AIR QUALITY ASSESSMENT

MOOLARBEN COAL PROJECT

OC4 SOUTH-WEST MODIFICATION

Moolarben Coal Operations Pty Ltd

16 April 2015

Job Number 14010276

Prepared by

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Air Quality Assessment – Moolarben Coal Project OC4 South-West Modification

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Todoroski Air Sciences has been engaged by Moolarben Coal Operations Pty Ltd (MCO) to prepare an air quality assessment for the proposed Open Cut 4 (OC4) South-West Modification (hereafter referred to as the Modification).

Previously, a detailed air quality impact assessment (**Todoroski Air Sciences, 2013**) was prepared for the Moolarben Coal Project Stage 1 Optimisation Modification (MOD9) and appended to the previous MOD9 environmental assessment as Appendix D. This report utilises some of the work and data presented in the MOD9 report to assess the potential for air quality impacts associated with this Modification and to compare the predicted impacts of this Modification with the previous predictions.

This report incorporates the following aspects:

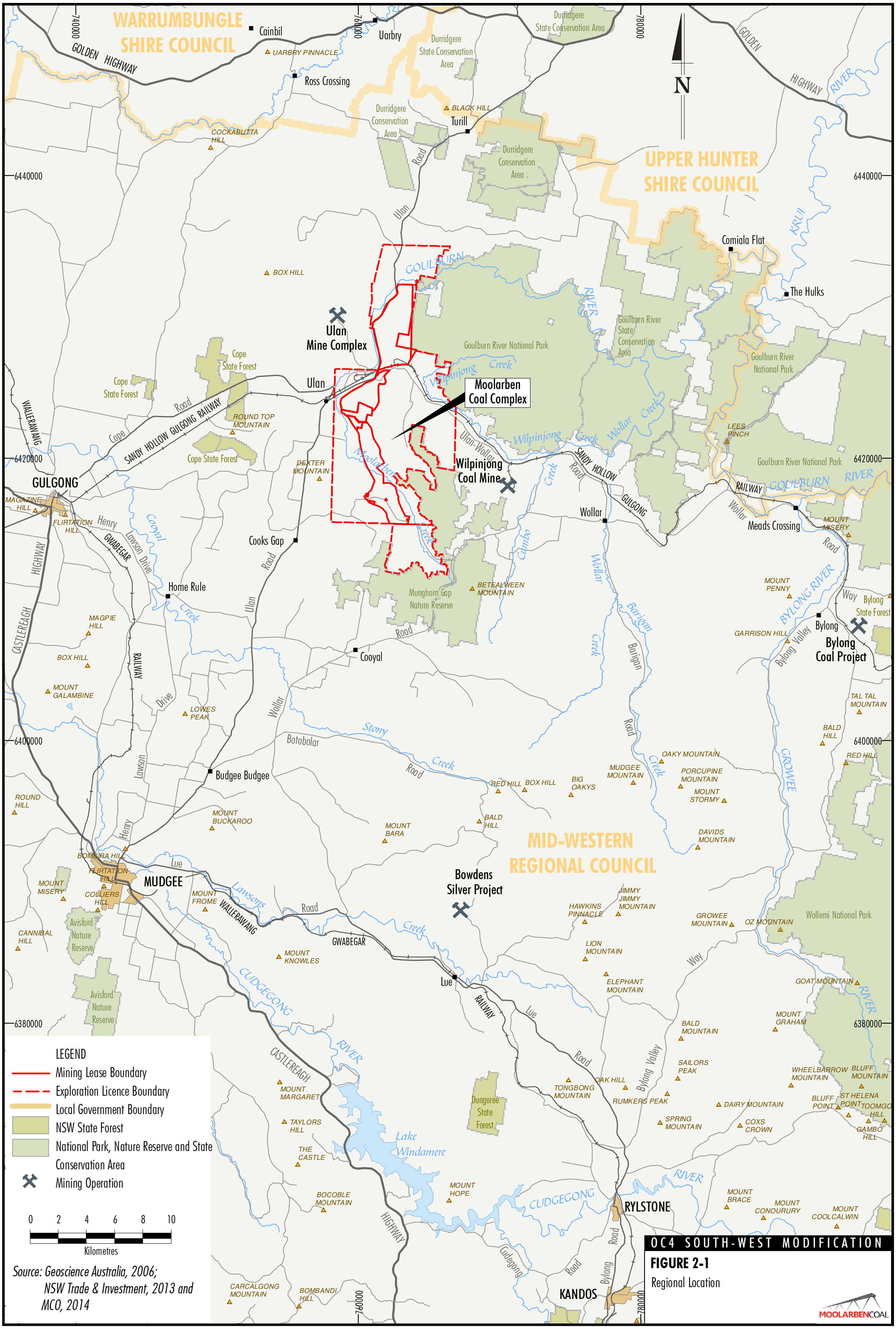
- A description of the proposed Modification;
- A summary of the dispersion modelling approach used to assess potential air quality impacts;
- Presentation of the predicted results and comparison with existing/approved predictions; and
- Discussion of the potential air quality impacts as a result of the Modification and proposed management measures.

2 PROJECT BACKGROUND

The Moolarben Coal Complex is located at Moolarben in the Western Coalfields of New South Wales (NSW), approximately 40 kilometres north of Mudgee (see **Figure 2-1**).

It is bordered by the Goulburn River to the northwest, Goulburn River National Park to the northeast and Munghorn Gap Nature Reserve to the south. The Ulan Coal Mine is located to the northwest and Wilpinjong Coal Mine is located to the east. Ulan settlement and Cooks Gap are located to the west and southwest, respectively.

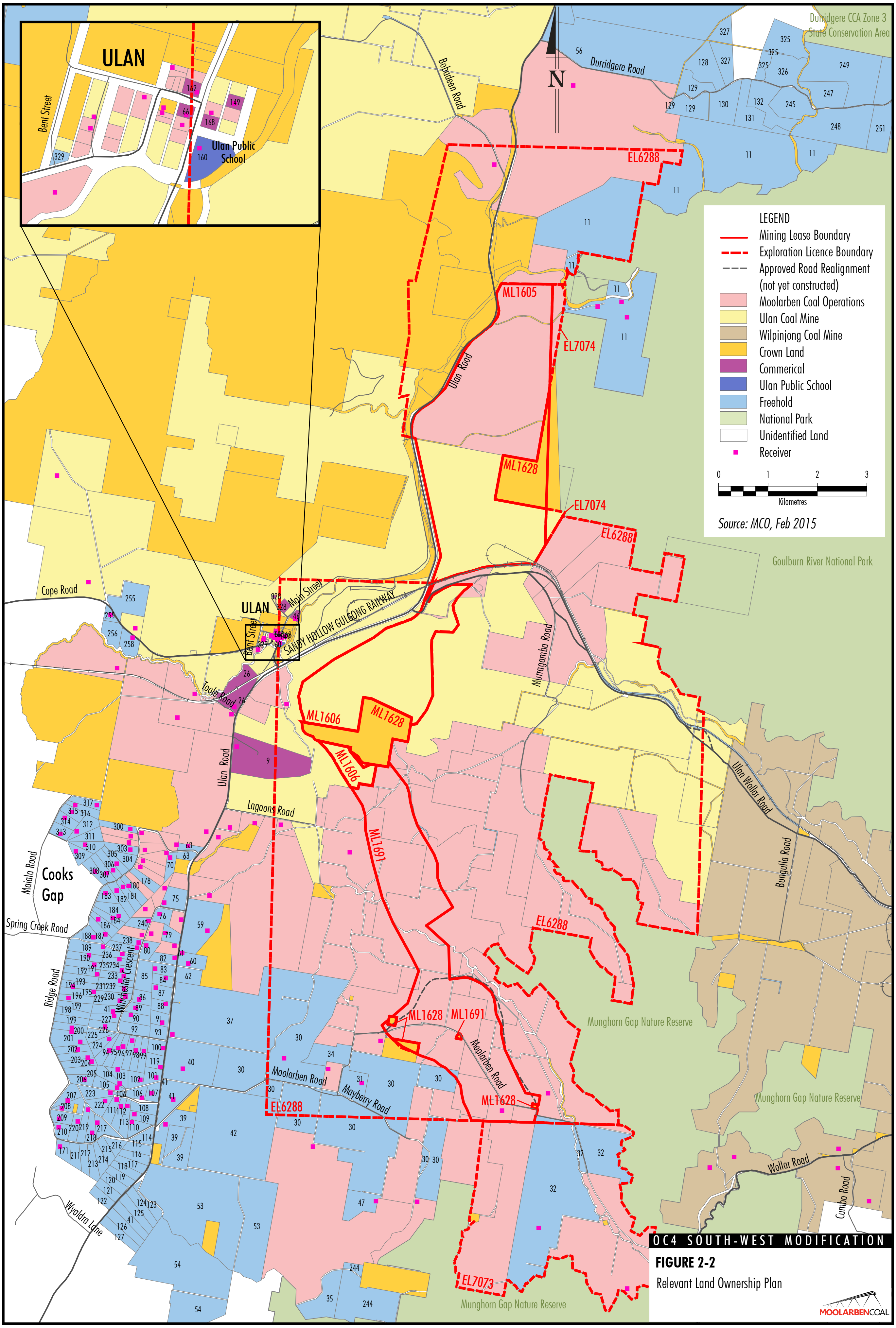
The relevant land ownership in the vicinity of the Moolarben Coal Complex is shown in **Figure 2-2** and **Figure 2-3**.



MOC4 SOUTH-WEST MODIFICATION

FIGURE 2-1
Regional Location

MCM-13-02 MOC4_SWMod EA_App AQ_201B



OC4 SOUTH-WEST MODIFICATION

FIGURE 2-2

Relevant Land Ownership Plan

MCM-13-02 MOC4_SWMod EA_App AQ_202C

Ref No	Landholder
9	Orica Australia Pty Limited
11	JE Mullins & CD Imrie
26	Forty North Pty Limited
30	RB Cox
31	MB Cox
32	DJ & JG Stokes
34	J Asztalos
35	PR Johnson & MS & GJ Thompson & PH & FH Debreczeny
37	J Szymkarczuk
39	RM & DJ Sprigg
40	JM Devenish
41	PP Libertis
42	C & L Schmidt
46	North Eastern Wiradjuri Wilpinjong Community Fund Limited
47	SF & MR Andrews
53	WD & MS Bryant
54	MA & C Harris
56	MJ & V Cundy
59	G & GM Szymkarczuk
60	CL Rayner & DM Mundey
61	MA Miller
62	R Menchin
63	BF & B Whiticker
66	Rostherne Pty Limited
70	DJ & A Coventry
75	P Ban
76	SR & PC Carbone
79	PTJ & SE Nagle
80	W & D Sebelic
82	SC Hungerford & MC Clemens
83	CF & CR Wall
84	DS Sebelic
85	J & Z Nikolovski
86	NW Harris
87	BJ & K Howe
88	BC Meyers
89	MV & HM Glover & E & BJ Tomlinson
90	SA Powell
91	HM Graham
92	VA Pullicino & J & S & G Bonnici
93	F & M Fenech
94	LK Mittemayer
95	BJ Withington
96	D Lazicic
97	DJ & MD Smith
98	ME & JJ Piper
99	DE Jenner & WB Jensen
100	A Kapista
101	RD & DMZ Hull
102	KA Roberts
103	SB Burnett & SL Grant
104	RA & LA Deeben
105	DJ & N Katsikaris
106	TB & JH Reid
107	ZJ & M & AA Raso
108	R Varga
109	DA Evans
110	JT Thompson & HT Evans
111	GJ & NJ McEwan

Ref No	Landholder
112	MJ & LM Croft
113	CPG Ratcliff
114	TF & K Holland
115	AK & BH Ouinn
116	DJ & SM Reid
117	JM Dick
118	A Scott
119	PJ Kearns
120	PS & DR Ord
121	EJ Cullen
122	WF Wirth
123	ND Sullivan
124	WJ & HE Bailey
125	DB McBride
126	MP Julian
127	BKT & SA Bracken
128	AW Sims
129	M Yelds
130	GP McEwen
131	GR & RA King
132	N Atkins
149	Mid-Western Regional Council
151	AI Cunningham (Land entrusted to Catholic Church)
160	Minister For Education And Training
162	DM Harrison
168	PJL Constructions Pty Limited
171	AD & SA McGregor
178	PR Stone
180	CD & LL Barrett
181	SM Forster
182	J Dutoitcook
183	R & EA Steines
184	LA Stevenson
186	RW & IJ Adamson
187	BT & KM Feeney
188	KR & T Fielding
189	M, M, D & A Goggin & J, A, P & R Hyde
190	T & LK Sahyoun
191	BW & TS Lasham
192	D Williams
193	DJ Moloney
194	PM & K Potts
195	R Cottam
196	F Saxberg & M Weir
198	GR & ME Metcalfe
199	PGG & I Nielsen
200	VK Grimshaw
201	KR & GM Towerton
202	H & VF Butler
203	DJ Miller
204	RB & JE Donnan
205	DW Sparrow & M Tallan
206	CA Marshall & R Vella
207	AA & DM Smith
208	SA & CR Hasaart
209	F Mawson
210	JM & AM Tebutt
211	SA McGregor & WJ Gray
212	E & M Lepik
213	D & J Parsonage
214	RK & EG O'Neil

Ref No	Landholder
215	SG & PM Green
216	G Holland & FA Handicott
217	RP & JL Patterson
218	GF & GEL Soady
219	T & S Riger
220	SJ Rusten & NJ Smith
222	BJ Purtell
223	EW Palmer & JM Stewart
224	RS & PCC Dupond
225	G & RF Doualetas
226	LAA & FC Muscat
227	WP & JA Hughes
229	JJ & BA Lowe
230	DA Hoole & DT Rawlinson
231	T Morrison & SM Benny
232	L & JA Haaring
233	K & D Boal
234	D & L Gaw
235	LM & RS Wilson
236	RG & CA Donovan
237	A Puskaric
238	B Powell
240	GJ & DM Hartley
244	JT & YR Jones
245	MP & KLE Cresham
247	J & K Batshon
248	G Boustani
249	CJ & JI Eldridge
251	NF Potter & CE Selley
255	HJ & H Schmitz
256	RC Campbell
258	PM & CD Elias
300	CM Collins & CY Marshall
303	HJ Ungaro
304	G Balajan
305	L Barisic & M Aul
306	E Armstrong
307	M Chant & NK Young
308	NA Dower
309	GS Maher
310	KI Death
311	BJ & LC Williamson
312	MS & JJ Ioannou
313	NJ & BDE Pracy
314	SL Ford
315	WJ Richards & BJ Uzelac
316	CR Vassel & CM Williams
317	RJ Hore & V Bingham
325	S & T Fevale
326	AW & LM Murray
327	CA Tanner
328	Essential Energy
329	Tuck-Lee

Source: MCO, Feb 2015

OC4 SOUTH-WEST MODIFICATION

FIGURE 2-3
Relevant Landholder List

MOOLARBENCOAL

3 EXISTING AIR QUALITY MONITORING AND MANAGEMENT

The existing Air Quality Management Plan (**MCO, 2013**) describes the air quality management and monitoring regime at the Moolarben Coal Complex.

The Air Quality Management Plan describes:

- Project Approval air quality criteria;
- Dust monitoring locations and frequency, comprising:
  - four Tapered Element Oscillating Microbalance measuring PM_{10} continuously (i.e. real-time monitor);
  - two High Volume Air Samplers measuring PM_{10} on a one day in six cycle; and
  - Eleven dust deposition gauges.
- Ongoing dust management measures; and
- Performance indicators (real-time response triggers) which, if exceeded, trigger the implementation of additional dust management measures.

The existing Air Quality Management Plan is currently being reviewed and updated.

Operational air quality management measures that are implemented at the Moolarben Coal Complex include:

- Disturbance of only the minimum area necessary for mining (e.g. typically only one strip ahead of the active mining operations);
- Limiting clearing and topsoil stripping activities as far as practicable during the drier months;
- Adoption of progressive rehabilitation of mining operations to minimise exposed soils;
- Employing appropriate dust suppression methods at the coal handling facilities;
- Use of water carts on all trafficked areas to minimise dust generation as necessary and practicable;
- Use of chemical dust suppressants where watering alone is unable to achieve required dust control efficiencies;
- Use of constructed roads only, minimisation of access roads and removal of obsolete access roads;
- Maintaining coal handling areas and stockpiles in a moist condition using water carts and/or water sprays;
- Relocation, modification and/or temporarily ceasing mining operations in adverse meteorological conditions to minimise the short term air quality impacts;

- Use of dust suppression systems on stationary and mobile plant (such as the dump hopper, transfer stations, drill rigs);
- Long term topsoil stockpiles, not used for over 6 months will be revegetated with grass;
- Use of dust aprons and water injection systems on drills;
- Partial enclosure of coal conveyors where possible;
- Watering of out-of-pit emplacement areas that will remain inactive for prolonged periods creating a dry crust layer to reduce dust emissions associated with wind erosion; and
- Increasing excavator bench height when working on drier weathered rock near the natural surface to allow blending with underlying overburden which contains more moisture.

MCO has recently implemented new software that assists in pro-active management of dust emissions. The system provides daily reports and predictions of upcoming meteorological conditions and potential dust risks. Based on prevailing wind conditions, MCO can strategically alter its operations to reduce these impacts.

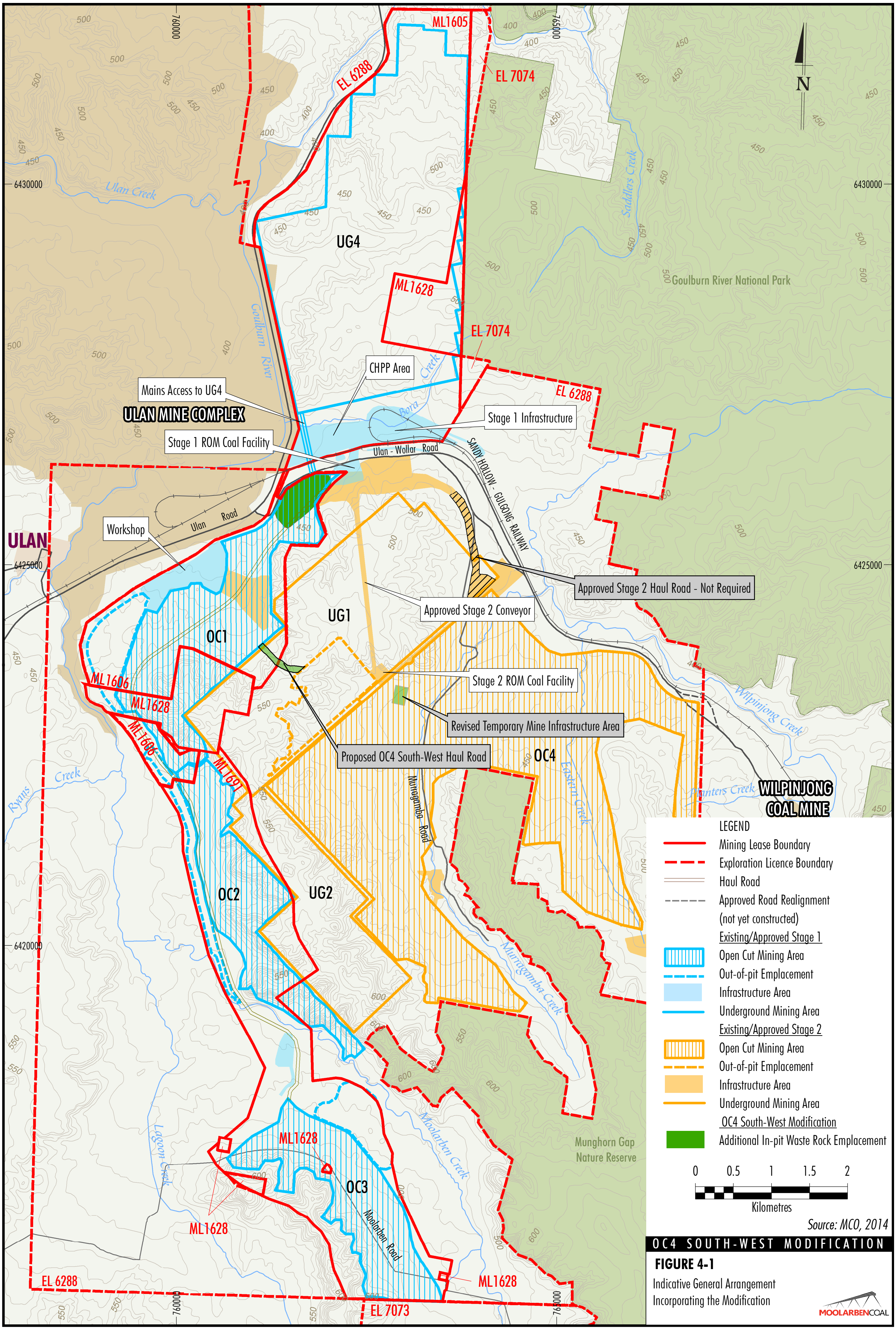
A predictive system would reduce the peak periods of elevated dust effects due to the mining activities and the operation of an effective predictive system has been applied in the modelling results presented in this assessment.

4 PROPOSED MODIFICATION

MCO has reviewed the mining sequence and associated infrastructure layout requirements at the Moolarben Coal Complex to enable more efficient access to the OC4 resource. As a consequence, the approved Stage 2 haul road (to the north of OC4) would no longer be required, and would be replaced by a shorter, more direct, haul road route to OC1 (to the southwest of the approved Stage 2 haul road) (see **Figure 4-1**).

The Modification includes construction of the OC4 South-West haul road, adjustments to the site water management system, and refinements to the early stages of mining and associated infrastructure layout at OC4 and placement of waste rock in OC1 including the following key components (**Figure 4-1**):

- construction of the OC4 South-West haul road between OC4 and OC1 (and therefore the approved Stage 2 haul road would not need to be constructed);
- adjustments to the site water management system to contain surface water runoff from the south-west haul road and diversion of clean water;
- refinements to the early stages of mining and associated infrastructure layout at OC4 (wholly located within the approved surface disturbance footprint); and
- backfilling of the northern OC1 final void to approximately pre-mining elevations.



OC4 SOUTH-WEST MODIFICATION

FIGURE 4-1

Indicative General Arrangement Incorporating the Modification

MCM-13-02 MOC4_SWMod EA_App AQ_203B

4.1 Modelling scenario

This assessment has considered a single mine plan year to represent the proposed Modification. The assessed scenario was selected to demonstrate a worst-case operational scenario for the Modification with the maximum ROM coal and overburden removal production and with the maximum fleet using the proposed OC4 South-West haul road realignment.

The air quality model was updated to account for the relocation of the OC4 South-West haul road, changes to the progression of the mine and the implementation of current air quality controls and management measures.

Relevant to potential air quality impacts, 2016 was chosen for the air quality modelling scenario as this year includes:

- maximum ROM coal and waste rock extraction;
- first year of maximum fleet operations in OC4;
- maximum fleet using the proposed OC4 south-west haul road;
- fleet in OC4 (where the majority of the fleet is located) focused in the west resulting in potential maximum impacts at Ulan and Cooks Gap; and
- dumping of overburden on the OC4 out-of-pit waste emplacement.

Potential wind erosion emissions associated with the inactive OC2 pit have been included in the air quality model.

The 2016 scenario is considered to be representative of a scenario equivalent to MOD9 Year 6 (which included the early development of the OC4 pit) and therefore allows for a comparison to be made between the existing/approved Moolarben Coal Complex and the Modification.

The indicative year 2016 mine plan scenario is provided in **Appendix A**.

4.2 Emission estimation

The rate of dust emission arising from the worst case scenario selected for modelling has been calculated by analysing the various dust generating activities and applying appropriate emission factors.

The emission factors applied are considered the most applicable and representative factors available for calculating the dust generation rates for the proposed activities. The emission factors were sourced mainly from studies supported by the United States Environmental Protection Authority (1985 and updates) and from local studies where possible. The emissions inventory for the Modification has been based on the emissions inventory developed for the MOD9 assessment (**Todoroski Air Sciences, 2013**).

The maximum annual ROM coal and overburden production rates and total dust emissions from all significant dust generating activities for the Moolarben Coal Complex incorporating the proposed Modification are presented in **Table 4-1**. A detailed emission inventory for the modelled scenario is presented in **Appendix B**.

Table 4-1: Summary of estimated annual quantities of material and emissions for the Modification

Activity	MOD9 Year 6	Modification	Percent (%) Change
ROM Coal – OC (tonnes)	12,382,041	13,000,000	5.0
ROM Coal – UG (tonnes)	4,000,000	4,000,000	0.0
Overburden (tonnes)	111,600,000	112,576,506	0.9
TSP emission (kg)	5,930,324	4,370,856	-26.3

The estimated dust emissions for the Modification presented in **Table 4-1** and **Appendix B** reflect the application of best practice dust mitigation currently being implemented at Moolarben Coal Complex in accordance with its Air Quality Management Plan and Pollution Reduction Program (PRP) for wheel generated dust.

MCO implements PRP dust control measures in accordance with Environment Protection Licence 12932:

- PRP U1: Particulate Matter Control Best Practice Implementation – Wheel Generated Dust;
- PRP U2: Particulate Matter Control Best Practice Implementation – Disturbing and Handling Overburden under Adverse Weather Conditions; and
- PRP U3: Particulate Matter Control Best Practice Implementation – Trial of Best Practice Measures for Disturbing and Handling Overburden.

In accordance with PRP U1, MCO must achieve a wheel generated dust control efficiency of 80% or more. A monitoring Program was undertaken by Todoroski Air Sciences and demonstrated a control efficiency of 93 to 99% was achieved through the use of watering of haul roads, and that a control efficiency of 90% could be maintained on a day-to-day basis (**Todoroski Air Sciences, 2014**). Therefore, a dust control efficiency on haul roads of 90% has been adopted for the Modification.

The estimated dust emissions for the Modification presented in **Table 4-1** and **Appendix B** do not include the dust reduction effects of PRP U2. These effects are however considered in the modelling results only for a few periods with adverse weather conditions and to be conservative only for activity in OC1.

The net reduction in dust emissions relative to the MOD 9 Year 6 emissions arises due to some increased efficiencies in the mine design, but also the application of the MCO's current control measures.

4.3 Modelling methodology

The dispersion modelling methodology applied in this assessment is the same as that applied in the MOD9 assessment using the CALPUFF modelling suite. Further specific detail regarding the approach used can be found in the air quality impact assessment (**Todoroski Air Sciences, 2013**).

The CALMET meteorological modelling has been revised to incorporate the changes to the local mine terrain for the proposed modelling scenario which affect the local wind flows of the area (e.g. to account for the updated sequencing of the open cut pits). This assessment used the same meteorological conditions assessed in the MOD9 assessment which were based on data for January 2011 to December 2011 from six surrounding monitoring sites.

Dust emissions from each activity were represented by a series of volume sources and included in the CALPUFF model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and levels of dust generating activity were considered in calculating the hourly varying emission rate for each source.

It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment.

4.4 Reactive dust mitigation measures

Initial screening dispersion modelling for the Modification (without mitigation measures in place) was conducted and indicated the potential for elevated dust levels to occur at nearby sensitive receptor locations, in particular receptors in Ulan.

An investigation was conducted to determine the cause of the elevated predicted dust levels. The investigation found that the elevated dust levels arise in the modelling due to a combination of adverse meteorological conditions and the worst case clustering of activities associated with the OC1 and OC4 pits in the model.

An analysis of the meteorological conditions determined that the potential for elevated dust levels occurred under poor dispersion conditions occurring when the wind was blowing from the Modification to the receptors (e.g. Ulan) for an extended period of time.

An example of these typical wind conditions affecting receptors in Ulan is presented in **Figure 4-2**.

The conditions which may result in elevated dust level predictions are relatively infrequent and were found to only occur approximately 2% of the time in the 12 month long modelling period.

In accordance with the Air Quality Management Plan, MCO currently operates a real-time air quality monitoring system and implements dust management measures in response to weather conditions and real-time dust monitoring trigger levels. When a real-time response trigger event occurs, MCO may be required to relocate or shutdown fleet until monitoring indicates that dust levels have fallen below the real-time response trigger.

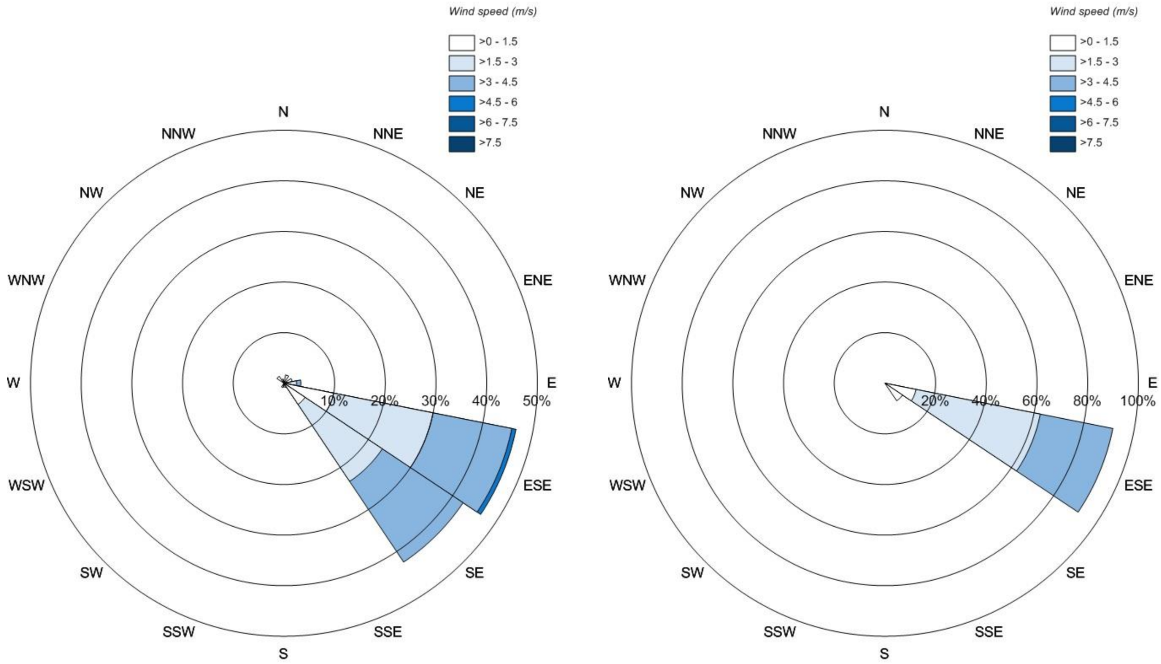


Figure 4-2: Examples of wind conditions which can cause air quality impacts

To assess the effectiveness of these reactive dust mitigation measures in mitigating the predicted worst case elevated dust levels, the air dispersion modelling was setup to examine the cessation of operations in the OC1 pit when the worst case conditions occurred. Dust emissions due to wind erosion from the OC1 pit areas and all other activities occurring at the Modification, including activities associated with OC4 and UG1, were assumed to continue to operate.

It should be noted that this demonstration of the reactive dust mitigation measures only considered cessation of activities in the OC1 pit, whereas in reality MCO would investigate and cease and/or relocate specific fleet in any pit as required to minimise potential adverse dust impacts. Nevertheless, with application of reactive measures in OC1 only, the modelling results (see **Section 5**) indicate that the use of reactive management would achieve compliance with approved impact assessment criteria in the vicinity of Ulan.

5 DIPSERSION MODELLING RESULTS

The incremental dispersion modelling results for the Moolarben Coal Complex incorporating the Modification are presented in **Figure 5-1** and **Figure 5-2** showing the predicted maximum 24-hour average PM_{10} and annual average PM_{10}, respectively.

The predicted maximum 24-hour average PM_{10} 50 µg/m^3 contour is separately overlaid with the previous predictions for Year 6 of the MOD9 (**Todoroski Air Sciences, 2013**). This is considered to be representative of a scenario equivalent to the Year 2016 scenario modelled for the proposed Modification, in **Figure 5-3** to examine the potential change resulting from the proposed Modification. It should be noted that the previous modelling did not incorporate reactive mitigation measures in the predicted results.

The comparison shows that dust levels for the Modification are generally lower when compared to the approved Moolarben Coal Complex (MOD9), however effects occur in somewhat different positions, as would be expected due to the different mine layout and different mine topography used in the contemporary modelling.

With the implementation of the air quality management measures and real-time response triggers described in the existing Air Quality Management Plan, the results indicate that the predicted dust levels would not exceed the 24-hour average PM_{10} criteria at any sensitive receptor as a result of the proposed Moolarben Coal Complex incorporating the Modification.

Dispersion modelling results for $PM_{2.5}$, TSP and dust deposition arising from the Moolarben Coal Complex incorporating the Modification are presented in **Appendix C**. The results indicate that the Modification would result in negligible change to the extent of the predicted levels in the MOD9 assessment and indicate compliance with the relevant criteria levels.

The modifications to the Wilpinjong Coal Mine since the MOD9 assessment (i.e. Wilpinjong Modifications 5 and 6) would not materially impact on the cumulative air quality of receptors in the vicinity of the Moolarben Coal Complex due to spatial displacement of activities occurring at these operations and the Ulan Coal Mine has not been modified since the MOD9 assessment. Therefore, as the Modification is unlikely to result in additional project-only air quality impacts (i.e. in addition those approved for the Moolarben Coal Complex), it is unlikely that there would be any increase in potential cumulative air quality impacts.

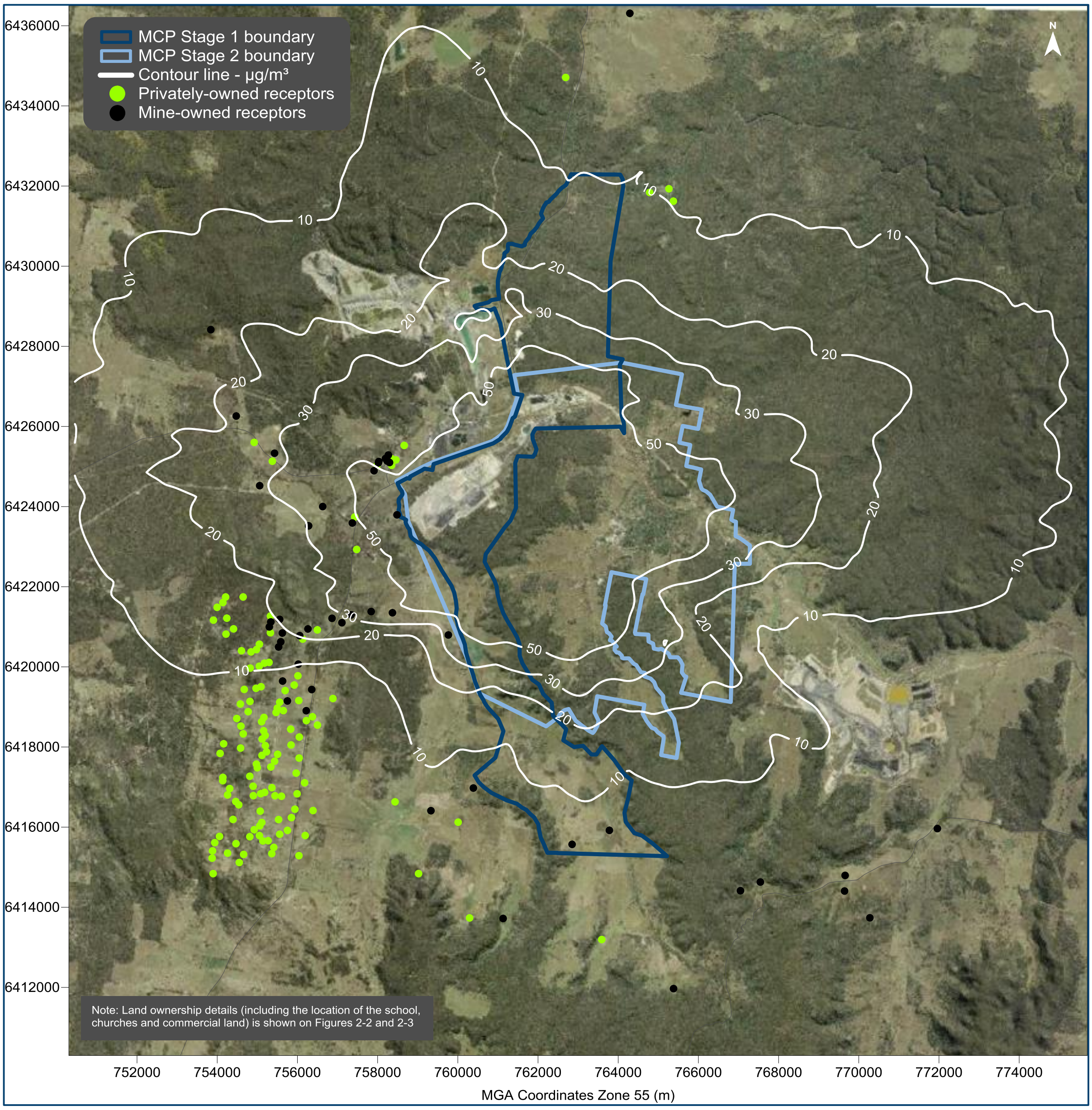


Figure 5-1: Predicted maximum 24-hour average PM_{10} concentrations due to emissions from the Modification

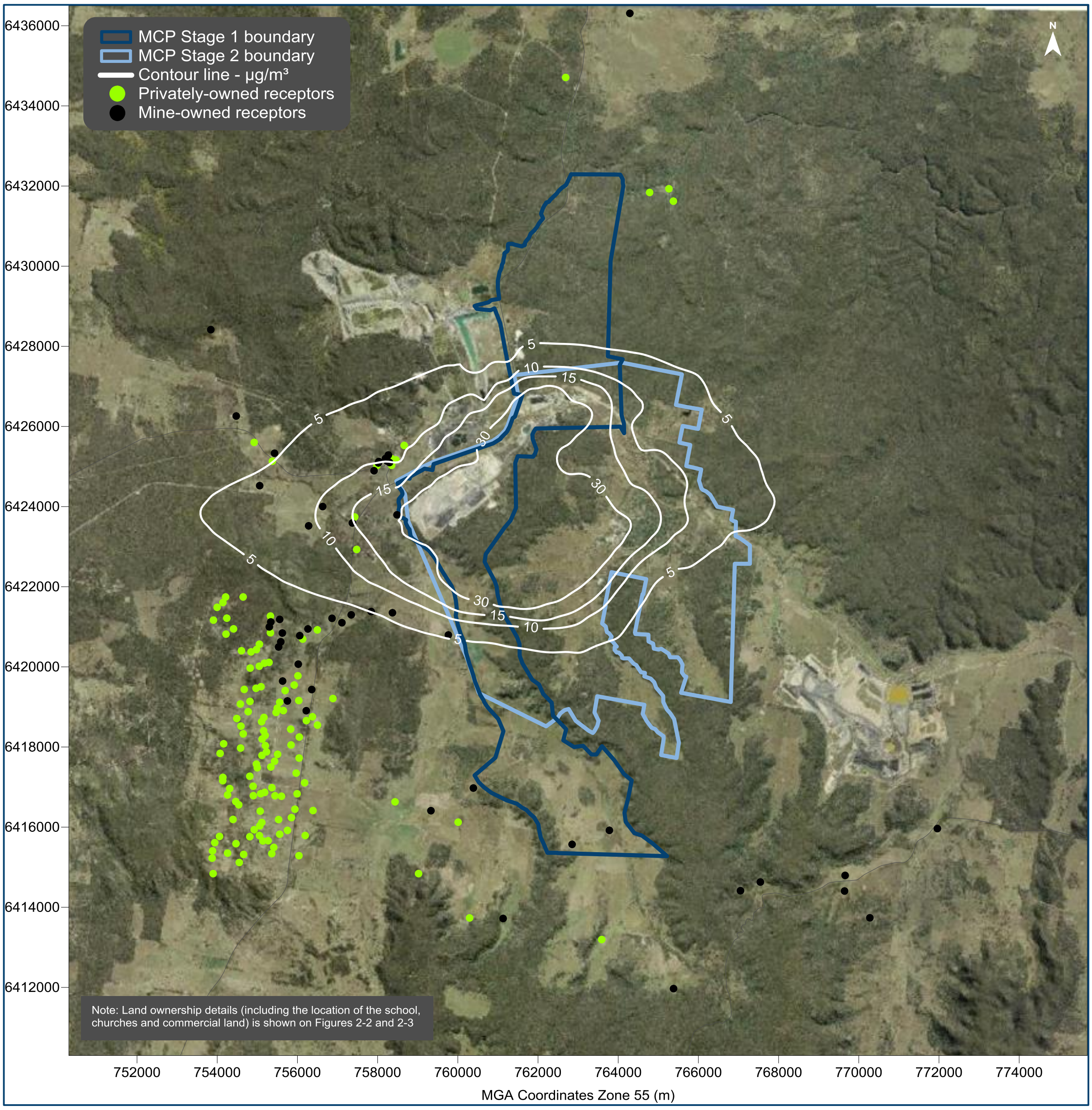


Figure 5-2: Predicted annual average PM_{10} concentrations due to emissions from the Modification

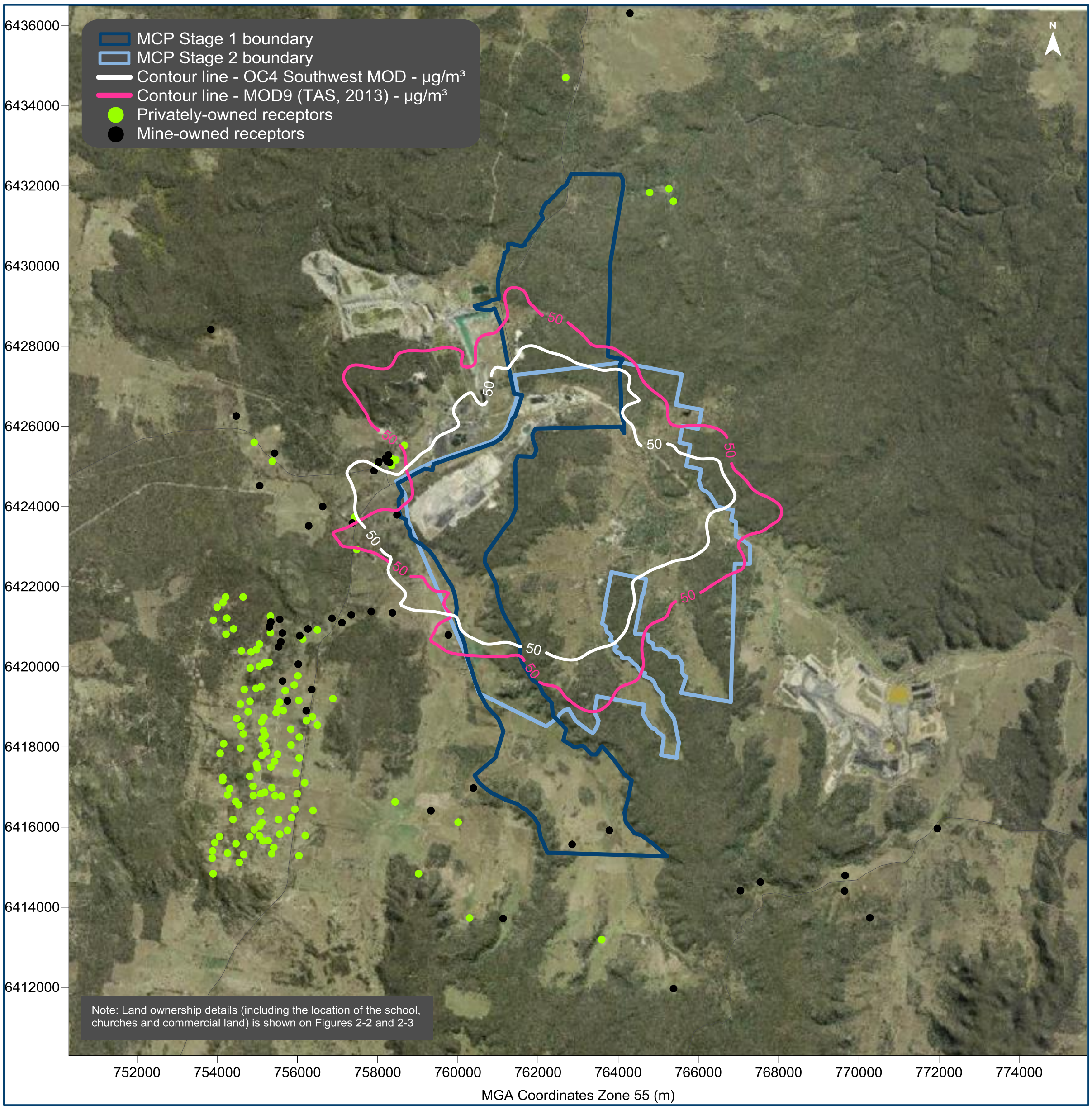


Figure 5-3: Comparison of predicted maximum 24-hour average PM_{10} concentrations

6 SUMMARY AND CONCLUSIONS

This assessment has examined the likely air quality effects resulting from the proposed Modification.

Air dispersion modelling has been conducted for a single mine plan year selected to demonstrate a potential worst-case operational scenario for the Moolarben Coal Complex incorporating the Modification. For the modelling assessment, the operations in the OC1 and OC4 pits were concentrated in areas that are likely to have the greatest potential for air quality impacts for the majority of receivers to the west (i.e. Ulan) and southwest (i.e. Cooks Gap).

The assessment estimated that activities associated with the proposed Modification would be generally within the existing envelope of impact approved for MOD9 (**Todoroski Air Sciences, 2013**), noting that in this (proposed Modification) assessment the effects of the existing air quality management strategies are more fully considered.

The reactive dust mitigation measures have a positive effect in minimising potential air quality impacts in the local area. It is expected that MCO would continue to implement these measures and ensure best practice dust management measures are in place at the Moolarben Coal Complex.

Therefore it is reasonable to conclude that the proposed Modification is unlikely to cause any exceedance or additional impact at any surrounding sensitive receptor locations.

Notwithstanding, MCO would review and update the Air Quality Management Plan, where necessary, to incorporate the OC4 South-West Modification.

7 REFERENCES

Moolarben Coal Operations (2013)
"Air Quality Management Plan", prepared by Moolarben Coal Operations Pty Ltd, 2013.

Todoroski Air Sciences (2013)
"Moolarben Coal Project Stage 1 Optimisation Modification Air Quality and Greenhouse Gas Assessment", prepared for EMGA Mitchell McLennan by Todoroski Air Sciences, May 2013.

Todoroski Air Sciences (2014)
"DRAFT Particulate Matter Control Best Practice Implementation Wheel Generated Dust & Disturbing and Handling Overburden in Adverse Weather Conditions", prepared by Todoroski Air Sciences, August 2014.

United States Environmental Protection Authority (1985 and updates)
"Compilation of Air Pollutant Emission Factors", AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711.

Appendix A

Indicative Mine Plan Scenario

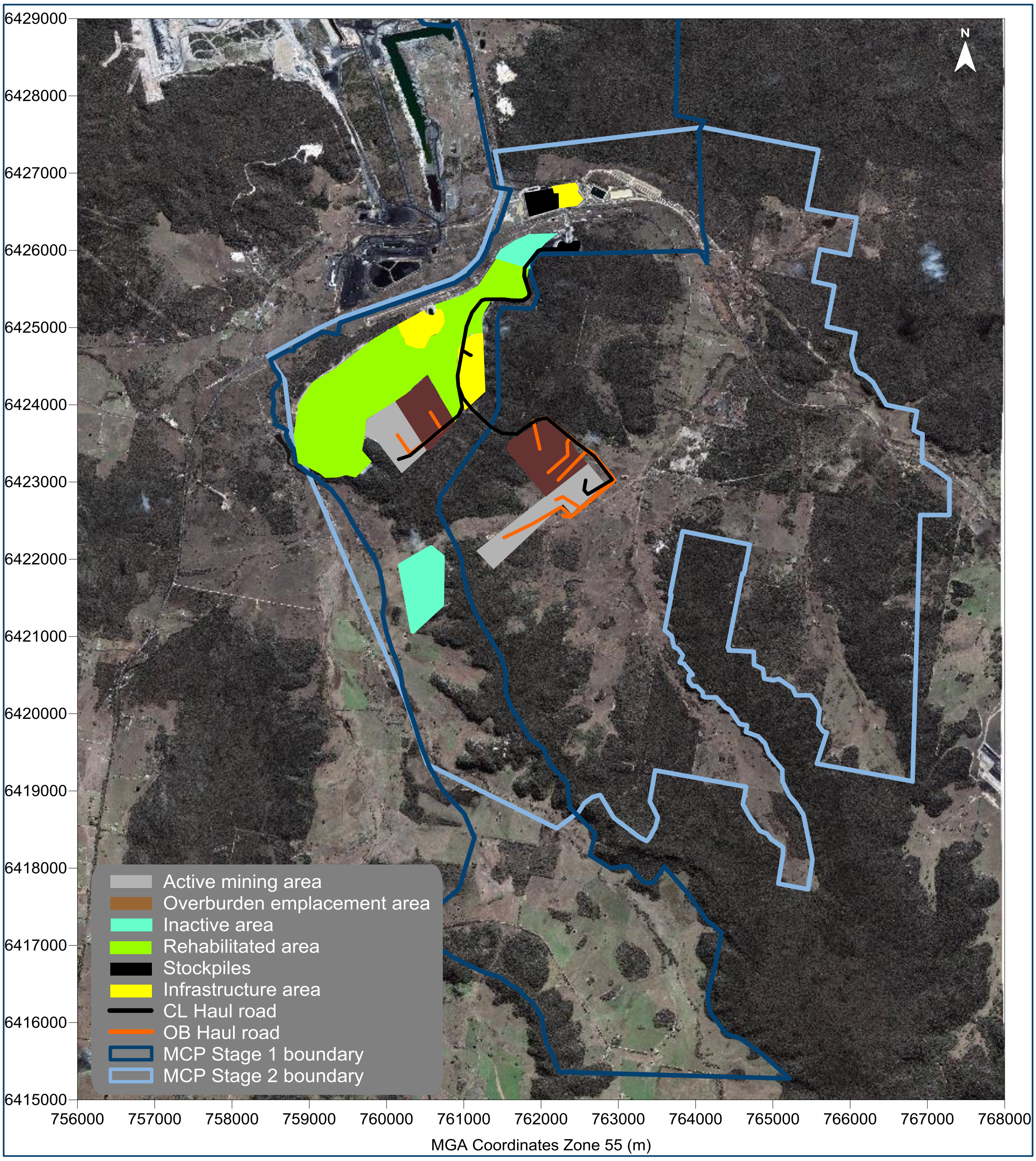


Figure A-1: Indicative mine plan scenario for year 2016

Appendix B

Emissions Inventory

Table B-1: Emission Inventory

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units
OB - Stripping Topsoil - OC1	1,050	75	hours/year	14	kg/h												
OB - Stripping Topsoil - OC4	5,250	375	hours/year	14	kg/h												
OB - Drilling - OC1	963	5,438	holes/year	0.59	kg/hole											70	% Control
OB - Drilling - OC4	2,409	13,611	holes/year	0.59	kg/hole											70	% Control
OB - Blasting - OC1	20,099	107	blasts/year	188	kg/blast	9000	Area of blast in square metres										
OB - Blasting - OC4	50,341	268	blasts/year	188	kg/blast	9000	Area of blast in square metres										
OB - Excavator loading OB to haul truck - OC1	26,356	22,968,763	tonnes/year	0.001	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
OB - Excavator loading OB to haul truck - OC4	102,822	89,607,742	tonnes/year	0.001	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
OB - Hauling to dump - OC1	106,520	22,968,763	tonnes/year	0.046	kg/t	240	tonnes/load	2.1	km/return trip	5.21	kg/VKT	4.2	% silt content	266	Ave GMV (tonnes)	90	% Control
OB - Hauling to dump - OC4	729,665	89,607,742	tonnes/year	0.081	kg/t	240	tonnes/load	3.8	km/return trip	5.21	kg/VKT	4.2	% silt content	266	Ave GMV (tonnes)	90	% Control
OB - Emplacing at dump - OC1	26,356	22,968,763	tonnes/year	0.001	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
OB - Emplacing at dump - OC4	102,822	89,607,742	tonnes/year	0.001	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %								
OB - Dozers on OB at dump - OC1	91,635	5,476	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Dozers on OB at dump - OC4	358,898	21,446	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Dozers on OB in pit - OC1	77,166	4,611	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
OB - Dozers on OB in pit - OC4	358,898	21,446	hours/year	16.7	kg/h	10	silt content in %	2	moisture content in %								
CL - Drilling - OC1	626	3,535	holes/year	0.59	kg/hole											70	% Control
CL - Drilling - OC4	1,532	8,654	holes/year	0.59	kg/hole											70	% Control
CL - Blasting - OC1	5,072	27	blasts / year	188	kg/blast	9000	Area of blast in square metres										
CL - Blasting - OC4	12,397	66	blasts / year	188	kg/blast	9000	Area of blast in square metres										
CL - Dozers ripping/pushing/clean-up - OC1	40,802	5,476	hours/year	14.9	kg/h	5	silt content in %	7.4	moisture content in %							50	% Control
CL - Dozers ripping/pushing/clean-up - OC4	75,162	10,087	hours/year	14.9	kg/h	5	silt content in %	7.4	moisture content in %							50	% Control
CL - Loading ROM coal to haul truck - OC1	132,933	2,530,951	tonnes/year	0.053	kg/t	7.4	moisture content in %										
CL - Loading ROM coal to haul truck - OC4	560,047	10,662,888	tonnes/year	0.053	kg/t	7.4	moisture content in %										
CL - Conveying from UG1 portal	39	0.04	ha	0.4	kg/ha/hour	8760	hours									70	% Control
CL - Unloading to stockpile at UG1	735	4,000,000	tonnes/year	0.000	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	7.4	moisture content in %								
CL - Loading ROM coal to haul truck - UG1	105,046	4,000,000	tonnes/year	0.053	kg/t	7.4	moisture content in %									50	% Control
CL - Hauling ROM to hopper - OC1	51,148	2,530,951	tonnes/year	0.202	kg/t	200	tonnes/load	8.4	km/return trip	4.82	kg/VKT	4.2	% silt content	224	Ave GMV (tonnes)	90	% Control
CL - Hauling ROM to hopper - OC4	312,618	10,662,888	tonnes/year	0.293	kg/t	200	tonnes/load	12.2	km/return trip	4.82	kg/VKT	4.2	% silt content	224	Ave GMV (tonnes)	90	% Control
CL - Hauling ROM to hopper - UG1	47,908	4,000,000	tonnes/year	0.120	kg/t	200	tonnes/load	5.0	km/return trip	4.82	kg/VKT	4.2	% silt content	224	Ave GMV (tonnes)	90	% Control
CHPP - Unloading ROM to hopper - OC1	19,940	2,530,951	tonnes/year	0.053	kg/t	7.4	moisture content in %									85	% Control
CHPP - Unloading ROM to hopper - OC4	84,007	10,662,888	tonnes/year	0.053	kg/t	7.4	moisture content in %									85	% Control
CHPP - Unloading ROM to hopper - UG1	31,514	4,000,000	tonnes/year	0.053	kg/t	7.4	moisture content in %									85	% Control
CHPP - Rehandle ROM at hopper	13,546	1,719,384	tonnes/year	0.053	kg/t	7.4	moisture content in %									85	% Control
CHPP - Conveying from hopper to CHPP	183	0.17	ha	0.4	kg/ha/hour	8760	hours									70	% Control
CHPP - Handling coal at CHPP	2,073	17,193,839	tonnes/year	0.000	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %								
CHPP - Dozer pushing ROM coal	23,451	4,797	hours/year	9.777	kg/h	5	silt content in %	10	moisture content in %							50	% Control
CHPP - Dozer pushing Product coal	53,825	14,391	hours/year	7.480	kg/h	4	silt content in %	10	moisture content in %							50	% Control
CHPP - Conveying from CHPP to stockpile	208	0.20	ha	0.4	kg/ha/hour	8760	hours									70	% Control
CHPP - Loading Product coal to stockpile	1,575	13,067,318	tonnes/year	0.0001	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %								
CHPP - Conveying from stockpile to train	247	0.24	ha	0.4	kg/ha/hour	8760	hours									70	% Control
CHPP - Loading Product coal to trains	394	13,067,318	tonnes/year	0.0001	kg/t	0.969	average of (wind speed/2.2)^1.3 in m/s	10	moisture content in %							75	% Control
CHPP - Conveying rejects from CHPP to loadout	183	0.17	ha	0.4	kg/ha/hour	8760	hours									70	% Control
CHPP - Hauling rejects	49,722	4,126,521	tonnes/year	0.12	kg/t	200	tonnes/load	5.0	km/return trip	4.82	kg/VKT	4.2	% silt content	224	Ave GMV (tonnes)	90	% Control
WE - Overburden emplacement areas	144,003	82	ha	0.4	kg/ha/hour	8760	hours									50	% Control
WE - Inactive areas	52,102	74	ha	0.4	kg/ha/hour	8760	hours									80	% Control
WE - Open pit	325,798	93	ha	0.4	kg/ha/hour	8760	hours										
WE - ROM stockpiles	5,471	3	ha	0.4	kg/ha/hour	8760	hours									50	% Control
WE - Product stockpiles	21,843	12	ha	0.4	kg/ha/hour	8760	hours									50	% Control
Grading roads	133,454	216,835	km	0.615	kg/VKT	8	speed of graders in km/h										
Total TSP emissions (kg/yr)	**4,370,856**																

Appendix C

Dispersion Modelling Results for $PM_{2.5}$, TSP and Dust Deposition

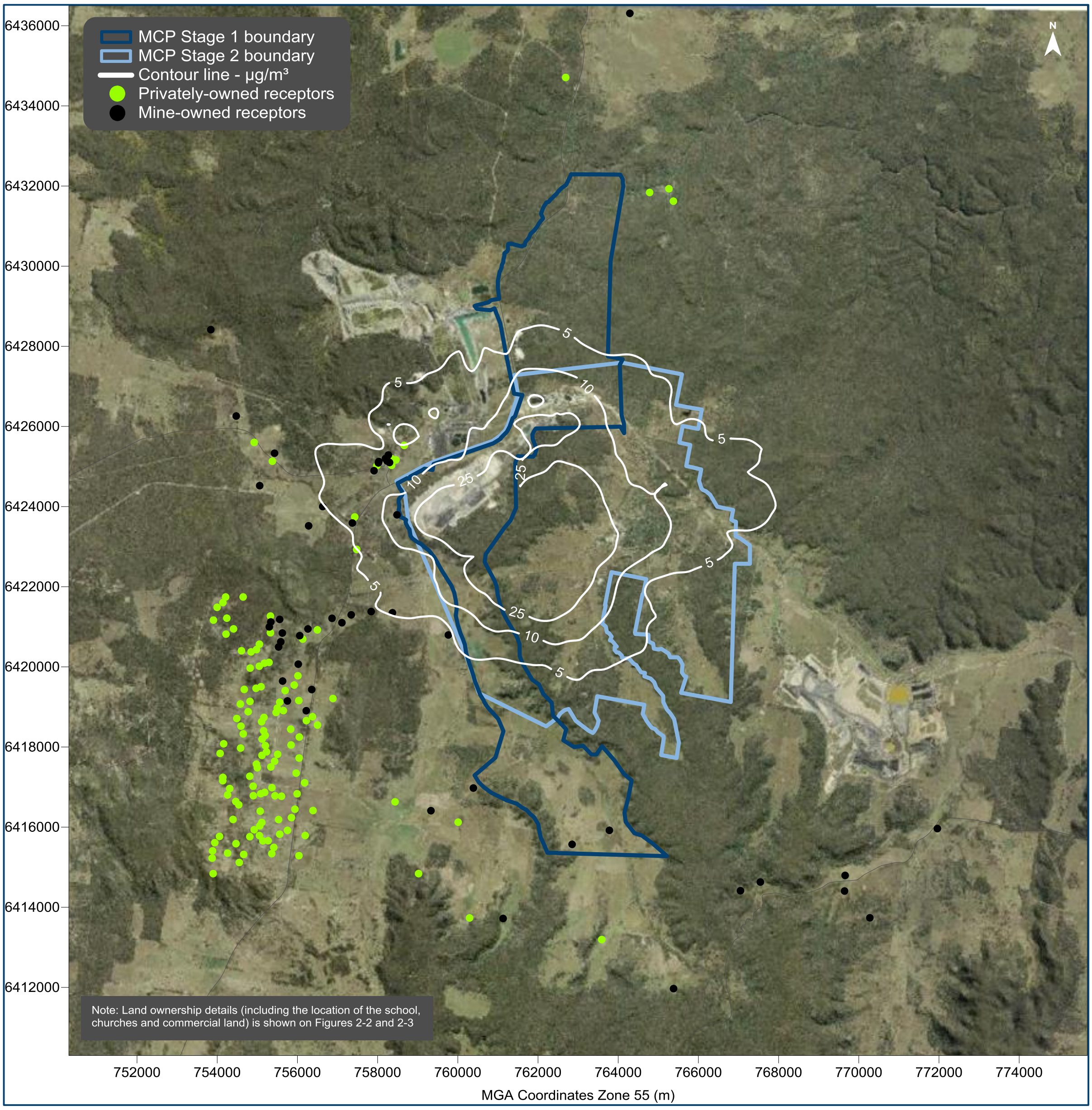


Figure C-1: Predicted maximum 24-hour average $PM_{2.5}$ concentrations due to emissions from the Modification

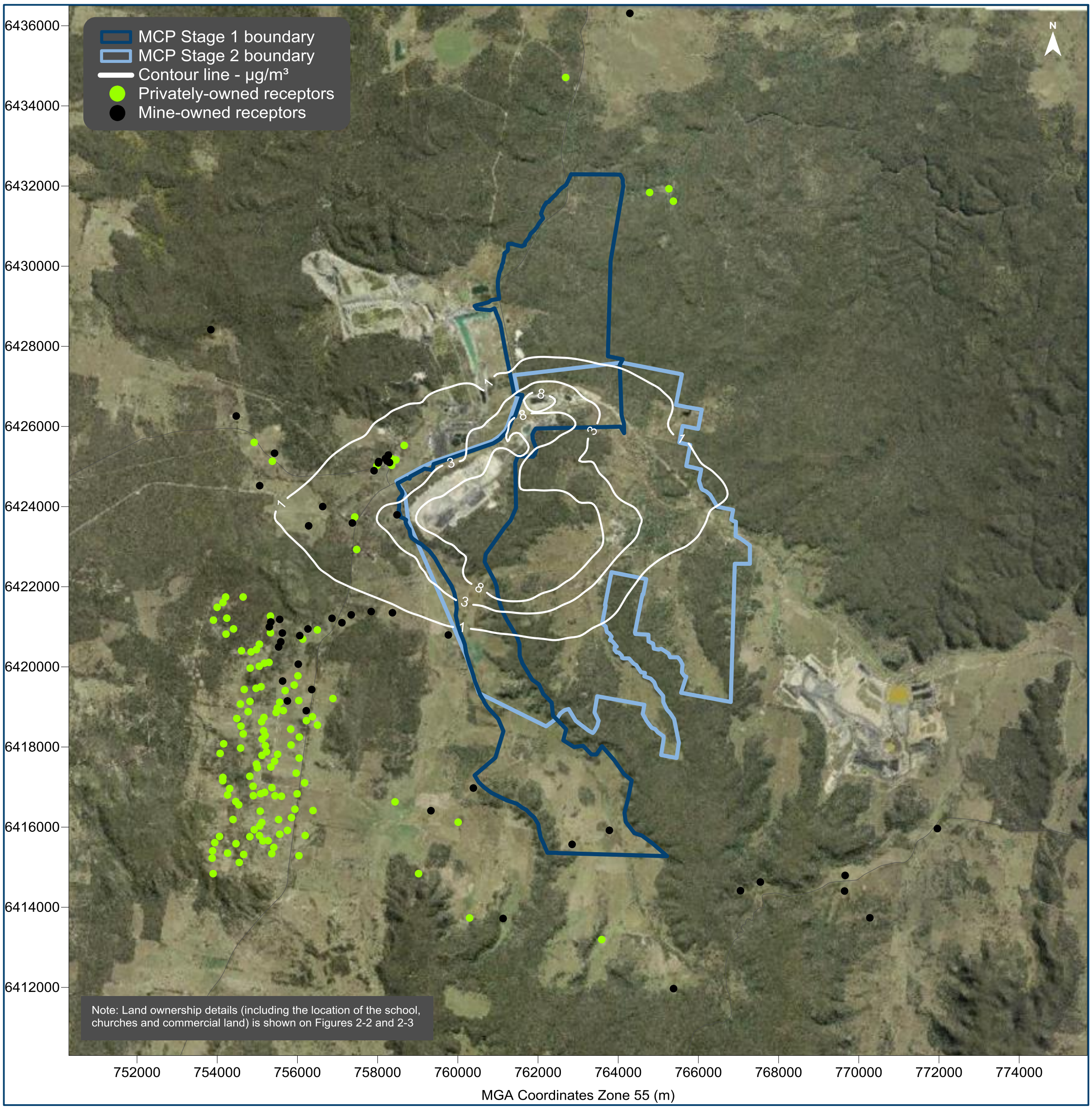


Figure C-2: Predicted annual average $PM_{2.5}$ concentrations due to emissions from the Modification

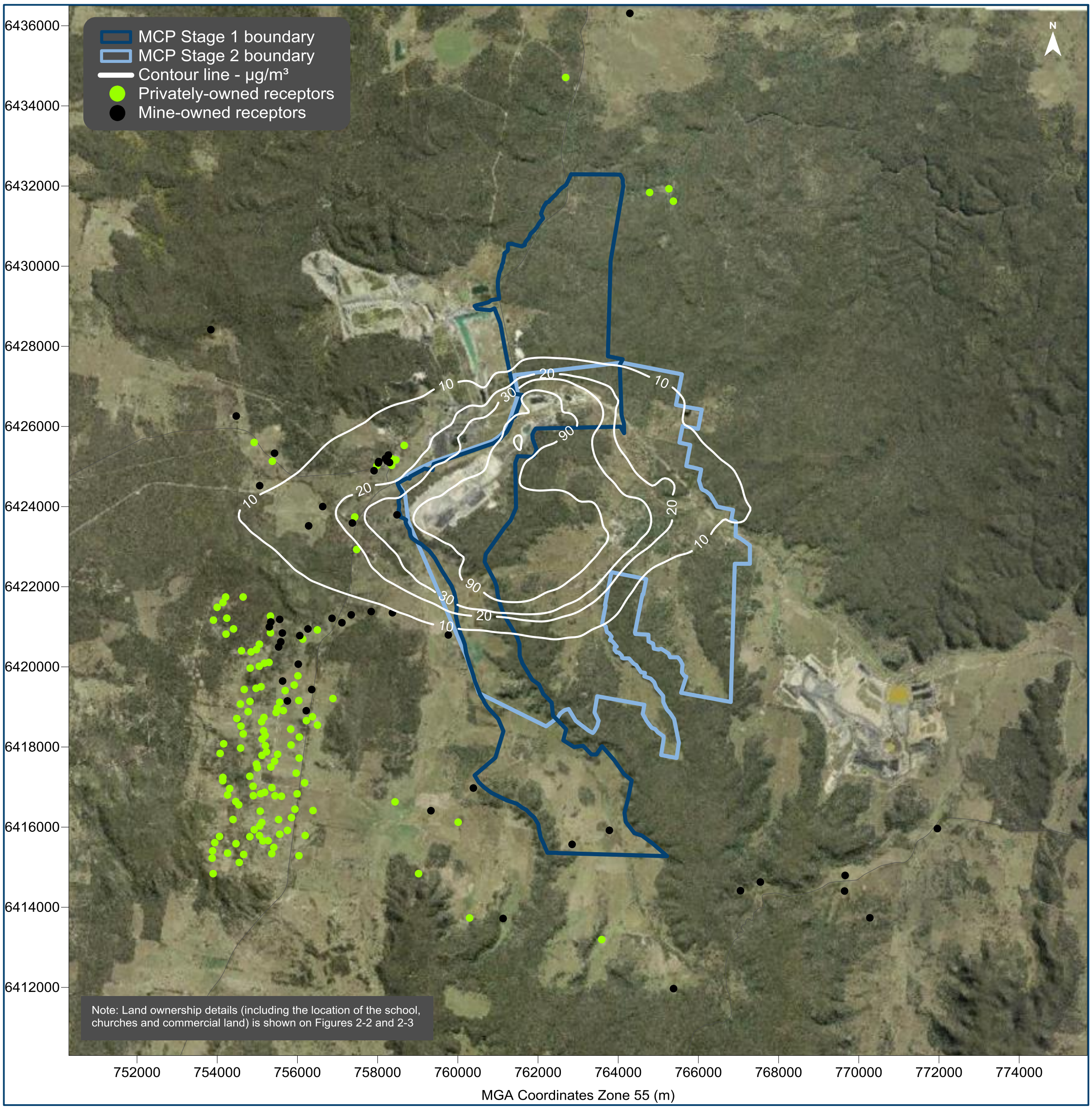


Figure C-3: Predicted annual average TSP concentrations due to emissions from the Modification

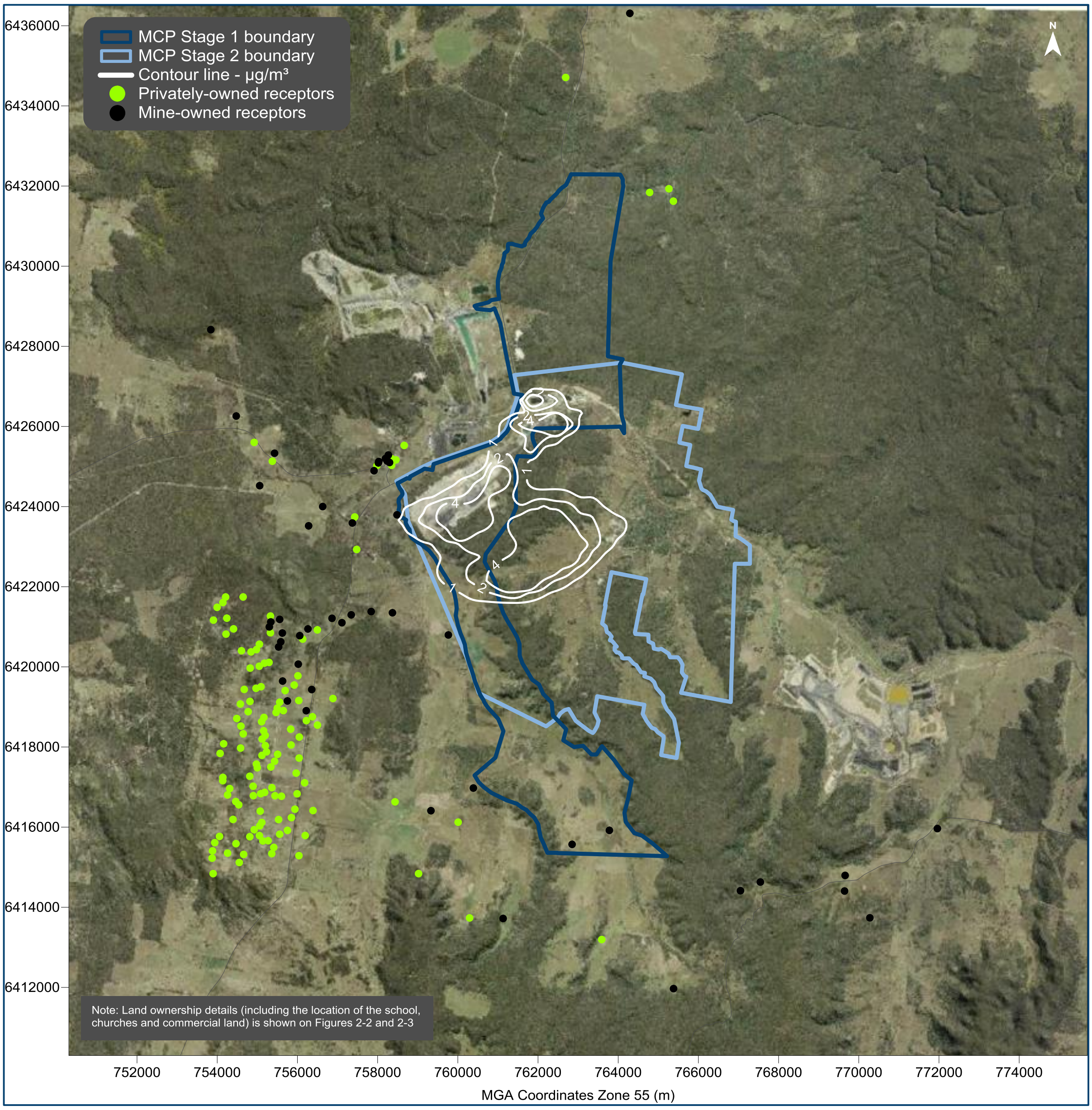


Figure C-4: Predicted annual average dust deposition levels due to emissions from the Modification