calciner B stack	3,000	29	9.0	0.50	85
Slimes treatment roaster stack	30,000	20	23.0	0.75	60
Slimes treatment NOx stack	6,000	20	14.5	0.40	35
Concentrate dryer stack	20,000	22	9.0	1.20	30

[1] AGL = above ground level.

Table 13.17 Existing average point source emission rates (mg/Nm^3)

Stack	SO_2	NO_x	CO	Pb	F
Smelter 2 main smelter stack	150	50	n.a.	1	0.05
Acid plant tails gas stack	1,050	75	n.a.	0	0.05
Smelter 1 shaft furnace stack	2	20	n.a.	8	0.1
Calciner A stack	0	0	n.a.	0	0
Calciner B stack	0	0	n.a.	0	0
Slimes treatment roaster stack	0	700	n.a.	0.005	0
Slimes treatment NOx stack	0	170	n.a.	0.005	0
Concentrate dryer stack	1	35	n.a.	0.05	0.5

Plate 13.5 Saline aerosols capture infrastructure

Plate 13.6 Operations in the limestone quarry

Existing ground level concentrations

The air quality of the existing operation is monitored by the Airborne Emissions Monitoring Program which assesses the effectiveness of controls and compliance with regulatory limits. The program centres on estimating ground level concentrations of sulphur dioxide, measuring total ground level concentrations of suspended particulates and dust deposition rates, and measuring concentrations of radon progeny. The monitoring results are described in the annual site Environmental Management and Monitoring Report (BHP Billiton 2007) for SO_2, TSP and dust deposition and are summarised below, together with additional pollutants as described in Section 13.2.3.

Particulate matter (TSP, PM_{10} and $PM_{2.5}$)

Total suspended particulate (TSP) matter is monitored via high-volume air samplers established on the western side of Olympic Dam Village (see Plate 13.7), and on the north-west edge of Roxby Downs (see Figure 13.11 for results).

Plate 13.7 TSP high volume air sampler at Olympic Village

PM_{10} monitoring has only recently started at Olympic Dam Village and Roxby Downs (see Plate 13.8), and no $PM_{2.5}$ monitoring is currently undertaken. The available PM_{10} monitoring data are shown in Figure 13.12. Although limited conclusions can be drawn from the data, they indicate that the operation's contribution to the annual average ground level concentration is about 17 $\mu g/m^3$ at Olympic Dam Village and 13 $\mu g/m^3$ at Roxby Downs, which is below the annual average PM_{10} goal of 30 $\mu g/m^3$. An analysis of simultaneous TSP and PM_{10} monitoring results undertaken at Olympic Dam indicates that 40–50% of TSP consists of particulate in the PM_{10} size fraction, consistent with the 45–50% suggested in the NPI Emission Estimation Technique Manual for Mining.

Dust deposition is currently monitored by a system of 14 passive dust deposition gauges (see Plate 13.9). The results of this monitoring are presented in the annual site Environmental Management and Monitoring Report (see BHP Billiton 2007), and are summarised according to distance from the operation in Figure 13.13. These results show that dust deposition generally peaks at distances of between two and four kilometres from the operation, and then decreases to relatively constant levels about eight kilometres from the operation.

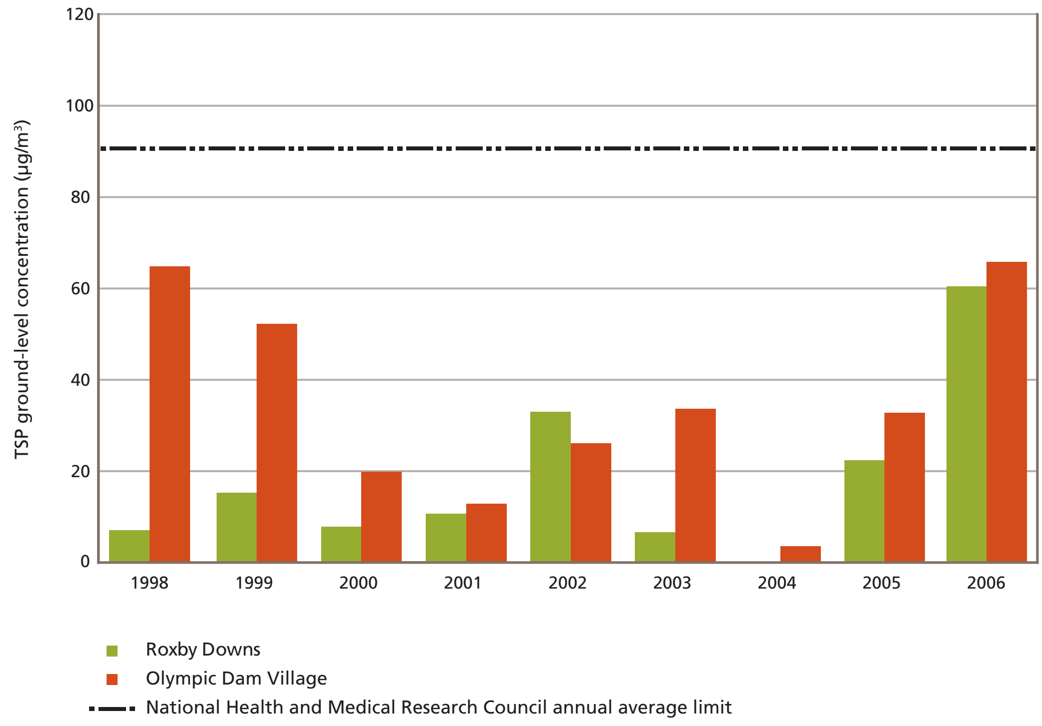

Figure 13.11 Existing operation contributed total suspended particulate (TSP) ground-level concentration

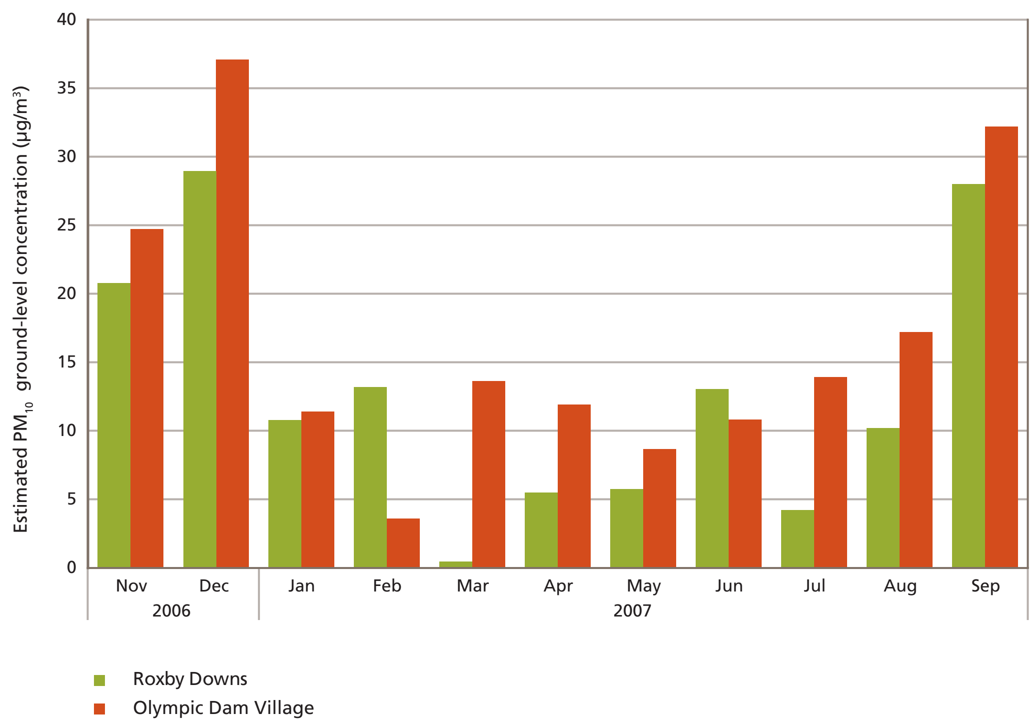

Figure 13.12 Existing PM_{10} particulate matter ground-level concentration

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Plate 13.8 PM_{10} high volume air sampler at Roxby Downs

Plate 13.9 Dust deposition gauge

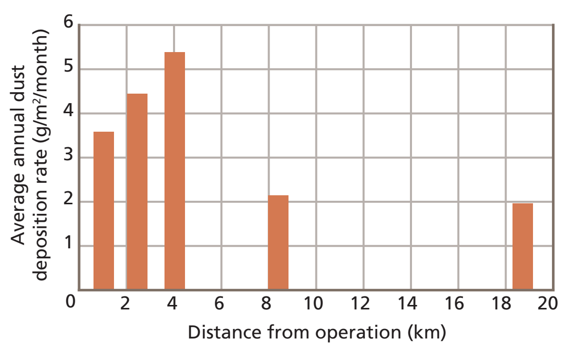


Figure 13.13 Existing dust deposition rate

Point-source monitoring of stacks for emitted particulate concentrations is undertaken at regular intervals. Historically, most stacks have complied with applicable limits, with the exception of the slimes treatment roaster scrubber stack and the calciner stacks. The cause of the non-compliances was investigated, appropriate corrective actions were taken, and these have improved the capture of emissions from these stacks. These actions included modifying the equipment and upgrading operating procedures.

Sulphur dioxide (SO_2)

Ground level concentrations of sulphur dioxide have been estimated using the Calpuff computer dispersion model. The ground level concentrations of SO_2 for the existing operation, over the one-hour maximum average, 24-hour maximum average and the annual average, are shown in Figures 13.14 to 13.16. The compliance criteria are also shown.

There were exceedances of the one-hour maximum average criterion in 2001 as a result of two bypass events in the acid plant following interruptions to equipment in the plant.

Oxides of nitrogen (as NO_2)

Monitoring of the stacks that could potentially emit NO_x (reported as NO_2) has confirmed that all point sources are below the criteria specified in Table 13.15.

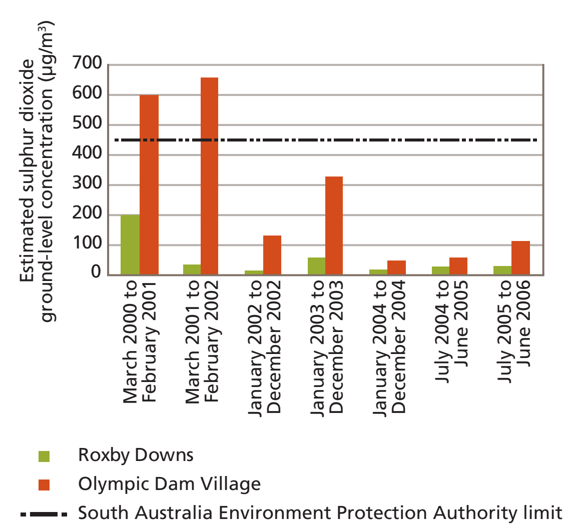


Figure 13.14 Estimated sulphur dioxide average concentration (one-hour maximum)

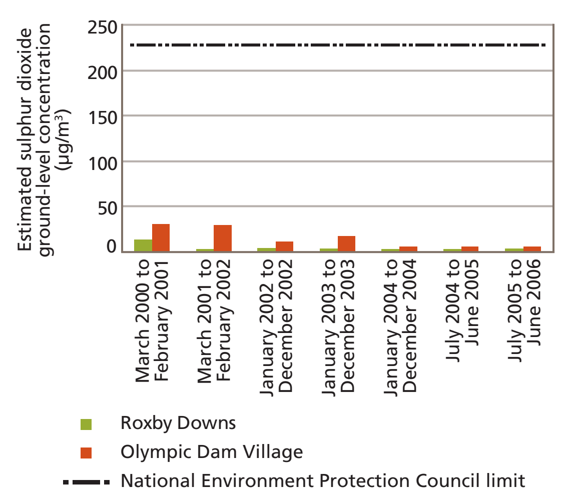


Figure 13.15 Estimated sulphur dioxide average concentration (24-hour maximum)

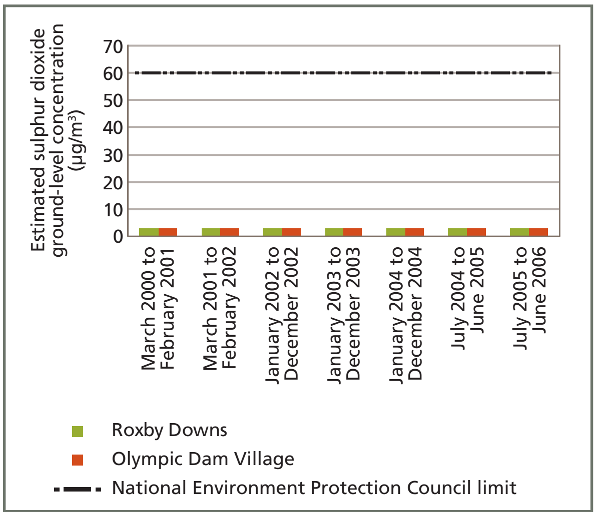


Figure 13.16 Estimated sulphur dioxide annual average concentration

Carbon monoxide (CO)

Using the NPI emission estimation techniques, together with fuel usage data, the point-source emissions are estimated to be below the criteria specified in Table 13.15.

Lead (Pb)

Point-source monitoring of particulate emissions from stacks and subsequent particulate analysis has been undertaken. The results indicate that point-source lead concentrations are below the criteria specified in Table 13.15.

Fluoride (as HF)

Point-source monitoring of HF emissions has been undertaken previously. The results confirm that all point sources measured are below the criteria specified in Table 13.15.

Carbon disulphide (CS_2)

No monitoring of ground level odour concentrations has been done at Olympic Dam beyond the current mining lease. A study commissioned in 2003 by BHP Billiton to investigate odours emanating from the hydrometallurgical areas of the metallurgical plant, however, found that the principal source of odour in the plant was the decomposition of xanthates to carbon disulphide within the flotation area (Glossop 2003).

In addition, an extensive survey of the mining industry was undertaken in 1995 as a part of the Australian Government Priority Existing Chemical Program because of the lack of information available regarding the health effects of xanthates, the large volumes used in the mining industry, and the potential for odorous emissions after the xanthates decompose in acid to form carbon disulphide.

The results of an investigation at Olympic Dam, as part of the 1995 industry survey, indicated that instantaneous atmospheric concentrations of carbon disulphide were less than 2.5 ppm (about 800 µg/m³) in the reagents storage area of the facility (see Plate 13.10), which was the major source of carbon disulphide at Olympic Dam. This was consistent with other operations benchmarked in the assessment report (NICNAS 1995).

In the past seven years, members of the public have filed two reports of nuisance odour in Roxby Downs (as a result of mining and metallurgical operations) with BHP Billiton. These were found to be the result of issues associated with the dosing of xanthate to the flotation area of the metallurgical plant. In these instances, the issues associated with the dosing system were corrected and the systems returned to service.

13.3.4 DESIGN MODIFICATIONS TO PROTECT ENVIRONMENTAL VALUES

Environmental values

The values in this instance relate to the sensitive receivers discussed in Section 13.3.2 and the existing quality of the air environment as described in Section 13.3.3.

Major elements of the project design

The initial design brief for the expanded mining and metallurgical operation, and the subsequent development of an emissions inventory for the purpose of air quality modelling, indicated that compliance with the 24-hour particulate matter ambient air quality goals would be a challenge. As a result, some mitigation measures were adopted into the emissions inventory that resulted in decreased particulate emissions from the mining operations. Other management decisions were made regarding the location of project infrastructure to reduce the potential impacts to sensitive receivers. These specific mitigation and management measures were:

- suppressing dust on unsealed haul roads and unsealed access roads using saline water or a suitable chemical dust suppressant
- providing a 500 m separation between the toe of the RSF and Arid Recovery to minimise direct and indirect impacts from particulate matter
- relocating Olympic Dam Village, including the existing heavy industrial estate, to reduce potential workforce exposures to particulate matter

Plate 13.10 Reagents storage area

- siting Hiltaba Village about halfway between Roxby Downs and Andamooka to maximise the distance between the particulate emissions sources and the residents, while considering the social and economic impacts associated with the construction and operation of a 6,000 person accommodation camp
- transferring dry materials using covered or otherwise enclosed conveyor systems, with baghouses at transfer points, and intermediate storage bins to minimise dust emissions. Differential pressure indicators would be fitted to alert operations personnel to a potential bag failure.

With regard to gaseous emissions from the expanded existing and proposed new metallurgical plants, and in particular the proposed sulphur-burning acid plants and the gas-fired power station, the following mitigation and management measures have been incorporated:

- the exhaust stacks for all four new sulphur-burning acid plants have been modelled at 50 m high, and would operate to at least the same efficiency as the existing acid plant
- the stack for the proposed CCGT power station has been modelled at 35 m high
- a gas cleaning system would be installed with the proposed additional calcining furnace so that the treated calciner off-gas would comply with the criteria discussed in Table 13.15
- a gas cleaning system similar to that currently installed for the existing anode furnaces would be installed with the additional smelter anode furnace. Like the existing furnaces, the system would be inter-locked to the process control system so that in the event of the gas cleaning system failure, the furnace would stop processing to minimise further emissions.

These management and mitigation measures have been incorporated into the air quality modelling discussed previously.

Further to these measures, a closed system would be designed at the Port of Darwin for the transport, storage and handling of concentrate. As part of the closed system, the concentrate storage shed at the East Arm facility would be a fully enclosed building fitted with automatic doors and a negative pressure particulate filtration and ventilation system. The closed system would extend from the production storage point at Olympic Dam to the ship hold at the Port of Darwin (see Appendix E4 for details).

13.3.5 IMPACT ASSESSMENT AND MANAGEMENT

The assessment of air quality relates to proposed sources and rates of emission from the expanded operation, the resultant concentrations of emissions at ground level at sensitive receivers, and the proposed management measures to comply with applicable limits at sensitive receivers.

Emissions sources

The two key emission sources from the proposed expansion would be the expanded metallurgical facility and activities associated with the new open pit mine. These are discussed in greater detail in the following sections, with the locations of emission sources relevant to the proposed expansion shown in Figures 13.10a and b.

Expanded metallurgical plant

The expanded metallurgical plant would be constructed to the south of the existing operation. However, the existing smelter, which would be upgraded to handle the additional volumes of copper concentrate (see Chapter 5, Description of the Proposed Expansion, for details), would remain the primary source of gaseous emissions. New flotation circuits would be constructed within the new concentrator plant and a new calciner would be constructed within the additional hydrometallurgical plant. Four new sulphur-burning acid plants, feeding into two new off-gas stacks, would also service the new hydrometallurgical plant.

Details of the point-emission sources associated with the expanded plant are shown in Table 13.18, and the estimated emission rates are listed in Table 13.19. As described in the following section, the expanded processing operation would be designed so that all point-source emissions comply with the requirements of the Environment Protection (Air Quality) Policy 1994 (see Table 13.15 for emission limits).

Emissions of carbon disulphide are expected to increase in proportion to the volume of sodium ethyl xanthate used within the new flotation facilities, with the estimated emission rate being 0.07 g/s from the new facility.

New furnace bypass stacks

The gas cleaning systems in all smelter-based furnaces would be bypassed in the event of abnormal or emergency conditions that may adversely affect the health and safety of personnel. As with the existing operation, these bypass stacks would be interlocked to the process, so that the failure of a gas cleaning system would interrupt feed to the relevant furnaces and minimise the potential environmental or health and safety risks.

CCGT power station

The proposed CCGT power station would be constructed to the south of the expanded metallurgical plant. Details of the modelled stack configuration are presented in Table 13.20.

Emissions from the gas-fired power station have been calculated using the NPI Emission Estimation Technique Manual for Fossil Fuel Electric Power Generation (NPI 2005) and estimates of the likely volume of natural gas that would be consumed. Table 13.21 shows the likely annualised emissions from the proposed power station where the NPI reporting thresholds have been triggered.

Table 13.18 Proposed point emission sources and indicative operating data

Stack	Flow rate (Nm³/hr)	Height (m AGL)	Velocity (m/s)	Inner Diameter (m)	Temp (°C)	Notes
Main smelter stack	635,000	90	24	3.8	55	Addition of new anode furnace (60,000 Nm³/hr) and taphole and launder ventilation (100,000 Nm³/hr) gases
Acid plant tails gas stack	100,000	90	6.5	2.9	70	Remains unchanged
Smelter 1 shaft furnace stack	45,000	40	15.5	1.3	38	Remains unchanged
Calciner A stack	2,500	29	9	0.5	45	Remains unchanged
Calciner B stack	3,000	29	9	0.5	85	Remains unchanged
Slimes treatment roaster stack	30,000	20	23	0.75	60	Flow rates and concentration do not change, although utilisation is increased
Slimes treatment NO_x stack	6,000	20	14.5	0.4	35	Flow rates and concentration do not change, although utilisation is increased
Concentrate dryer stack	40,000	22	18	1.2	30	An additional larger dryer, or two smaller dryers, are added, doubling flow rates. Concentrations remain the same
New acid plant tails gas stack	260,000	50	17	2.9	70	Additional acid plant built to handle additional flash furnace off-gas. The flow rate would be higher than the existing acid plant, although it would operate to the same efficiencies
New sulphur-burning acid plant stack 1	516,000	50	13	4.6	70	Sulphur-burning acid plants constructed adjacent to greenfield metallurgical plant. Would be larger than existing acid plant, and operate to the same efficiencies. There would be two exhaust flues in a common stack
New sulphur-burning acid plant stack 2	516,000	50	13	4.6	70	
New calciner stack	3,000	30	10	0.5	85	Similar to existing Calciner B

Table 13.19 Indicative average point source emission rates for the expanded operation (mg/Nm³)

Stack	SO_2	NO_x	CO	Pb	HF
Main smelter stack	150	50	1.6	1	0.05
Acid plant tails gas stack	1,050	75	3.6	0	0.05
Smelter 1 shaft furnace stack	2	20	14.4	8	0.1
Calciner A stack	0	0	1.5	0	0
Calciner B stack	0	0	1.2	0	0
Slimes treatment roaster stack	0	700	0	0.005	0
Slimes treatment NO_x stack	0	170	0	0.005	0
Concentrate dryer stack	1	35	0	0.05	0.5
New acid plant tails gas stack	1,050	75	3.6	0	0.05
New sulphur-burning acid plant stack 1	1,050	75	3.6	0	0.05
New sulphur-burning acid plant stack 2	1,050	75	3.6	0	0.05
New calciner stack	0	0	1.2	0	0

Table 13.20 Indicative emission point source operating data

Stack information	Values	Comments
Stack height	35 m	Minimum height
Stack diameter	6.2 m	–
Stack temperature	500 °C	Open cycle
Stack temperature	105 °C	Combined cycle
Stack velocity	20 m/s	–
Stack flow rate	1,550 kNm^3/h	Per stack
Number of stacks	4	–

Table 13.21 Indicative average emission rates for the proposed 600 MW gas-fired power station

Substance	Annual emission (kg/year)	Estimated concentration (mg/Nm^3)
Carbon monoxide	1,155,000	22
Oxides of nitrogen (expressed as nitrogen dioxide, NO_2)	2,520,000	46
PM_{10}	92,400	2
Polychlorinated dioxin and furans	0.0003	0
Polycyclic aromatic hydrocarbons	31.4	0
Sulphur dioxide	246	0
TVOCs	30,030	0.6

Open pit mining activities

The most significant potential impact to regional air quality would be particulate emissions associated with developing and operating the open pit, ore stockpile and RSF (see Figure 13.10b for the location of major emission sources). The main sources of particulate emission would be:

- drilling
- blasting
- dozers and graders
- crushing
- shovels loading haul trucks
- trucks operating on haul roads
- unloading materials at stockpiles/dumps
- road maintenance activities
- wind erosion of active surfaces.

The typical inventory of particulate emissions is summarised in Table 13.22, including the effects of design refinements provided in Section 13.4. Figure 13.17 shows the major contributors to PM_{10} emissions from open pit mining would be the loading, moving and unloading of haul trucks in and around the open pit, and the crushing operations on the pit rim. Details of emission factors used, and the resulting emission rates and assumptions, are provided in Appendix L2.

Predicted ambient air quality around the SML

Summary

Ground level concentrations of emissions were predicted using the Calpuff computer dispersion model. A summary of the predicted ground level concentrations is provided in Table 13.23.

Particulate

The particulate ground level concentration contours are shown in Figures 13.18a to 13.18d. The results of the air quality modelling indicate that the predicted annual average ground level concentrations would comply with the ambient air quality

Table 13.22 Estimated particulate emission rates for the proposed mining operation (kg/d)

Activity	Particulate (TSP)	Particulate (PM_{10})	Particulate ($PM_{2.5}$)[1]
Drilling	103	54	n.a.
Blasting	457	237	n.a.
Dozing and grading	4,300	780	450
Ore crushing	38,400	3,850	n.a.
Loading	14,750	13,100	280
Haul roads	19,450	8,200	4,750
Unloading	13,500	4,850	n.a.
Road maintenance	0	0	n.a.
Wind erosion	175	90	n.a.

[1] $PM_{2.5}$ emission factors are not documented for some emission sources.

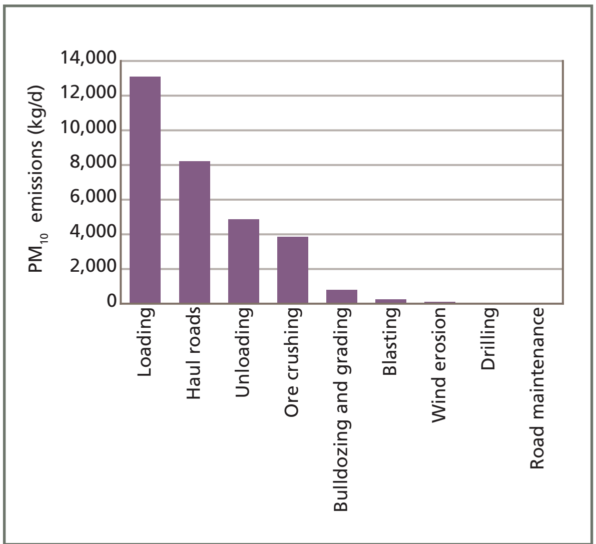


Figure 13.17 Estimated PM_{10} particulate matter emission rates for the proposed mining operation

goals at both Roxby Downs and Hiltaba Village for all particulate size fractions, as would the maximum 24-hour average $PM_{2.5}$ ground level concentration. The maximum 24-hour average PM_{10} concentrations, however, are predicted to exceed the ambient air quality goals at Roxby Downs on 10 days per year, and at Hiltaba Village on five days during the worst-case year. The National Environment Protection (Ambient Air Quality) Measure, 2003, permits up to five exceedances of the PM_{10} 24-hour average ambient air quality goal per year.

As the air quality modelling already includes the effect of the design refinements identified in Section 13.3.4, operational controls may be required to maintain ground level concentrations of PM_{10} dust to within applicable compliance limits during the predicted five to ten days per annum of worse-case weather conditions, should such conditions eventuate. Other large mining and materials handling operations currently use such systems with success (e.g. KCGM 2006 and BHP Billiton 2006).

A dust management plan would be developed to record and monitor the following process of applying operational control:

- a network of real-time dust monitors, which may include TSP, PM_{10} and $PM_{2.5}$ monitors, around the mining operation, at the sensitive receivers, and at intervals between these receivers and the mining operation. These would be integrated within the mining process control system as an early warning of rising particulate concentrations at the sensitive receivers
- a real-time meteorological system, integrated with the real-time dust monitors, which would permit mining operations to be planned and adjusted to ensure the particulate criteria would not be exceeded at the sensitive receivers
- additional monitoring sites would be placed north, east and west of the operation to determine the concentration of particulates contributed by the expanded operation.

Table 13.23 Predicted ground level concentrations at Roxby Downs and Hiltaba Village

Pollutant	Averaging period	Ambient air quality goal[1] (µg/m³)	Allowable exceedances (days per year)	Roxby Downs[2] (µg/m³)	Hiltaba Village[2] (µg/m³)
TSP	Annual	90		5.7	7.1
	Deposition (g/m²/month)	4	Nil	0.2	0.2
PM_{10}	24 hour	50	5	**83.0**	**65.9**
	Annual	30	Nil	4.3	5.0
$PM_{2.5}$	24 hour	25	n.a.	13.9	17.8
	Annual	8	n.a.	1.0	0.9
Sulphur dioxide	1 hour max	450	1	**460**	260
	24 hour	228	1	51.9	43.0
	Annual	57	Nil	1.6	1.4
Nitrogen dioxide	1 hour max	158	1	87.7	70.7
	Annual	60	Nil	0.44	0.33
Carbon monoxide	1 hour max	29	Nil	20.0	17.2
	8 hour	10,000	1	3.2	4.4
Lead	Annual	0.5	Nil	0.001	0.001
Fluoride	24 hour	2.9	Nil	0.003	0.003
Carbon disulphide	3 minute	130	Nil	0.4	0.2

[1] The ambient air quality goal for each compound is the lower of those presented in Table 13.13.
[2] Numbers in bold indicate that concentrations exceed ambient air quality criteria.

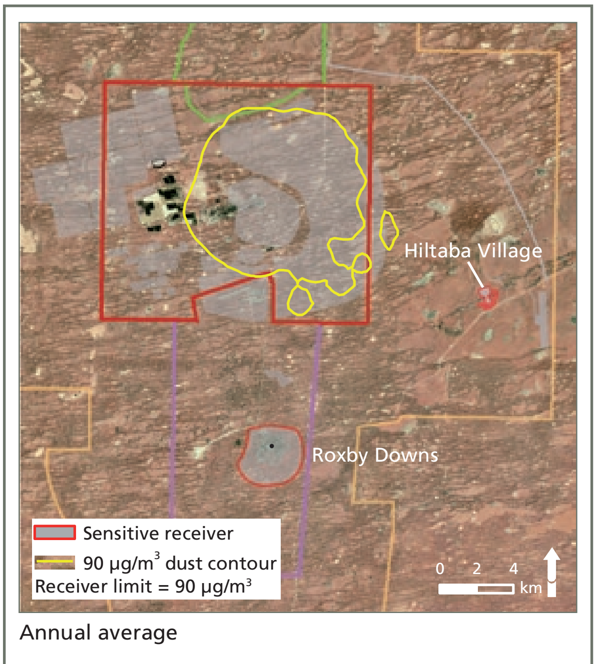


Figure 13.18a Predicted total suspended particulate ground-level concentrations (µg/m3)

Figure 13.19 shows the response procedure should ambient dust concentrations rise to a point where the ambient air quality goals are likely to be exceeded. The controls would be based around managing the scale of the dust generating activities, and the timing and location of such activities. The management response may include:

- relocating some or all blasting/loading or unloading activities to more favourable areas of the mining operation
- redirecting mine rock haulage activities
- modifying planned blasting activities
- increasing the frequency of dust suppression activities on haul roads
- cessation of operations.

The effects of dust on health and amenity have been raised as issues in consultation undertaken for the Roxby Downs Draft Master Plan (see Appendix F4) and in the Outback Areas Community Development Trust – Community Forum Report (2007).

Research into the amenity impacts of dust arising from mining operations has been undertaken for communities in the Hunter Valley region of New South Wales exposed to varying concentrations of dust, including dust deposition rates in excess of those predicted for the expanded operation. A 1986 survey of three communities (Dean et al. 1987) showed that there was 'no specific dust deposition threshold that represented a precise point where people generally perceive a decline in their level of amenity commencing'. This study subsequently concluded that the most important factor in determining a community's response to dust was likely to be the existing air quality and its rate of change.

A similar study undertaken in 1999 (ACARP 1999), also for the Hunter Valley, concluded that 'community perceptions to air quality do not correlate well with exposure to long-term average PM_{10} concentrations, nor do community perceptions appear to correlate well with even quite extreme exposures to dust measured at a particular location'. It was suggested that a possible explanation for this is that community perception of dust is based on visual cues (such as general haze and dust fallout onto roofs and cars) rather than compliance or otherwise with health-based limits. The additional particulate emissions associated with the expanded operation, although complying with ambient air quality goals specified in Table 13.23 through

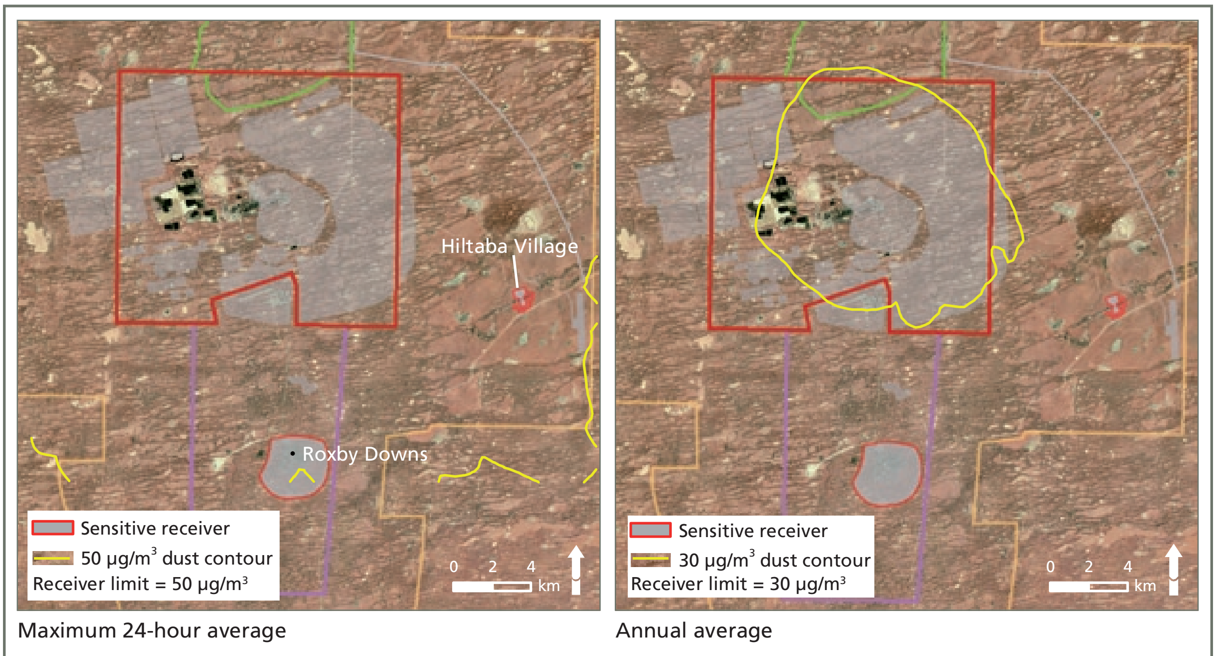
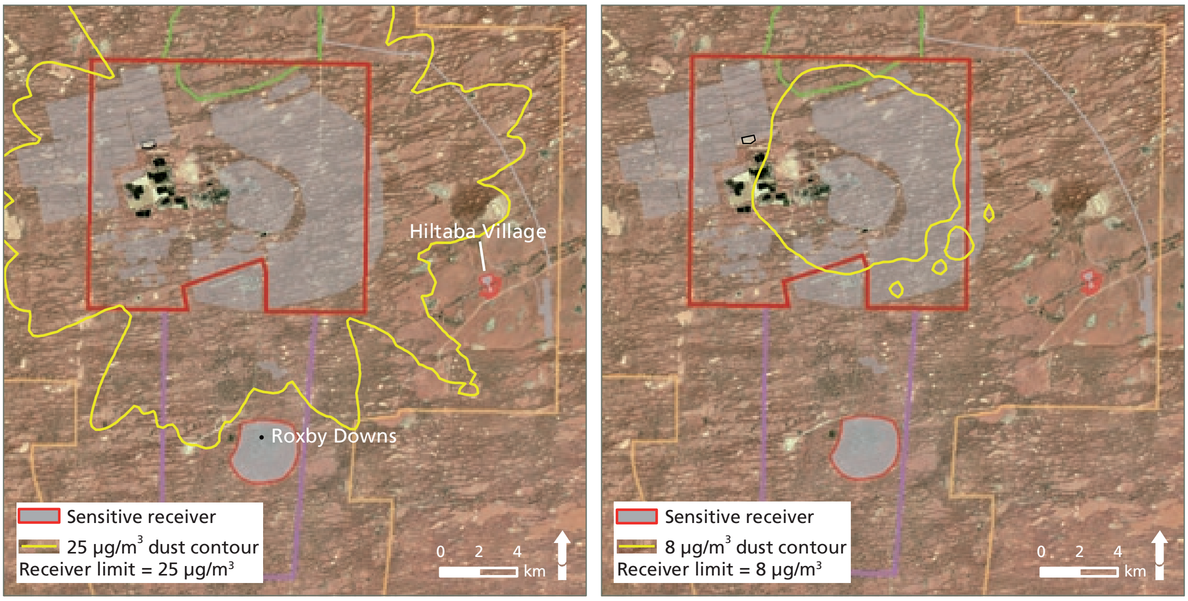


Figure 13.18b Predicted PM_{10} ground-level concentrations for the expanded operation (µg/m3)



Maximum 24-hour average

Annual average

Figure 13.18c Predicted $PM_{2.5}$ ground-level concentrations (µg/m3)

the use of dust suppression and operational control, are predicted to increase dust deposition by about 10% over current levels at both Roxby Downs and Hiltaba Village. This would be visible by residents and therefore may be perceived negatively by the community. As a result, it has been categorised as a moderate residual impact.

To assist in fostering a greater understanding of impacts of particulates on community amenity and health, BHP Billiton would provide information to residents of Roxby Downs and Hiltaba Village on dust and dust emissions through:

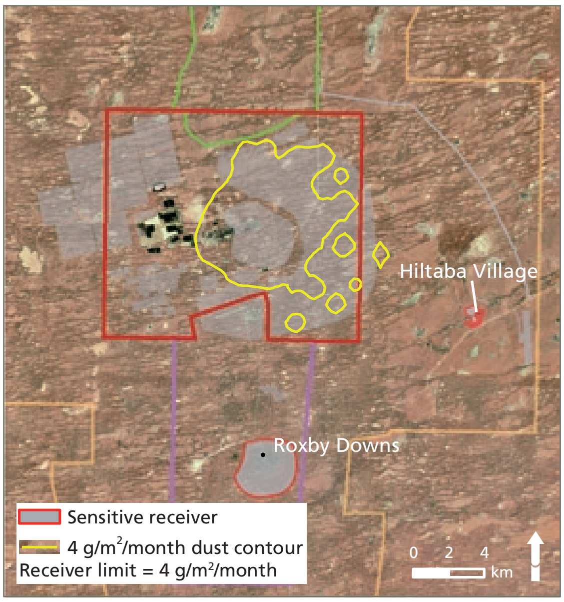
- information packs for all new and existing residents
- a web-based system that enables the community to have access to dust monitoring results
- feedback to the community about on-site and off-site environmental performance through the EMMR.

Chapter 15, Terrestrial Ecology, and Chapter 22, Health and Safety, also provide further details on predicted impacts to ecosystems and human health, respectively.

Other airborne emissions

The results of the air quality modelling indicate that other airborne emissions would comply with the ambient air quality goals as described in Table 13.14 for the proposed expanded operation (see results in Table 13.23), with the adoption of the design components detailed in Section 13.3.4. The SO_2 one-hour maximum average concentration slightly exceeds the SA EPA ambient air quality goal at Roxby Downs on one occasion during the modelled worst-case year. An analysis of the ground level concentration data for SO_2 indicates that the next highest one-hour maximum concentration at Roxby Downs is around 315 µg/m³, significantly below the goal (of 450 µg/m³). The operation of the four sulphur-burning acid plants is the largest factor in the increase in ground level sulphur dioxide concentrations,

and calculations of final stack height and acid plant efficiency would be undertaken during detailed design with the aim of reducing the potential ground level concentrations. The National Environment Protection (Ambient Air Quality) Measure permits one exceedance of the one-hour maximum average SO_2 goal per year.



Annual average dust deposition rate

Figure 13.18d Predicted dust deposition rate (g/m2/month)

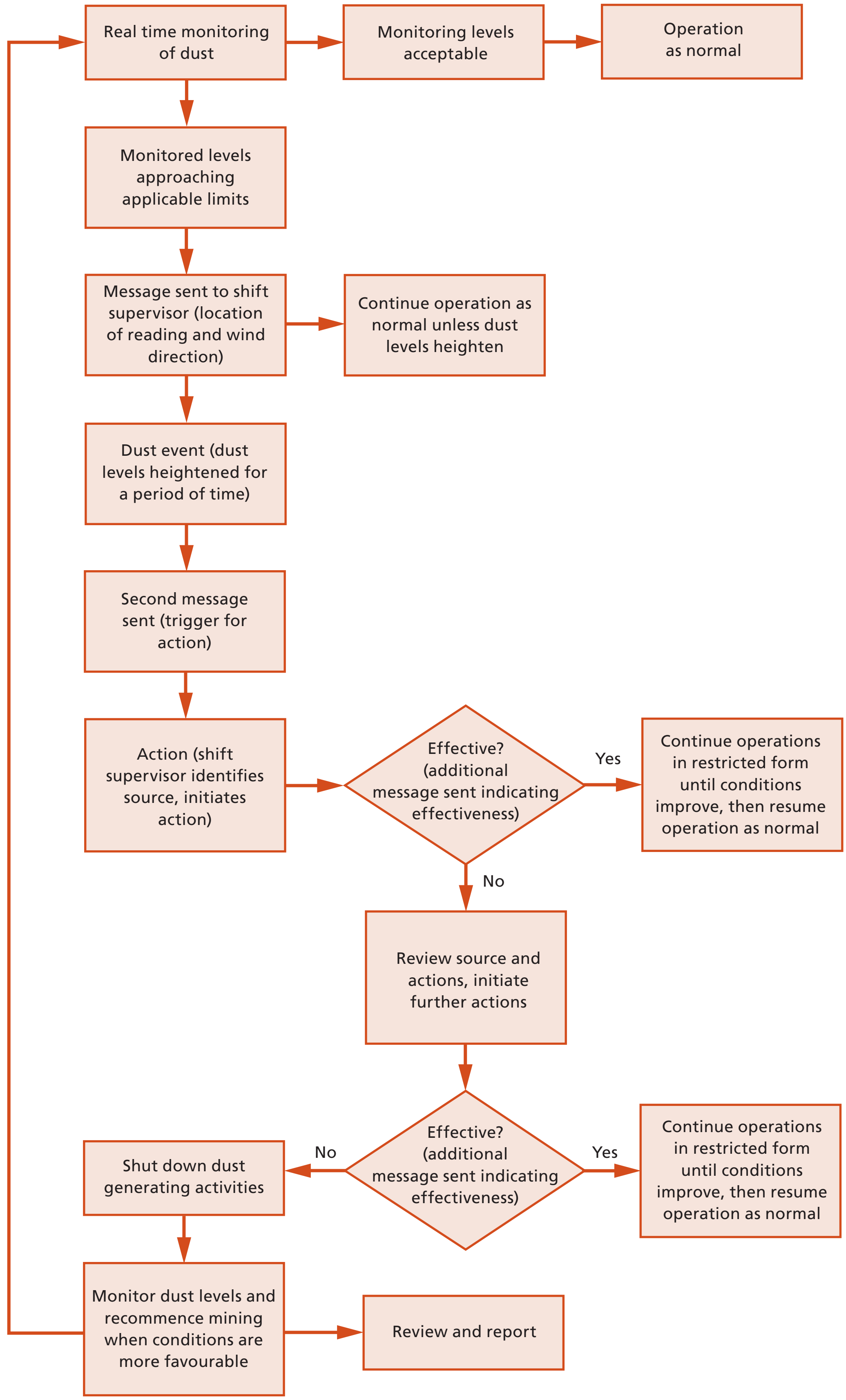


Figure 13.19 Indicative response procedure should operational dust control be required

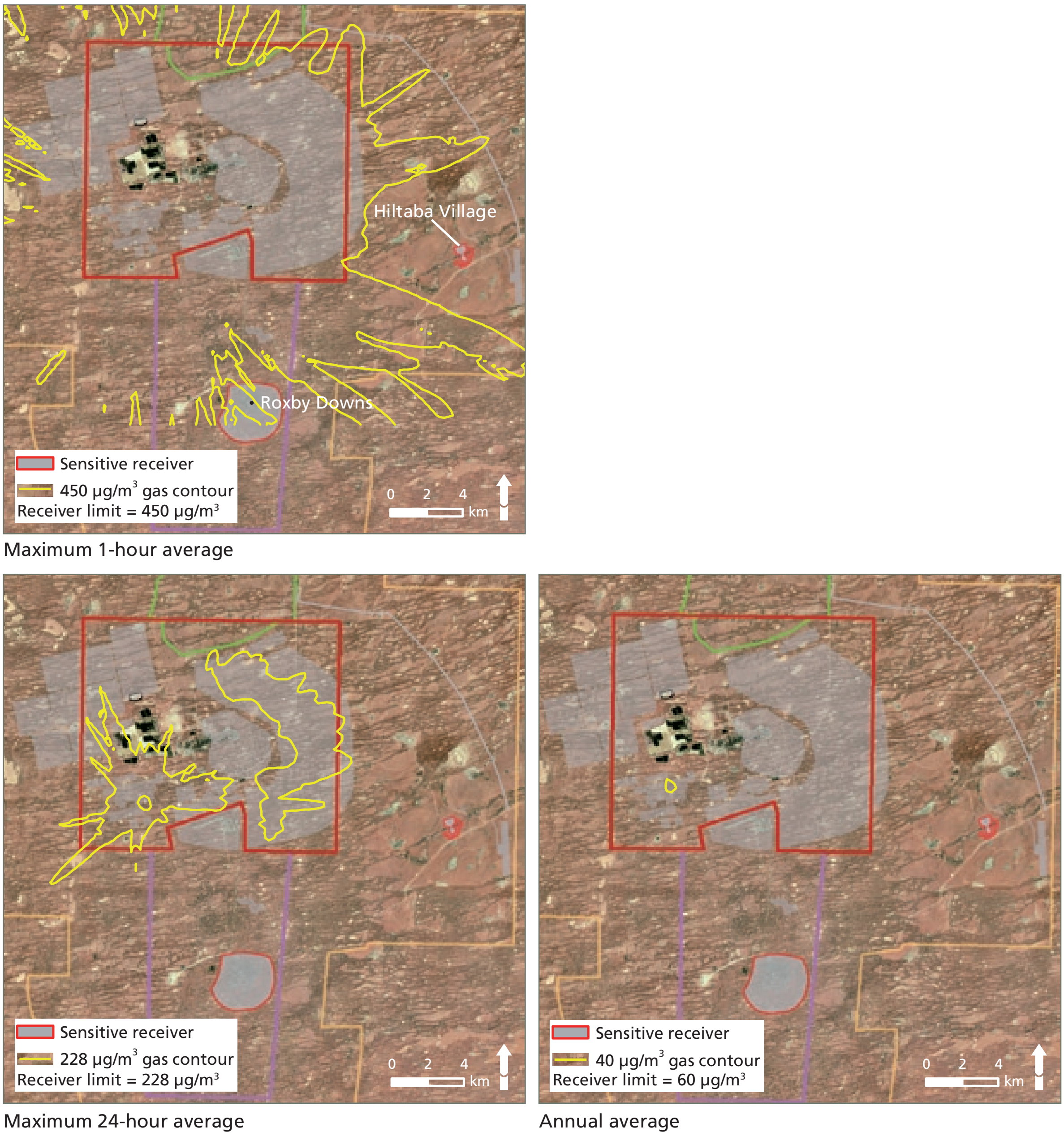
Figures 13.20a to 13.20f show the ground level concentration contours for the other airborne emissions compared with the ambient air quality limits. The relatively low predicted ambient concentrations of gaseous emissions would result in a low residual impact.

Predicted ambient air quality around off-site infrastructure

The construction and operation of off-site infrastructure associated with the expanded operation may also result in additional air quality impacts, although in the majority of cases these are not considered significant because of the considerable distance between the dust generating activities (generally related to infrastructure construction) and the nearest sensitive receivers and the use of dust mitigation, such as the watering of construction areas, during occasions when dust generation is likely.

Emissions from the following infrastructure elements were considered:

- coastal desalination plant during construction and operation
- water supply pipeline during construction
- transmission line during construction
- gas supply pipeline during construction
- constructing the Pimba to Olympic Dam rail spur during construction
- constructing and operating the Pimba intermodal road/ rail facility



Maximum 24-hour average

Annual average

Figure 13.20a Predicted sulphur dioxide ground-level concentrations (μg/m3)

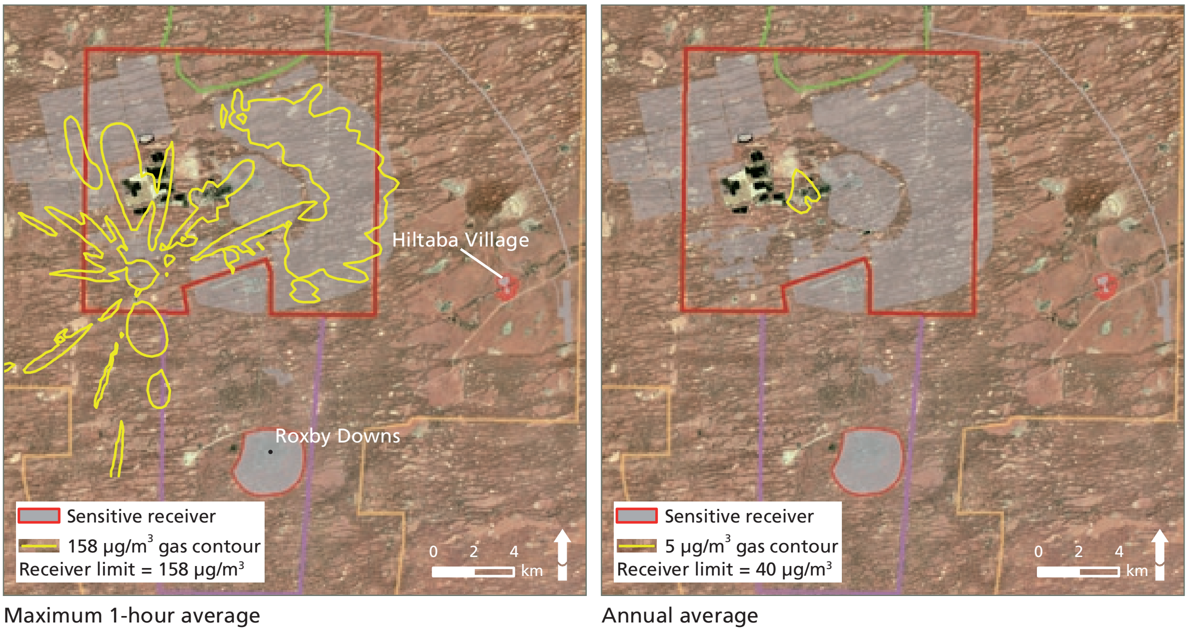


Figure 13.20b Predicted nitrogen dioxide equivalent ground-level concentrations (µg/m3)

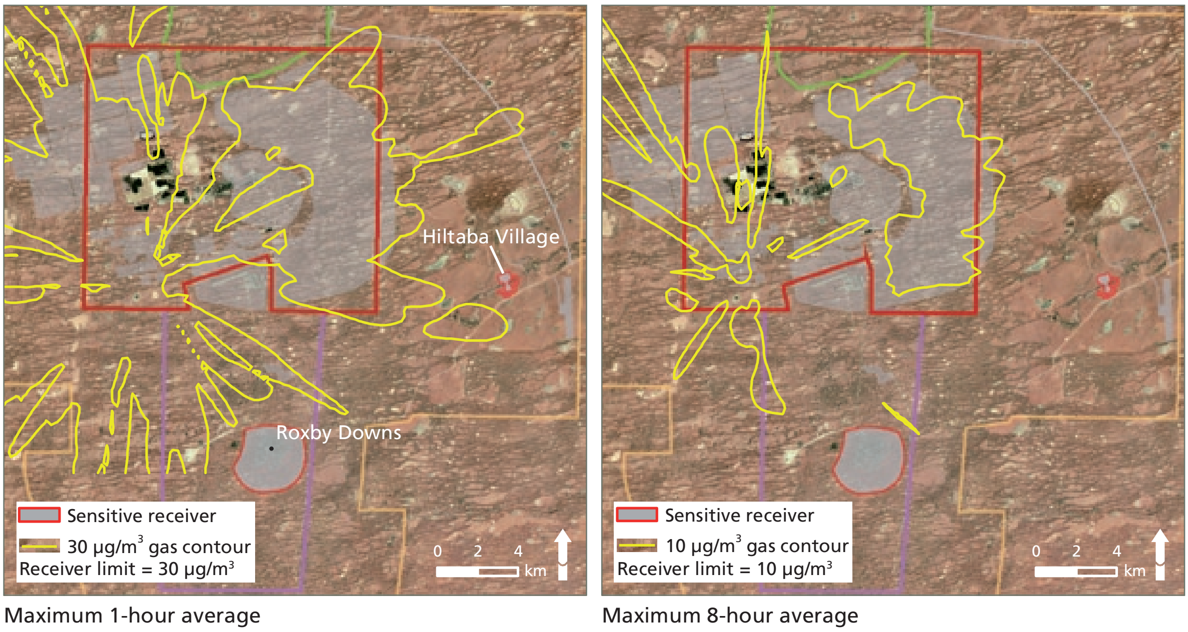


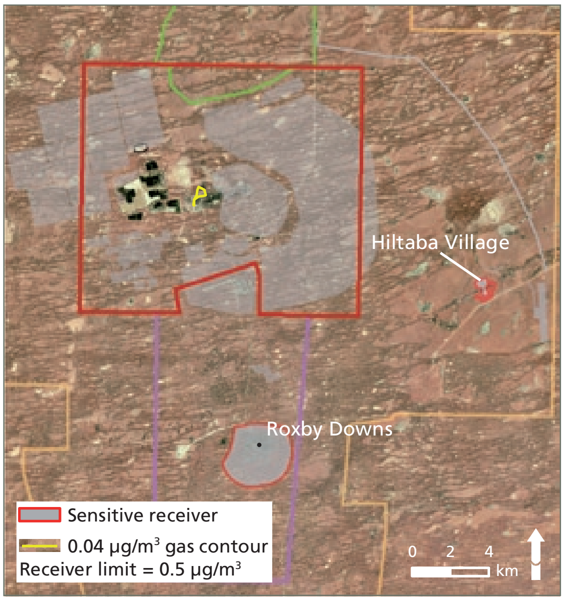
Figure 13.20c Predicted carbon monoxide ground-level concentrations (µg/m3)

- constructing roadways, including the relocated Borefield Road, passing bays on the Stuart Highway and Olympic Way and the road/rail overpass north of Woomera
- constructing and operating the Outer Harbor sulphur handling facility, the Port of Darwin concentrate handling facility and the landing facility at Port Augusta
- constructing the new airport
- constructing additional accommodation infrastructure.

Some likely ambient air quality impacts are common to multiple infrastructure elements, and these are discussed below in general terms. The potential air quality impacts specific to a particular infrastructure element are also discussed in the following sections.

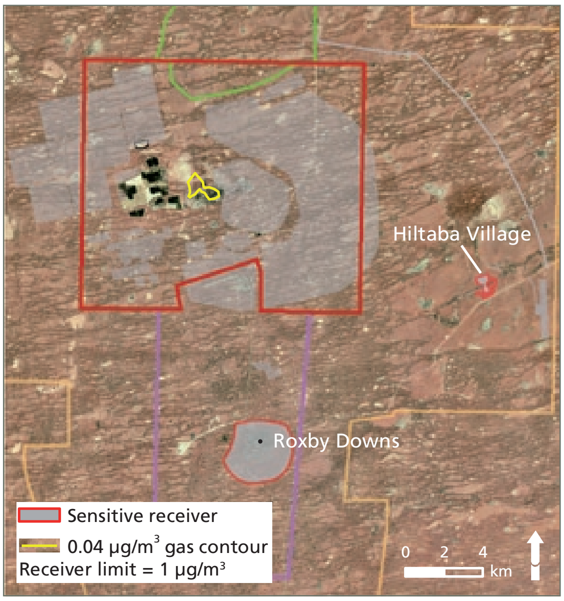
General ambient air quality impacts

The emission of dust during construction activities and from unsealed areas during operations would be the most common air quality issue for most off-site infrastructure. An allowance for the use of low-quality water for dust suppression has been made for all infrastructure projects (see Chapter 5, Description of the Proposed Expansion, for further details).



Annual average

Figure 13.20d Predicted lead ground-level concentrations (µg/m3)



Maximum 24-hour average

Figure 13.20e Predicted fluoride (as hydrogen fluoride) ground-level concentrations (µg/m3)

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Dust suppression water may be supplemented with dust suppressive chemicals to reduce water demand, and would be applied by water carts or mobile sprinklers. Disturbed areas that are no longer required would be rehabilitated in order to minimise ongoing dust impacts and reduce water demand (see Chapter 23, Rehabilitation and Closure).

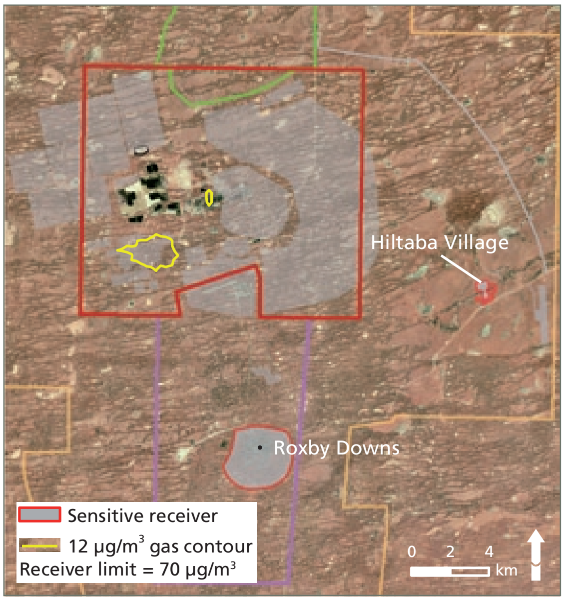
Borrow pits

About 23 borrow pits would be excavated to provide material for the construction of the additional road and rail infrastructure. The 10 pits planned north of Pimba would be around 130 m^2, and the 13 pits south of Pimba would be around 50 m^2. All of the pits would be around five metres deep. The borrow pits would be located away from sensitive receivers; the minimum distance between a proposed borrow pit and a homestead would be around 1,700 m. The borrow pits would use water carts and mobile sprinklers to suppress dust during operations and prevent adverse impacts on the sensitive receivers. After excavation of the pit has finished, the pits would be ripped and left to revegetate (see Chapter 23, Rehabilitation and Closure Plan).

Coastal desalination plant

The proposed coastal desalination plant would utilise backwashing to remove debris and scale from the seawater filters. Entrained solids would be removed from this backwashed material before it is discharged into the sea. The solids contained in the backwash would have the potential to cause slight odours if left to stagnate in lagoons as marine organic matter it contains decomposes.

The plant's backwash lagoons would be shallow to maintain a relatively high rate of inflow and outflow, minimising the potential for odorous (anaerobic) conditions to develop.



Maximum 1-hour average

Figure 13.20f Predicted odour (as carbon disulphide) ground-level concentrations (µg/m3)

The backwash solids would be periodically removed from the lagoons and disposed of at a licensed landfill facility.

Outer Harbor sulphur handling facility

The sulphur handling facility at Outer Harbor would be located in a heavy industrial area, at least 1 km from residential properties. As a consequence, it would not adversely impact the ambient air quality at these receivers. Nonetheless, the sulphur would be delivered in a pellet form (called prill), which is designed not to dust, and the unloading equipment and associated conveyors and transfer points would be fully enclosed to prevent the release of dust. The sulphur prill would also be stored in a covered shed facility. Sulphur prill emits little-to-no odour, and therefore presents negligible potential odour impact to nearby sensitive receivers.

Port of Darwin concentrate handling facility

The facilities at the Port of Darwin for the export of concentrate would be designed specifically to manage fugitive dusts in order to keep potential radiation exposures as low as reasonably achievable. The concentrate handling facility would be a closed system; that is, the conveyors, transfer points, loading and unloading facilities and storage areas would be enclosed and suitably ventilated. As a result of this design, there would be a negligible adverse air quality impact on nearby sensitive receivers (see Appendix E4 for details).

National pollutant inventory

Additional reporting thresholds under the National Pollutant Inventory (NPI) scheme would be triggered by the proposed expansion because it is, in general, a scaled version of the existing metallurgical, mining and quarrying facility, which already uses a significant volume of reagents. The emissions volumes presently reported would, however, increase in line with production.

13.4 FINDINGS AND CONCLUSIONS

13.4.1 GREENHOUSE GAS

The assessment of the potential increase in greenhouse gas emissions for the proposed expansion has identified the sources and quantified the volumes of greenhouse gases likely to be emitted. Potential mitigation measures that could reduce greenhouse gas emissions from the proposed expansion have also been identified.

It is estimated that at full operating capacity (of 60 Mtpa of ore), a peak of 4.7 Mtpa of greenhouse gases (with an NGER-reportable component of 3.3 Mtpa) would be emitted as a result of the proposed expansion, in addition to the existing greenhouse gas emission of 1.1 Mtpa. This includes the positive effects of the addition of a cogeneration plant which would use waste heat to generate electricity, saving about 1.2 Mtpa of CO_2-e emissions and the use of renewable electricity, contracted through the NEM, for the coastal desalination plant. In terms of emissions intensity, measured as a function of the mass of ore milled per annum, the increased size of the operation is predicted to result in a decrease from around 105 kg of CO_2-e per tonne of ore milled to about 79 kg of CO_2-e per tonne of ore milled over the long term, following an initial increase to 119 kg of CO_2-e per tonne of ore milled during the early mining operations when large quantities of mine rock but little ore are being moved.

Greenhouse gas emissions for the expanded operation are predicted to represent about 7–10% of South Australia's future greenhouse gas emissions, 0.5–0.75% of Australian future greenhouse gas emissions and around 0.01% increase in future global emissions. Although these proportions are relatively small, the residual impacts of greenhouse gas emissions have been categorised as high, representing a long-term state-wide impact.

BHP Billiton is negotiating a Sectoral Agreement with the South Australian Government setting out the objectives and strategies for greenhouse gas emission abatement.

13.4.2 AIR QUALITY

The assessment of the potential air quality impacts of the proposed expansion has identified the location and properties of potential additional airborne emission sources, and assessed them against state and national legislation, standards and guidelines.

In general, improvements to process technology enable the scaled-up process facilities to meet criteria for emissions to air and ground level air quality under normal operations for sulphur dioxide, oxides of nitrogen, lead, fluoride and carbon disulphide (odour).

The modelled air quality impacts for particulates on sensitive receptors around the expanded operation meet criteria for all indicators except the 24-hour criterion for PM_{10} (predicted to be exceeded at Roxby Downs and Hiltaba Village on between five and ten days per year).

Dust suppression methods will generally prevent PM_{10} exceedances, but operational control via a dust management system would be implemented to cope with occasionally severe dusting conditions. The dust management system has two elements, namely:

- pre-emptive particulate controls which would involve suppressing dust on haul roads and covering conveyors and conveyor transfer points to minimise dust lift-off from vehicle traffic
- a real-time response system which would be used to monitor the weather and fugitive particulates around the mine and towards sensitive receptors such as Roxby Downs and Hiltaba Village, identify impending exceedances and direct remedial action at specific dust sources. This may include periods during which significant dust generating activities are postponed.

The dust suppression and operational response measures proposed for the expansion project work at existing mines. On this basis, the residual air quality impacts of dust are predicted to be moderate. It is acknowledged that dust nuisance to residents of Roxby Downs and Hiltaba Village may occur, and education materials would be provided, and corrective actions applied, as appropriate.

The ground level concentrations of all other investigated substances, including odour, would comply with air quality criteria in all cases, resulting in a low residual impact requiring no further mitigation.


Sources of particulate emissions include the open pit


Covered conveyors would reduce dust

Sensitive receivers include Arid Recovery (looking south from the viewing platform to Olympic Dam)

Sensitive receivers include the Roxby Downs township

ENERTRADE

Emissions from the construction of a water pipeline were considered

Watering a haul road to reduce dust generation