PROJECT CHINA STONE

Air Quality 15

CONTENTS

15 Air Quality 15-1

15.1 Introduction 15-1

15.2 Project Site and Sensitive Receptors 15-1

15.3 Air Quality Issues 15-2

15.4 Regulatory Requirements 15-3

15.5 Meteorology 15-5

15.6 Existing Air Quality 15-5

15.7 Prediction Methodology 15-6

15.7.1 Estimation of Emissions 15-6

15.7.2 Dispersion Modelling 15-7

15.8 Impact Assessment 15-7

15.8.1 PM_{10} 15-7

15.8.2 $PM_{2.5}$ 15-8

15.8.3 TSP 15-8

15.8.4 Dust Deposition 15-9

15.8.5 Visibility 15-9

15.8.6 NO_2 15-9

15.8.7 SO_2 15-10

15.8.8 CO 15-11

15.8.9 Odour 15-12

15.8.10 Other Pollutants 15-12

15.8.11 Cumulative Impacts 15-12

15.8.12 Dust Impact Mitigation Measures 15-14

15.9 Greenhouse Gas 15-15

15.9.1 Greenhouse Gas Emissions 15-15

15.9.2 Greenhouse Gas Mitigation Measures 15-15

Tables

Table 15-1 Sensitive Receptors
Table 15-2 Ambient Air Quality Objectives Relevant to Mine Operations
Table 15-3 Ambient Air Quality Objectives Relevant to Power Station Operations
Table 15-4 Existing Background Air Quality
Table 15-5 Predicted Concentrations of PM_{10} and $PM_{2.5}$ Including Background Levels
Table 15-6 Predicted Concentrations of TSP and Dust Deposition Rate Including Background Levels
Table 15-7 Predicted Concentrations of NO_2 Including Background Levels
Table 15-8 Predicted Concentrations of SO_2 Including Background Levels
Table 15-9 Predicted Concentrations of CO Including Background Levels
Table 15-10 Predicted Cumulative 24-hour Average Concentrations of PM_{10}
Table 15-11 Predicted Cumulative 1-hour Average Concentrations of NO_2
Table 15-12 Range of Greenhouse Gas Emission Rates ($ktCO_{2\text{-}e}$)

Figures

Figure 15-1 Sensitive Receptors
Figure 15-2 Predicted 6^{th} Highest 24-hour Average Ground Level Concentrations of PM_{10} Due to the Project, including the Power Station and Ambient Background Levels
Figure 15-3 Predicted Maximum 24-hour Average Ground Level Concentrations of $PM_{2.5}$ Due to the Project, including the Power Station and Ambient Background Levels
Figure 15-4 Predicted Annual Average Ground Level Concentrations of $PM_{2.5}$ Due to the Project, including the Power Station and Ambient Background Levels
Figure 15-5 Predicted Annual Average Ground Level Concentrations of TSP Due to the Project, including the Power Station and Ambient Background Levels
Figure 15-6 Predicted Maximum Monthly Average Dust Deposition Rates Due to the Project, including the Power Station and Ambient Background Levels

15 AIR QUALITY

15.1 INTRODUCTION

This section provides a summary of the key findings from the Environmental Impact Statement (EIS) air quality assessment undertaken for Project China Stone (the project) by Katestone Environmental Pty Ltd. The detailed assessment is provided in the *Air Quality Report* (Appendix L).

15.2 PROJECT SITE AND SENSITIVE RECEPTORS

The terrain in the region is generally flat at around 200 - 300 m Australian Height Datum (AHD) with the exception of Darkies Range which runs north – south along the western edge of the project site. Darkies Range reaches a height of approximately 500 m AHD. Lake Buchanan is located approximately 18 km north-west of the project site.

The main existing land uses in the region are cattle grazing and coal exploration. The region is sparsely populated, with a few isolated homesteads, but no towns or cities are located nearby.

The sensitive receptors considered in this assessment are presented in Table 15-1 and are also shown in Figure 15-1. With the exception of the proposed accommodation village for the Carmichael Coal Mine Project and the Dooyne Outstation, the receptors are individual homesteads. The closest homestead (Moonoomoo Homestead) is located approximately 7 km from the project site. The Dooyne Outstation is not permanently occupied and is only used intermittently. Only four of the identified sensitive receptors are located within 20 km of the project site.

Table 15-1 Sensitive Receptors

RECEPTOR ID	RECEPTOR NAME	DISTANCE FROM PROJECT SITE	LOCATION (UTM Z55S)	
			Easting (m)	Northing (m)
R1	Moonoomoo Homestead	7.2 km west	402,365	7,584,444
R2	Dooyne Outstation	9.9 km east	432,541	7,588,505
R3	Carmichael Homestead	11.8 km south-west	406,412	7,571,007
R4	Old Hyde Park Homestead	20.2 km north-east	441,637	7,599,565
R5	Bowie Homestead	17.4 km west	389,708	7,589,881
R6	Hyde Park Homestead	22.8 km north-east	443,426	7,602,282
R7	Proposed Carmichael Coal Mine Accommodation Village	27.7 km south-east	448,412	7,569,905
R8	Doongmabulla Homestead	20.6 km south	422,016	7,559,462
R9	Ulcanbah Homestead	24.7 km south-west	395,073	7,564,172
R10	Kyong Homestead	31.5 km south-west	383,829	7,570,838
R11	Scott Homestead	27.6 km west	382,339	7,579,701
R12	Ronlow Park Homestead	28.9 km west	378,067	7,595,246
R13	Bulliwallah Homestead	42.8 km north-east	461,962	7,609,699

RECEPTOR ID	RECEPTOR NAME	DISTANCE FROM PROJECT SITE	LOCATION (UTM Z55S)	
			Easting (m)	Northing (m)
R14	Moray Downs Homestead	40.0 km south-east	462,027	7,572,602
R15	Yarrowmere Homestead	29.7 km north-west	382,749	7,627,056
R16	Plain Creek Homestead	51.0 km north-east	463,718	7,623,213

In addition to the sensitive receptors listed in Table 15-1, the project also includes an on-site accommodation village. On-site accommodation villages do not meet the definition of a sensitive receptor in accordance with the Department of Environment and Heritage Protection (EHP) Model Mining Conditions. However, the health and wellbeing of workers accommodated at the village has been considered and is discussed in Section 22 – Hazard and Risk.

15.3 AIR QUALITY ISSUES

The key air emissions generated by mining activities will be particulate matter (i.e. dust). Particulate matter can be categorised by size and/or by chemical composition. The potential for harmful effects depends on both. The human respiratory system has a built-in defence mechanism that prevents particles larger than approximately 10 µm (ten one-thousandths of one millimetre) from reaching the more sensitive parts of the respiratory system.

Laboratory and epidemiological studies have shown that elevated levels of very fine particles (aerodynamic diameter less than 2.5 µm or $PM_{2.5}$) mainly generated through combustion processes and vehicle exhaust, have the potential to cause adverse health impacts in susceptible people. Such studies form the basis of the current ambient air quality standards that are used in Australia. For this reason health impacts are determined primarily by the concentration of particles with aerodynamic diameters of less than 2.5 µm. Other larger particles can be suspended in the air and can give rise to nuisance and residential amenity effects through soiling of clothes, building surfaces and other surfaces.

The total mass of particles suspended in the air is referred to as total suspended particulates (TSP). This includes particles in the $PM_{2.5}$ and PM_{10} size ranges and larger particles up to approximately 30 to 50 µm in aerodynamic diameter. Particles larger than 30 to 50 µm settle out of the atmosphere quickly and are generally not considered to be a concern for human health. However, these large particles still have the capacity to give rise to nuisance effects and the potential for this is measured by the dust deposition rate.

The key air emissions generated by the power station operation will include nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). Studies have shown that both short term (1-hour) and long term exposure have the potential to cause adverse health impacts in susceptible people. Air quality objectives are generally set at 50% of the lowest observed effect level, which is the minimum concentration at which adverse health effects can be observed. This approach is designed to ensure adequate protection for more vulnerable people.

Minor emissions of other substances such as volatile organic compounds and trace metals will be generated by the project, mainly due to the power station and vehicle exhausts from mine-site vehicles and off-site project generated traffic. The project will not, however, emit these pollutants in sufficient levels to result in any measurable adverse air quality impacts at sensitive receptors.

Greenhouse gas emissions are also discussed within this section.

15.4 REGULATORY REQUIREMENTS

The project air quality objectives have been adopted from the Queensland Government's *Environmental Protection (Air) Policy 2008* (Air EPP) and *Odour Guideline* (EHP, 2013). Where an objective is not defined in the Air EPP, criteria have been adopted from other jurisdictions including:

- *Approved methods for the modelling and assessment of air pollutants in NSW* (NSW DEC, 2005);
- *Texas Commission on Environmental Quality Effects Screening Levels 2009* (TCEQ, 2009); and
- *Ambient Air Quality Criteria, 2008* (OME, 2008).

The objectives and guidelines relevant to the project are reproduced in Table 15-2 and Table 15-3 and are discussed further in the *Air Quality Report* (Appendix L). These objectives and guidelines are applicable to dust and odour levels at sensitive locations, such as residences.

Table 15-2 Ambient Air Quality Objectives Relevant to Mine Operations

INDICATOR	ENVIRONMENTAL VALUE	AVERAGING PERIOD	AIR QUALITY OBJECTIVE
Particulates in the form of $PM_{2.5}$	Health and wellbeing	24-hour	25 µg/m³
		Annual	8 µg/m³
Particulates in the form of PM_{10}	Health and wellbeing	24-hour [a]	50 µg/m³
TSP	Health and wellbeing	Annual	90 µg/m³
Dust deposition rate	Amenity	1-month	120 mg/m^2/day
Odour	Amenity	1-hour, 99.5th percentile	2.5 odour units

Note [a] Five days per year allowed to exceed the objective

Table 15-3 Ambient Air Quality Objectives Relevant to Power Station Operations

INDICATOR	ENVIRONMENTAL VALUE	AVERAGING PERIOD	AIR QUALITY OBJECTIVE
Arsenic and compounds	Health and wellbeing	Annual	6 ng/m³
Beryllium and compounds	Health and wellbeing	1-hour	4 ng/m³
Boron and compounds	Health and wellbeing	1-hour [a]	50 µg/m³
	Health and wellbeing	Annual [a]	5 µg/m³
Cadmium and compounds	Health and wellbeing	Annual	5 ng/m³
Chromium (III) and compounds	Health and wellbeing	1-hour [b]	9 µg/m³
Chromium (VI) and compounds	Health and wellbeing	1-hour [b]	0.09 µg/m³
Cobalt and compounds	Health and wellbeing	1-hour [a]	0.2 µg/m³
	Health and wellbeing	24-hour [c]	0.1 µg/m³
	Health and wellbeing	Annual [a]	0.02 µg/m³
Copper and compounds (dust)	Health and wellbeing	1-hour [b]	18 µg/m³
Copper and compounds (fumes)	Health and wellbeing	1-hour [b]	3.7 µg/m³

INDICATOR	ENVIRONMENTAL VALUE	AVERAGING PERIOD	AIR QUALITY OBJECTIVE
Cumene	Health and wellbeing	1-hour [b]	21 µg/m³
Carbon monoxide (CO)	Health and wellbeing	8-hour	11 mg/m³
Fluoride and compounds	Health and biodiversity of ecosystems (other than protected areas)	24-hour	2.9 µg/m³
		30-day	0.84 µg/m³
		90-day	0.5 µg/m³
	Health and biodiversity of ecosystems (for protected areas)	90-day	0.1 µg/m³
	Protecting agriculture	24-hour	1.5 µg/m³
		30-day	0.4 µg/m³
		90-day	0.25 µg/m³
Lead and compounds	Health and wellbeing	Annual [b]	0.5 µg/m³
Manganese and compounds	Health and wellbeing	Annual	0.16 µg/m³
Mercury and compounds (organic)	Health and wellbeing	1-hour [b]	0.18 µg/m³
Mercury and compounds (inorganic)	Health and wellbeing	1-hour [b]	1.8 µg/m³
Nickel and compounds	Health and wellbeing	Annual	20 ng/m³
Nitrogen dioxide (NO_2)	Health and wellbeing	1-hour	250 µg/m³
		Annual	62 µg/m³
	Health and biodiversity of ecosystems	Annual	33 µg/m³
Sulfuric acid	Health and wellbeing	1-hour [b]	18 µg/m³
Sulfur dioxide (SO_2)	Health and wellbeing	1-hour	570 µg/m³
		24-hour	230 µg/m³
		Annual	57 µg/m³
	Protecting agriculture	Annual	32 µg/m³
	Health and biodiversity of ecosystems (for forests and natural vegetation)	Annual	22 µg/m³
Zinc and compounds (zinc chloride fumes)	Health and wellbeing	1-hour [b]	18 µg/m³
Zinc and compounds (zinc oxide fumes)	Health and wellbeing	1-hour [b]	90 µg/m³

Note:

[a] *Objective from TCEQ 2009*

[b] *Objective from NSW DEC 2005*

[c] *Objective from OME 2008*

The Air EPP does not specify an objective to protect against dust levels that may cause a hazard because of their visibility. An example of a hazard might be a thick dust plume that travels across a roadway and hampers a driver's ability to see oncoming traffic. In general it is expected that the health and amenity objectives specified in the Air EPP will also protect against the problems associated with visible dust because, at levels equivalent to Air EPP objectives, dust is essentially not visible.

15.5 METEOROLOGY

Wind flows are an important consideration in air quality studies as emissions are transported in the wind flow. The *Air Quality Report* (Appendix L) provides a detailed description of the site meteorology.

Locations that are downwind of a source will experience higher dust concentrations than sites located upwind. Wind speed is a critical factor as exposed dust sources, such as stockpiles, will have higher dust emissions during strong winds (greater than 6 m/s) than during lighter winds. This is due to dust particles being more likely to be lifted during strong winds and carried further off-site. With regard to the emissions from the tall power station stacks, convective conditions (highly unstable conditions) have the tendency to bring a plume to the ground, resulting in relatively elevated ground-level concentrations of air pollutants. These conditions generally occur during the day.

At the project site, wind flows occur predominantly from the north-eastern quadrant and least often from the south-western quadrant, with the most dominant individual wind directions being the north-northwest, south-southeast and east. Wind speeds between 0 and 2 m/s were found to occur at the site for 32% of the time and winds between 2 to 5 m/s were found to occur 59% of the time. Strong winds (>5 m/s), occur for only 9% of the year.

15.6 EXISTING AIR QUALITY

Potential sources of dust in the region include:

- Natural features of the environment such as pollens, grass seeds and smoke from bushfires;
- Grazing activities;
- Use of unsealed roads; and
- Coal exploration.

The closest mining project is the proposed Carmichael Coal Mine. This project involves open cut and underground mining and is currently in the approval process. The proposed Carmichael Mine site is located to the south-east of the project site (Figure 15-1).

There are currently no EHP air quality monitoring stations operating in the vicinity of the project site and therefore particulate matter data (i.e. PM_{10}, $PM_{2.5}$, TSP and dust deposition) has been sourced from air quality assessments for other coal mines in the region.

Monitoring data from the EHP's monitoring stations at Toowoomba and Townsville have been used to characterise existing levels of NO_2, CO and SO_2.

The background concentrations used in this air quality assessment are shown in Table 15-4.

Table 15-4 Existing Background Air Quality

POLLUTANT	AVERAGING PERIOD	CONCENTRATION
TSP	Annual average	22.0 µg/m³
PM_{10}	24-hour average	18.8 µg/m³
$PM_{2.5}$	24-hour average	3.3 µg/m³
	Annual average	3.3 µg/m³
Dust deposition	1-month average	52 mg/m²/day
NO_2	1-hour average	63.6 µg/m³
	Annual average	12.3 µg/m³
SO_2	1-hour average	14.3 µg/m³
	24-hour average	11.4 µg/m³
	Annual average	2.9 µg/m³
CO	8-hour average	2,749 µg/m³

The background concentrations of all other pollutants are expected to be low as there are no activities known to emit other air pollutants within the region surrounding the project site. Therefore the assessment of other pollutants likely to be emitted from the project has considered those air pollutants in isolation in accordance with normal practice.

15.7 PREDICTION METHODOLOGY

The *Air Quality Report* (Appendix L) combines detailed information on mining activities, the power station, local and regional meteorology and existing air quality to estimate the potential effect of project activities on ambient levels of air pollutants. Estimated levels of air pollutants were compared with the applicable air quality objectives and standards to confirm whether any potential adverse impacts on health or amenity may occur. Any potential for air quality impacts upon surrounding land uses (e.g. grazing) is considered to be transient and limited in effect. Health and amenity are the most sensitive environmental values and compliance with standards for health and amenity will confirm no significant impacts on other less sensitive environmental values will occur (e.g. grazing).

15.7.1 Estimation of Emissions

Mining Operations

Dust emission rates associated with mining activities were estimated accounting for proposed emission controls using emission factors published in authoritative sources, including the National Pollutant Inventory (NPI) Emission Estimation Technique (EET) handbooks and the USEPA AP42 Emission Estimation Manuals.

The air quality assessment included the key mining activities that could contribute to dust generation:

- Trucking Run of Mine (ROM) coal from the open cut mining areas to the ROM coal stockpiles;
- Trucking overburden from the open cut mining areas to the overburden emplacement areas;
- Transport of coal by conveyor;
- Crushing and processing of coal at the Coal Handling and Preparation Plant;
- Wind erosion of stockpiles;

- Stacking and reclaiming of coal at stockpiles; and
- Loading coal into trains.

The dust controls that have been adopted as part of the project design are described in Section 15.8.12. These dust controls were taken into account in the calculation of dust emission rates for the project.

Power Station

Emission rates of air pollutants associated with the power station were estimated using a combination of analysis of samples of the feed coal, accounting for the proposed emission control measures, relevant emission limits and emission factors published in the NPI EET handbook for fossil fuel electric power generation.

Off-site Traffic

Off-site project-generated traffic will access the project site via sealed roads and is therefore not a potentially significant dust emission source.

15.7.2 Dispersion Modelling

The dispersion modelling of emissions from mining operations and the power station has been undertaken using the CALPUFF dispersion model. CALPUFF is accepted for use by the EHP for modelling of air pollutants emitted from mining operations and power stations. Project Year 20 was selected as the basis for modelling as it will have the highest dust emissions over the life of the project and will generate the worst case air quality impacts.

15.8 IMPACT ASSESSMENT

15.8.1 PM_{10}

Table 15-5 presents the predicted 6th highest 24-hour average ground-level concentrations of PM_{10} and Figure 15-2 presents the predicted PM_{10} contours (including background levels). The predicted levels are below the relevant air quality objectives at all sensitive receptors.

Table 15-5 Predicted Concentrations of PM_{10} and $PM_{2.5}$ Including Background Levels

RECEPTOR		PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	
ID	**Name**	**24-hour Average***	**Maximum 24-hour Average**	**Annual Average**
R1	Moonoomoo Homestead	37.0	7.3	4.2
R2	Dooyne Outstation	26.3	8.5	3.4
R3	Carmichael Homestead	29.4	5.9	3.8
R4	Old Hyde Park Homestead	21.9	5.1	3.3
R5	Bowie Homestead	28.2	8.4	3.7
R6	Hyde Park Homestead	20.9	4.8	3.3
R7	Proposed Carmichael Coal Mine Accommodation Village	20.7	4.8	3.3
R8	Doongmabulla Homestead	23.3	5.5	3.4
R9	Ulcanbah Homestead	23.9	4.9	3.6
R10	Kyong Homestead	23.3	5.1	3.5

RECEPTOR		PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	
ID	Name	24-hour Average*	Maximum 24-hour Average	Annual Average
R11	Scott Homestead	24.6	5.2	3.6
R12	Ronlow Park Homestead	23.1	5.5	3.5
R13	Bulliwallah Homestead	19.3	4.1	3.3
R14	Moray Downs Homestead	19.6	3.9	3.3
R15	Yarrowmere Homestead	20.4	4.0	3.4
R16	Plain Creek Homestead	19.2	3.7	3.3
Air Quality Objective		**50**	**25**	**8**

** 6th highest concentrations*

15.8.2 $PM_{2.5}$

Table 15-5 presents the predicted maximum 24-hour average and annual average ground-level concentrations of $PM_{2.5}$ and Figure 15-3 and Figure 15-4 present the predicted $PM_{2.5}$ contours (including background levels). The predicted levels are below the relevant air quality objectives at all sensitive receptors.

15.8.3 TSP

Table 15-6 presents the predicted annual average TSP concentrations and Figure 15-5 presents the TSP contours (including background levels). The predicted levels are below the relevant air quality objectives at all sensitive receptors.

Table 15-6 Predicted Concentrations of TSP and Dust Deposition Rate Including Background Levels

RECEPTOR		TSP (µg/m^3)	DUST DEPOSITION RATE (mg/m^2/day)
ID	Name	Annual Average	Maximum Monthly Average
R1	Moonoomoo Homestead	28.2	97.5
R2	Dooyne Outstation	22.5	53.6
R3	Carmichael Homestead	24.7	78.8
R4	Old Hyde Park Homestead	22.2	53.3
R5	Bowie Homestead	24.1	74.3
R6	Hyde Park Homestead	22.2	52.9
R7	Proposed Carmichael Coal Mine Accommodation Village	22.1	52.4
R8	Doongmabulla Homestead	22.5	55.2
R9	Ulcanbah Homestead	23.2	60.8
R10	Kyong Homestead	23.0	59.1
R11	Scott Homestead	23.3	61.3

RECEPTOR		TSP (µg/m^3)	DUST DEPOSITION RATE (mg/m^2/day)
ID	**Name**	**Annual Average**	**Maximum Monthly Average**
R12	Ronlow Park Homestead	22.8	60.9
R13	Bulliwallah Homestead	22.0	52.2
R14	Moray Downs Homestead	22.1	52.2
R15	Yarrowmere Homestead	22.2	52.7
R16	Plain Creek Homestead	22.0	52.3
Air Quality Objective		**90**	**120**

15.8.4 Dust Deposition

Table 15-6 presents the predicted maximum monthly average dust deposition rates and Figure 15-6 presents the dust deposition rate contours (including background levels). The predicted levels are below the relevant air quality objectives at all sensitive receptors.

15.8.5 Visibility

Meeting the air quality objectives (which are designed for health and amenity) will also protect against problems associated with visible dust because, at levels equivalent to the air quality objectives, dust is essentially not visible.

TSP levels from the project, in conjunction with the existing background dust levels, are predicted to not exceed dust objectives at any sensitive receptors.

15.8.6 NO_2

Table 15-7 presents the predicted maximum 1-hour and annual average ground-level concentrations of NO_2 (including background levels). The predicted levels are well below the relevant air quality objectives at all sensitive receptors.

Table 15-7 Predicted Concentrations of NO_2 Including Background Levels

RECEPTOR		NO_2 (µg/m^3)	
ID	**Name**	**Maximum 1-hour**	**Annual Average**
R1	Moonoomoo Homestead	101	12.7
R2	Dooyne Outstation	78	12.4
R3	Carmichael Homestead	88	12.6
R4	Old Hyde Park Homestead	86	12.3
R5	Bowie Homestead	87	12.6
R6	Hyde Park Homestead	71	12.3
R7	Proposed Carmichael Coal Mine Accommodation Village	85	12.3

RECEPTOR		NO_2 (µg/m^3)	
ID	Name	Maximum 1-hour	Annual Average
R8	Doongmabulla Homestead	76	12.4
R9	Ulcanbah Homestead	73	12.5
R10	Kyong Homestead	81	12.5
R11	Scott Homestead	80	12.5
R12	Ronlow Park Homestead	76	12.4
R13	Bulliwallah Homestead	66	12.3
R14	Moray Downs Homestead	67	12.3
R15	Yarrowmere Homestead	67	12.3
R16	Plain Creek Homestead	66	12.3
Air Quality Objective		**250**	**62**

15.8.7 SO_2

Table 15-8 presents the predicted maximum 1-hour, and maximum 24-hour and annual average ground-level concentrations of SO_2 (including background levels). The predicted levels are well below the relevant air quality objectives at all sensitive receptors.

Table 15-8 Predicted Concentrations of SO_2 Including Background Levels

RECEPTOR		SO_2 (µg/m^3)		
ID	Name	Maximum 1-hour	Maximum 24-hour Average	Annual Average
R1	Moonoomoo Homestead	175	30	4.7
R2	Dooyne Outstation	79	21	3.2
R3	Carmichael Homestead	121	25	4.1
R4	Old Hyde Park Homestead	112	17	3.1
R5	Bowie Homestead	117	24	4.0
R6	Hyde Park Homestead	48	17	3.0
R7	Proposed Carmichael Coal Mine Accommodation Village	108	18	3.0
R8	Doongmabulla Homestead	68	21	3.3
R9	Ulcanbah Homestead	57	21	3.6
R10	Kyong Homestead	89	19	3.6
R11	Scott Homestead	88	20	3.7
R12	Ronlow Park Homestead	66	19	3.4

RECEPTOR		SO_2 (µg/m^3)		
ID	Name	Maximum 1-hour	Maximum 24-hour Average	Annual Average
R13	Bulliwallah Homestead	26	13	3.0
R14	Moray Downs Homestead	29	15	3.0
R15	Yarrowmere Homestead	31	15	3.1
R16	Plain Creek Homestead	25	14	2.9
Air Quality Objective		**570**	**230**	**57**

15.8.8 CO

Table 15-9 presents the predicted maximum 8-hour average ground-level concentrations of CO (including background levels). The predicted levels are well below the relevant air quality objective at all sensitive receptors.

Table 15-9 Predicted Concentrations of CO Including Background Levels

RECEPTOR		CO (µg/m^3)
ID	Name	Maximum 8-hour
R1	Moonoomoo Homestead	2,757
R2	Dooyne Outstation	2,754
R3	Carmichael Homestead	2,756
R4	Old Hyde Park Homestead	2,752
R5	Bowie Homestead	2,755
R6	Hyde Park Homestead	2,752
R7	Proposed Carmichael Coal Mine Accommodation Village	2,752
R8	Doongmabulla Homestead	2,752
R9	Ulcanbah Homestead	2,753
R10	Kyong Homestead	2,752
R11	Scott Homestead	2,752
R12	Ronlow Park Homestead	2,752
R13	Bulliwallah Homestead	2,750
R14	Moray Downs Homestead	2,750
R15	Yarrowmere Homestead	2,751
R16	Plain Creek Homestead	2,750
Air Quality Objective		**11,000**

15.8.9 Odour

Underground coal mines are ventilated to ensure that coal seam gases do not build up and become hazardous. At some coal mines in the Hunter Valley in New South Wales, the ventilation air from underground coal mines has been investigated as a possible source of odour annoyance at residential areas nearby. Sampling and analysis has been undertaken to quantify odour emission rates and odour concentrations. Detailed odour impact assessment studies (Holmes Air Sciences, 2003) have concluded that mine ventilation emissions are not likely to cause elevated odour levels.

The large distances between the underground mining areas and the closest sensitive receptors mean that potential odour impacts from ventilation are extremely unlikely for the project.

The construction and operation of the project do not involve any other activities that are likely to result in any potentially significant odour impacts.

15.8.10 Other Pollutants

The *Air Quality Report* (Appendix L) provides details on the predicted ground-level concentrations of air toxicants due to the project. Predicted ground-level concentrations of all air toxicants are well below the relevant air quality objectives and standards.

15.8.11 Cumulative Impacts

The Carmichael Coal Mine and Rail Project (CCM&RP) involves the proposed development of an open cut and underground coal mine located to the immediate south-east of the project site (Figure 15-1). The Moray Power Project (MPP) is proposed to provide power for the CCM&RP and is located adjacent to the proposed Carmichael Coal Mine site, approximately 23 km to the south-east of the project site (Figure 15-1). As the CCM&RP and MPP are proposed to be operating at the same time as the project, a cumulative assessment has been undertaken. PM_{10} was found to be the air pollutant that was closest to its respective air quality objective in the CCM&RP Supplementary Environmental Impact Statement (SEIS). Consequently, PM_{10} was included in the cumulative assessment. PM_{10} concentrations were estimated from the information contained in the CCM&RP SEIS. In addition, the most critical air pollutant relating to power station emissions is NO_2. Consequently, NO_2 was also included in the cumulative assessment. The contribution of the MPP to ground-level concentrations of NO_2 and PM_{10} has been obtained from the *Moray Power Station: Air Quality and Greenhouse Gas Assessment* (Katestone, 2014).The cumulative assessment is described in detail in the *Air Quality Report* (Appendix L).

Particulates as PM_{10}

The cumulative assessment is based on the 6th highest predicted 24-hour average concentration of PM_{10} from the project added to the maximum prediction from the CCM&RP SEIS (Katestone, 2014), and background concentrations. This is a conservative assessment because worst-case operational years of the project and CCM&RP have been assumed to occur at the same time, but this is not likely to be the case in reality.

The cumulative predicted PM_{10} concentrations are presented in Table 15-10. The predicted cumulative concentrations of PM_{10} are below the Air EPP objective at all receptors except for Dooyne Outstation (intermittent use only) and the proposed Carmichael Coal Mine Accommodation Village. The contribution of the project to the cumulative impact is minor at the Dooyne Outstation (11.4%) and the Accommodation Village (2.8%). At both of these receptors, the objective was predicted to be exceeded due predominantly to the Carmichael Coal Mine. The proponent will consult with the property owner and Adani, as the proponent of the CCM&RP, in relation to the management of any adverse cumulative impacts on these receptors.

Table 15-10 Predicted Cumulative 24-hour Average Concentrations of PM_{10}

RECEPTOR		PROJECT, CCM&RP AND MPP INCLUDING BACKGROUND (µg/m³)	CONTRIBUTION TO PREDICTED PM_{10} LEVEL (%)			
ID	Name		Project	CCM&RP	MPP	Ambient Background
R1	Moonoomoo Homestead	46.3	39.3	19.4	0.6	40.6
R2	Dooyne Outstation	65.6	11.4	59.5	0.5	28.7
R3	Carmichael Homestead	45.3	23.4	34.5	0.7	41.5
R4	Old Hyde Park Homestead	41.2	7.5	46.1	0.7	45.6
R5	Bowie Homestead	37.5	25.2	24.0	0.8	50.1
R6	Hyde Park Homestead	30.2	6.9	29.8	1.0	62.3
R7	Proposed Carmichael Coal Mine Accommodation Village	65.2	2.8	65.2	3.1	28.9
R8	Doongmabulla Homestead	49.3	9.2	52.1	0.6	38.1
R9	Ulcanbah Homestead	33.2	15.3	27.1	0.9	56.6
R10	Kyong Homestead	32.6	13.7	27.6	0.9	57.7
R11	Scott Homestead	33.9	17.0	26.6	0.9	55.5
R12	Ronlow Park Homestead	32.4	13.4	27.7	0.9	58.0
R13	Bulliwallah Homestead	28.6	1.8	31.4	1.0	65.7
R14	Moray Downs Homestead	39.8	1.9	50.5	0.3	47.3
R15	Yarrowmere Homestead	29.7	5.2	30.3	1.0	63.4
R16	Plain Creek Homestead	28.5	1.4	31.6	1.1	66.0
Air Quality Objective		**50**				

Nitrogen Dioxide

The cumulative assessment of NO_2 has been based on the maximum predicted 1-hour average concentration of NO_2 from the project added to the maximum prediction for the MPP (Katestone 2014) and including regional background concentrations. This is a conservative assessment because it is based on the assumption that the maximum 1-hour concentrations occur at same time, but this is not likely to be the case in reality due to the relative location of the power stations compared to the sensitive receptors and prevailing winds.

The cumulative predicted NO_2 concentrations are presented in Table 15-11. The results show that the predicted cumulative maximum 1-hour average concentrations of NO_2 are well below the Air EPP objective of 250 µg/m³ at all receptors.

Table 15-11 Predicted Cumulative 1-hour Average Concentrations of NO_2

RECEPTOR		PROJECT AND MPP WITH AMBIENT BACKGROUND (µg/m³)	CONTRIBUTION TO PREDICTED NO_2 LEVEL (%)		
ID	Name		Project	MPP	Ambient Background
R1	Moonoomoo Homestead	119	31.0	15.6	53.4
R2	Dooyne Outstation	97	15.3	19.2	65.5
R3	Carmichael Homestead	107	23.0	17.4	59.6
R4	Old Hyde Park Homestead	104	21.3	17.8	60.9
R5	Bowie Homestead	106	22.3	17.6	60.1
R6	Hyde Park Homestead	90	8.6	20.7	70.7
R7	CCM&RP Accommodation Village	198	10.9	57.0	32.1
R8	Doongmabulla Homestead	91	13.7	16.3	70.0
R9	Ulcanbah Homestead	92	10.7	20.2	69.1
R10	Kyong Homestead	99	17.2	18.7	64.0
R11	Scott Homestead	99	17.0	18.8	64.2
R12	Ronlow Park Homestead	94	12.6	19.8	67.6
R13	Bulliwallah Homestead	85	3.3	21.9	74.8
R14	Moray Downs Homestead	75	4.7	10.1	85.3
R15	Yarrowmere Homestead	86	4.3	21.6	74.0
R16	Plain Creek Homestead	85	2.9	22.0	75.1
Air EPP objective		**250**	-		

15.8.12 Dust Impact Mitigation Measures

The following key measures to control and manage dust emissions and minimise the potential impacts of the project are proposed:

- Haul roads will be watered to minimise dust emissions;
- Progressive rehabilitation will be conducted on the open cut mine overburden emplacement areas;
- Inactive disturbed areas will be rehabilitated as soon as possible;
- Electrostatic precipitators will be installed on the power station to minimise emissions of particulate matter; and
- Compliance with the relevant requirements of the Aurizon Coal Dust Management Plan at the train loading facility including the use of coal wagon veneering systems.

Due to the considerable distances to the closest sensitive receptors, the project has a low potential for adverse air quality impacts during short-term adverse (upset) conditions. Consequently, additional back-up dust mitigation measures are not likely to be necessary.

A complaints handling procedure will be implemented for the project. The procedure will include the investigation of any complaints in relation to air quality impacts. These investigations would include air quality monitoring, if necessary.

15.9 GREENHOUSE GAS

15.9.1 Greenhouse Gas Emissions

Greenhouse gases will be produced by the project as a result of the combustion of coal for power generation, fuel consumption and fugitive emission of coal seam gas. An assessment of greenhouse gas emissions has been undertaken consistent with the guidance provided in the National Greenhouse Accounts and the Greenhouse Gas Protocol and is detailed in the *Air Quality Report* (Appendix L) for each year of the life of the project. Greenhouse gas emission rates have been estimated using the *National Greenhouse Accounts Factors workbook* (DIICCSCRTE, 2013) and the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER). GHG emissions associated with land clearing have also been considered.

The EIS Terms of Reference requires that the air quality assessment provide an inventory of projected annual emissions for the life of the mine for each relevant greenhouse gas, with total emissions expressed in 'CO_2 equivalent' terms for scope 1 and scope 2 emissions. Scope 1 emissions result predominantly from coal combustion for power generation as well as fugitive methane emissions from coal extraction and diesel usage for site equipment and vehicles. Grid electricity will not be used on-site and as a result there will be no scope 2 emissions relevant to the project. Scope 3 emissions were not required by the EIS Terms of Reference and are not provided in this assessment.

Greenhouse gas emissions vary over the life of the project. Table 15-12 summarises the greenhouse gas emission rates for the operational years with the highest and lowest combined emissions and provides an estimate of average annual greenhouse emissions over the life of the project.

Table 15-12 Range of Greenhouse Gas Emission Rates ($ktCO_{2-e}$)

SOURCE	UNIT	HIGHEST (PROJECT YEAR 10)	LOWEST (PROJECT YEAR 49)	AVERAGE ANNUAL (OVER MINE LIFE)
Diesel O/C	$ktCO_{2-e}$	400	13	244
Diesel U/G	$ktCO_{2-e}$	20	15	15
Fugitive emissions	$ktCO_{2-e}$	726	49	359
Power Station	$ktCO_{2-e}$	5,710	-	4,546
Land Clearing/ Rehabilitation	$ktCO_{2-e}$	134	-	19
Total	**$ktCO_{2-e}$**	**6,989**	**77**	**4,707**

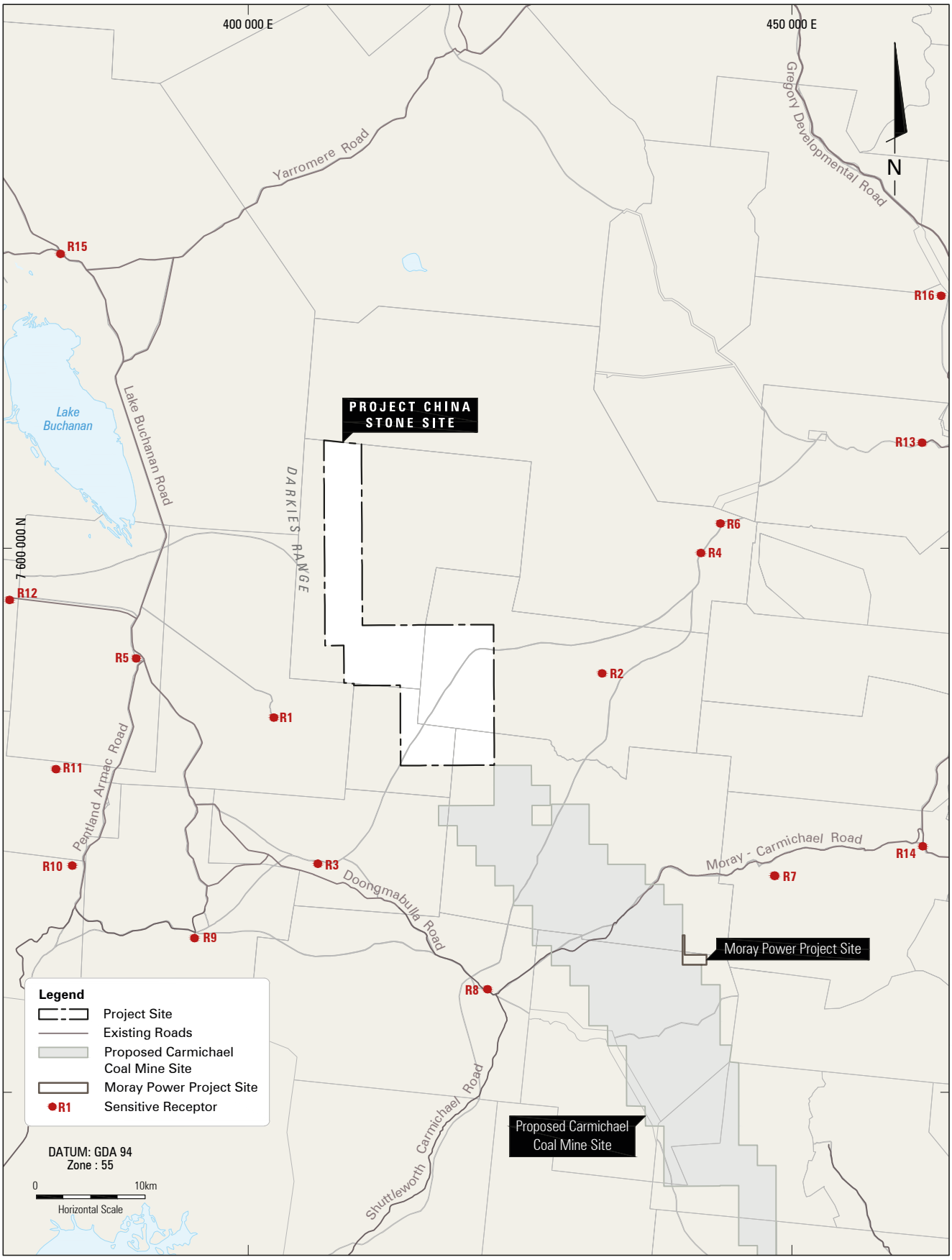
15.9.2 Greenhouse Gas Mitigation Measures

The project has significant energy requirements in terms of diesel and electricity. Any reduction in energy consumption will result in decreased GHG emission while at the same time providing a potential financial incentive. Anticipated initiatives that may mitigate, reduce, control or manage GHG emissions through energy efficiency include:

- Regular assessment, review and evaluation of greenhouse gas reduction opportunities;
- Procurement policies that require the selection of energy efficient equipment and vehicles;

- Monitoring and maintenance of equipment in accordance with manufacturer recommendations;
- Optimisation of diesel consumption through logistics analysis and planning; and
- Progressive rehabilitation of land areas to manage and limit the cumulative loss of carbon storage associated with land clearing.

FIGURES



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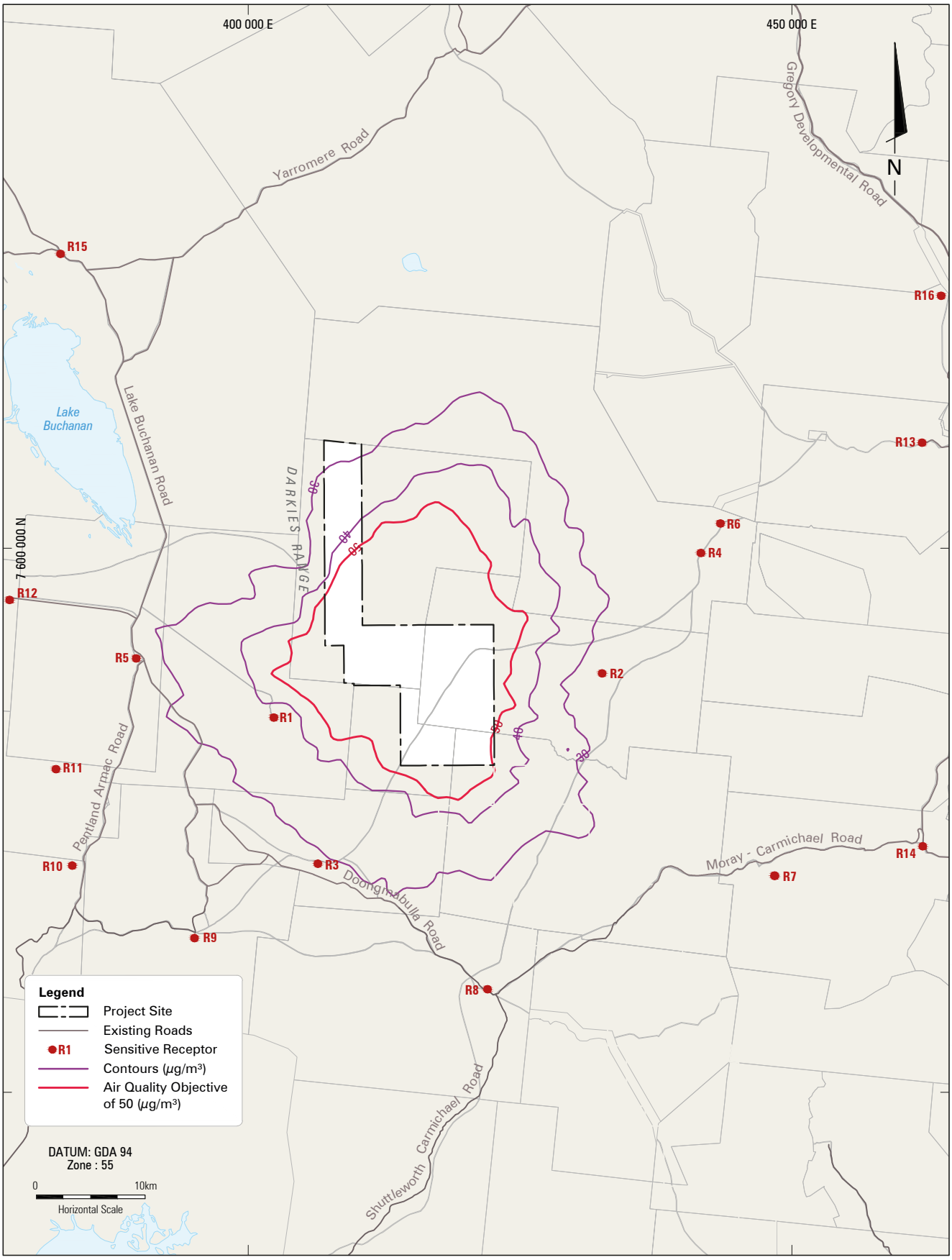
Sensitive Receptors

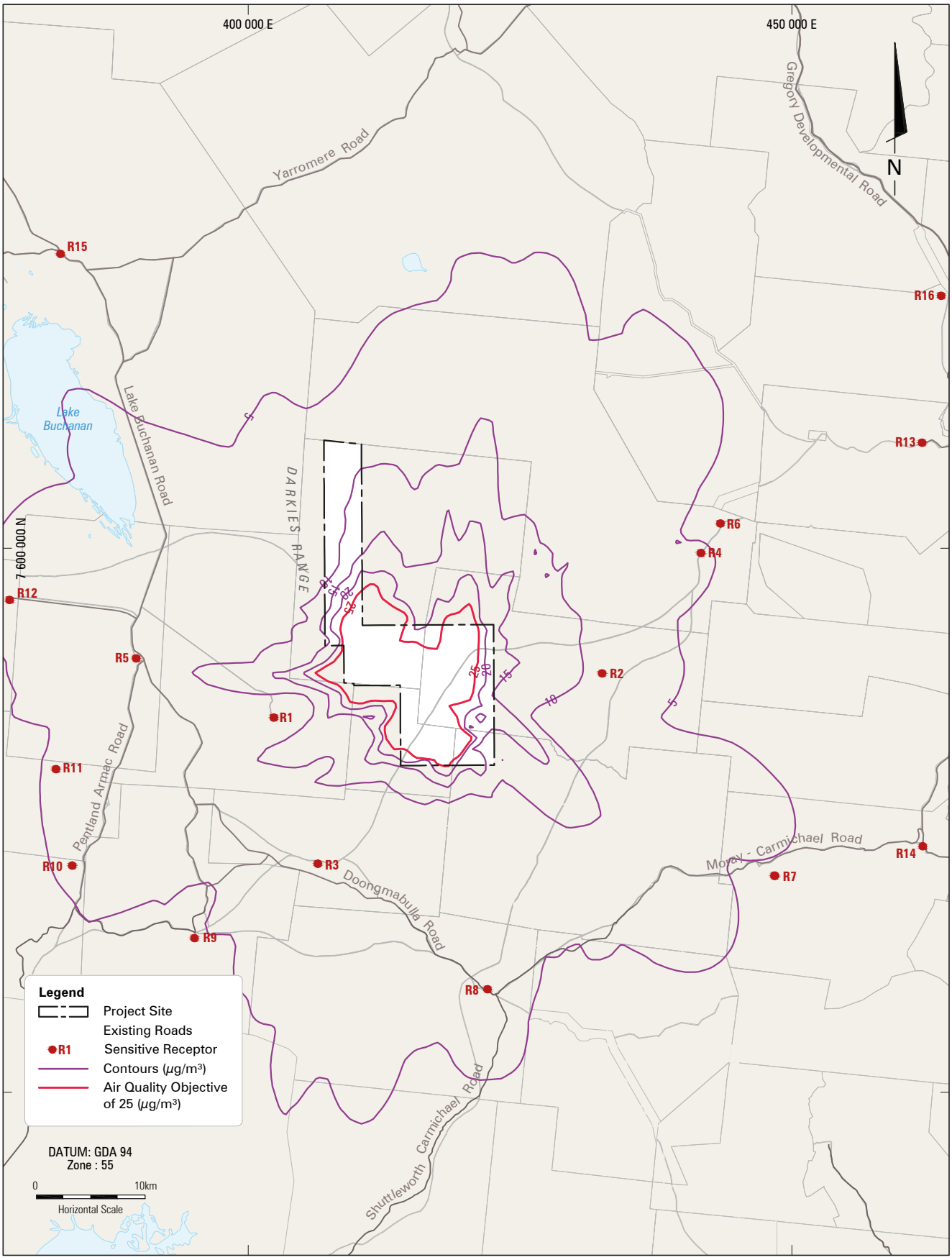
FIGURE 15-1



PROJECT CHINA STONE

Predicted 6th Highest 24-hour Average Ground Level Concentrations of PM_{10} Due to the Project, including the Power Station and Ambient Background Levels

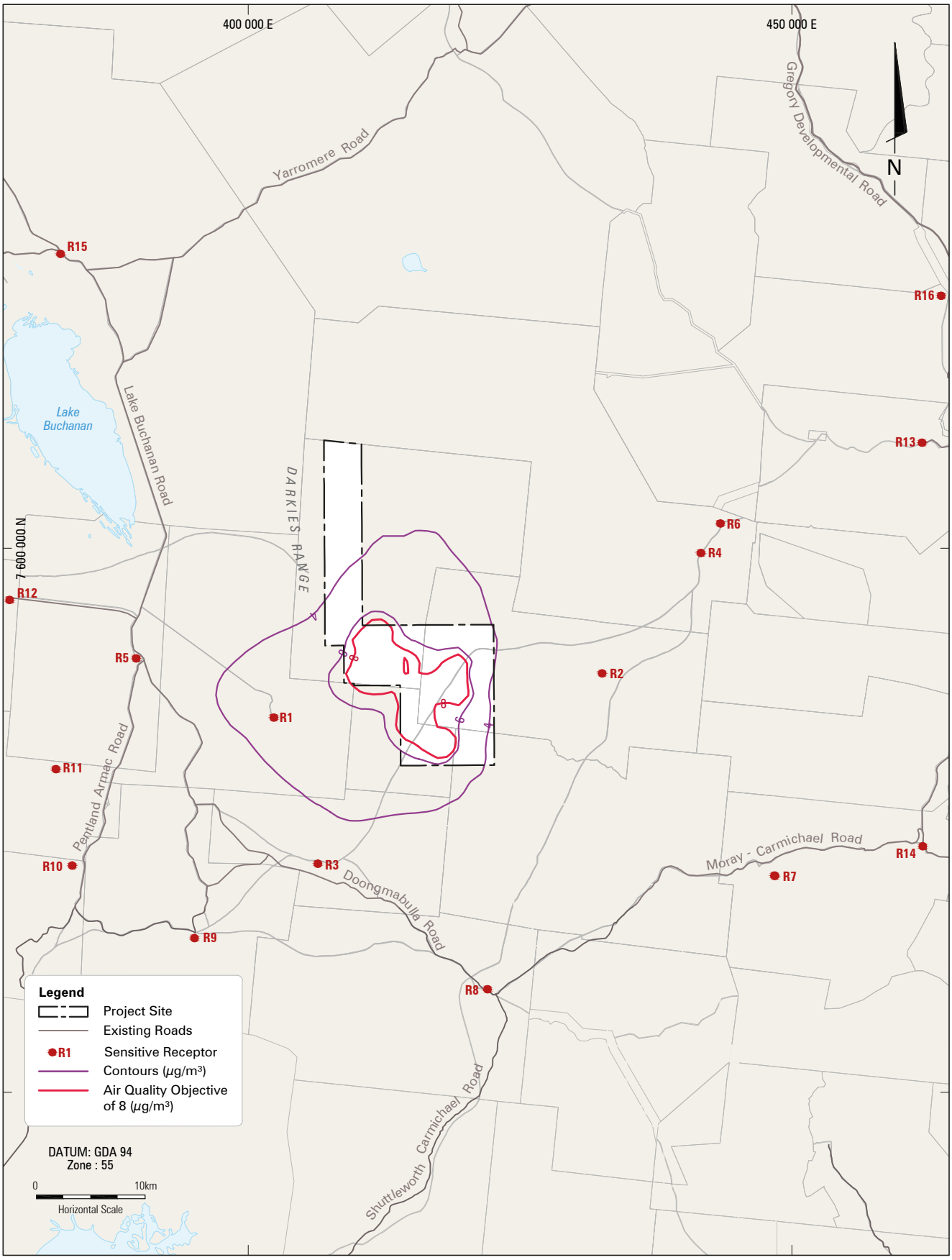
FIGURE 15-2



PROJECT CHINA STONE

Predicted Maximum 24-hour Average Ground Level Concentrations of $PM_{2.5}$ Due to the Project, including the Power Station and Ambient Background Levels

FIGURE 15-3



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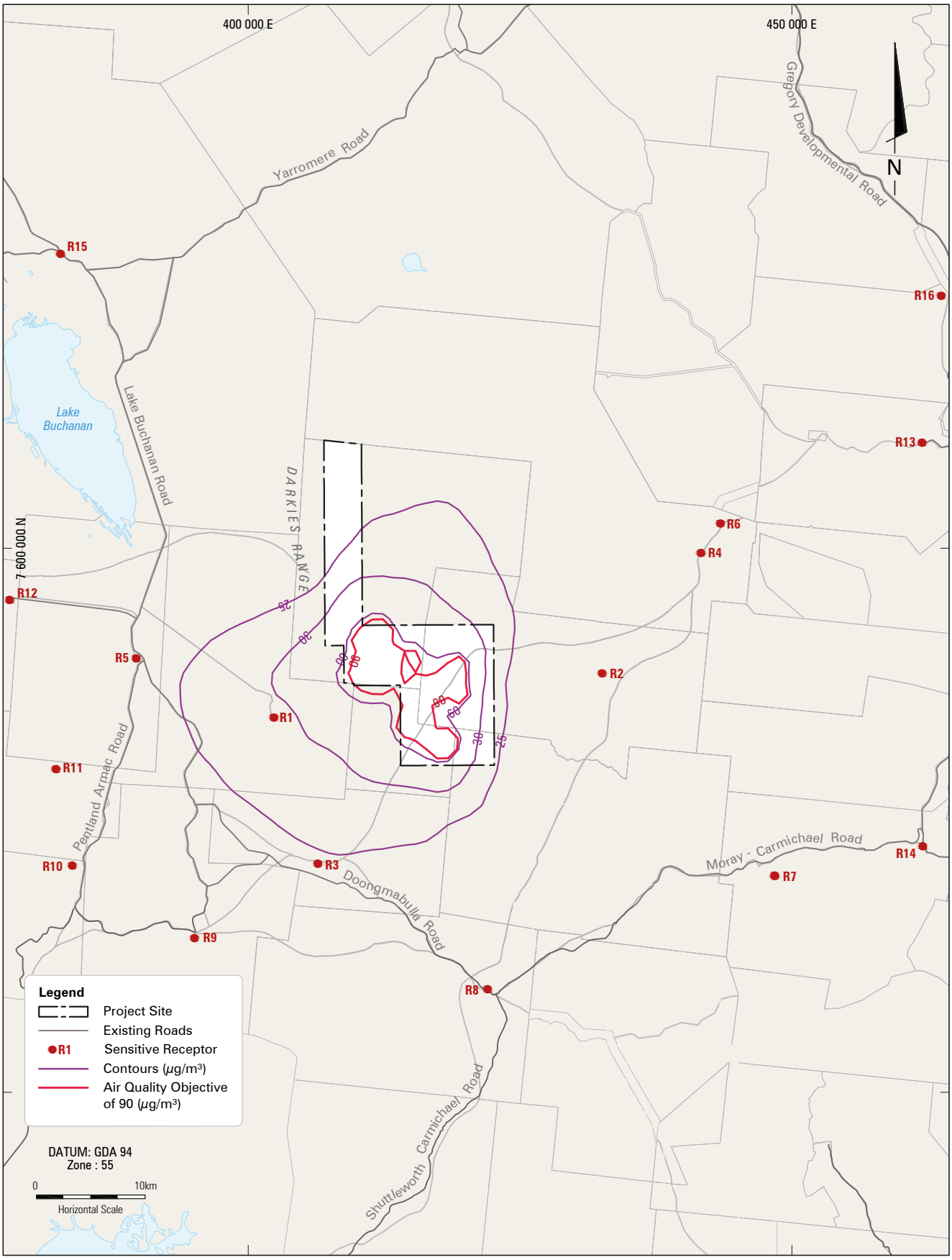
PROJECT CHINA STONE

Predicted Annual Average Ground Level Concentrations of $PM_{2.5}$ Due to the Project, including the Power Station and Ambient Background Levels

FIGURE 15-4



PROJECT CHINA STONE

Predicted Annual Average Ground Level Concentrations of TSP Due to the Project, including the Power Station and Ambient Background Levels

FIGURE 15-5

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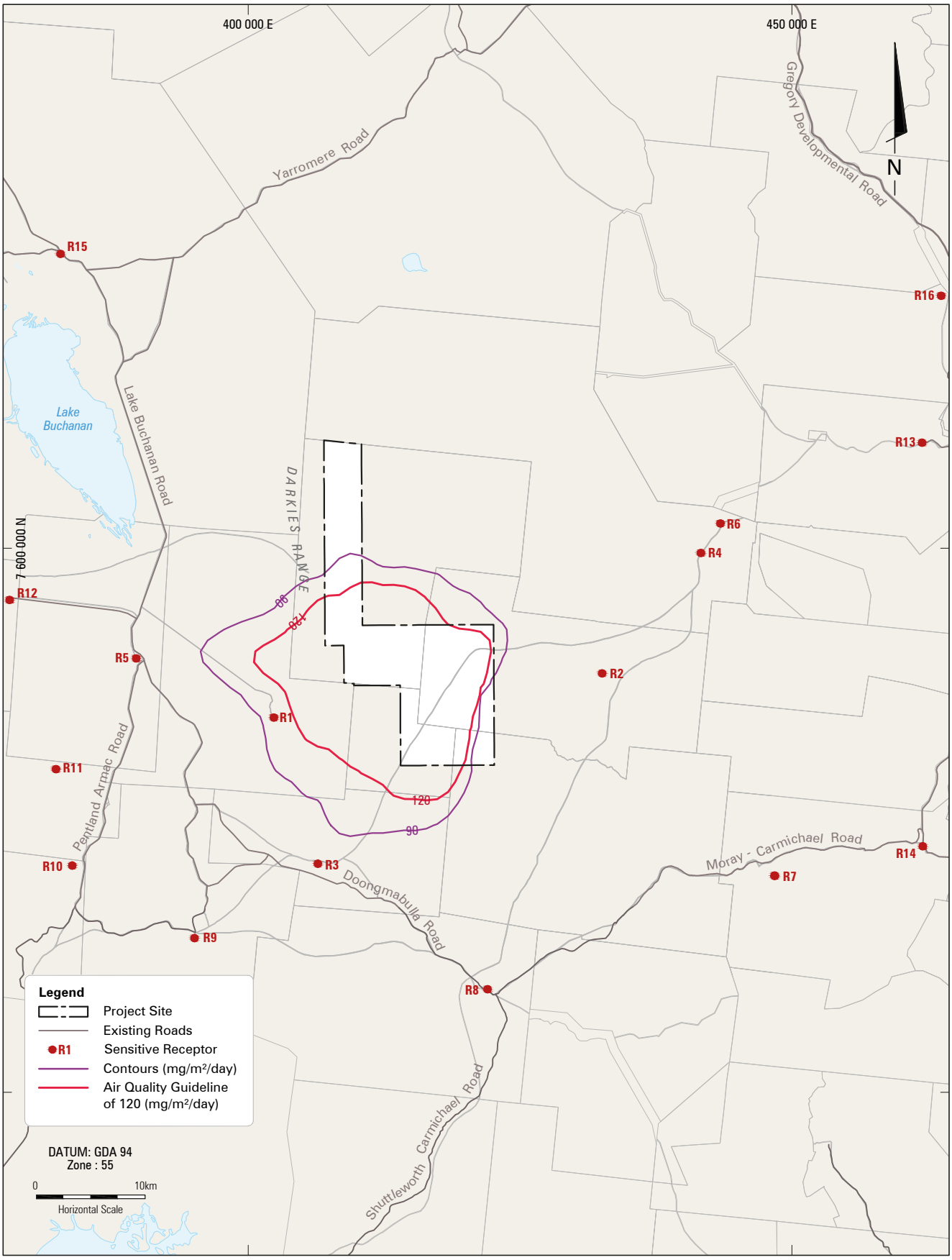

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PROJECT CHINA STONE

Predicted Maximum Monthly Average Dust Deposition Rates Due to the Project, including the Power Station and Ambient Background Levels

FIGURE 15-6