FINAL REPORT

ADDITIONAL CUMULATIVE AIR QUALITY ASSESSMENT FOR PROPOSED ASHTON COAL OPERATIONS LTD, INTEGRA COAL OPERATIONS PTY LTD AND RAVENSWORTH OPERATIONS PTY LTD

Job No: **3936**

1 July 2010

PROJECT TITLE:	Additional Cumulative Air Quality Assessment for proposed Ashton Coal Operations Ltd, Integra Coal Operations Pty Ltd and Ravensworth Operations Pty Ltd
JOB NUMBER:	3936
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1 INTRODUCTION

This report has been prepared by PAEHolmes on behalf of Ashton Coal Operations Ltd (ACOL), Integra Coal Operations Pty Ltd (Integra) and Ravensworth Operations Pty Ltd (Ravensworth Operations). It has been prepared in response to a request to each of the companies from the NSW Department of Planning (DoP) regarding additional air quality assessment requirements for projects currently under review, namely:

- Integra Open Cut Project (08_0102);
- Ashton South East Open Cut Project (08_0182); and
- Ravensworth Operations Project (09_0176).

2 DESCRIPTION OF REQUIREMENTS

The DoP request common for all three projects is reproduced below:

a) *An integrated cumulative air quality impact assessment from the following coal mines, focusing on all affected residences in and around Camberwell Village, at yearly intervals throughout the currency of operations proposed under the application and paying appropriate attention to seasonal wind variations:*

Existing Operations	***Proposed Operations***
• *Mt Owen Complex, including Ravensworth East and Glendell* • *Ashton North East open Cut* • *Integra Mine Complex, including Glennies Creek North open Cut* • *Rix's Creek Mine* • *Ravensworth Mine Complex, including Ravensworth West, Cumnock and Narama (including recently approved extension)*	• *Integra Open Cut Project (08_0102)* • *Ashton South East Open Cut Project (08_0182)* • *Ravensworth Operations Project (09_0176)*

Note: All approved operations (i.e. current and future) at existing sites should be included. Contributions from underground mining operations should be included within the model if necessary.

The aim of the request is to provide DoP with information so that in the vicinity of Camberwell village it can:

- Understand the likely total cumulative dust impacts arising from existing operations and the addition of the three proposed mine operations in future years; and,
- Understand who contributes how much and when to the dust impacts.

Table 2.1 presents a summary of the residences that were identified by the DoP for assessment in this study. The table is not intended to be an exhaustive list of potentially impacted residences; rather, these residences have been selected by DoP as being representative receptors that are potentially impacted by cumulative air quality impacts from the existing and proposed operations at individual mines.

The location of each of these residences is shown on **Figure 2.1**.

Table 2.1: Residences assessed in this study

Assessment ID	Ashton SEOC ID	Ravensworth Operations ID	Integra ID	Ownership
117	117	19	105	McInerney
114	114	7A	106	Richards B & R
34	34	44	91	Olofsson
32	32	10	100	Stapleton C
18	18	40B	103	Turner
120	120	42	112	Ernst
81	81	37	153	Hall R
101A	101A	N/A	80	Donnellan
129	129	47	132	Bowman W
130A	130A	3	133	Bowman A
130B	130B	N/A	N/A	Bowman A
RavOps34[a]	N/A	34	N/A	Stapleton B & D

a) Ravensworth Operations have a negotiated agreement with the owner of this property for existing operations.

It should be noted that a number of these residences were identified at the environmental assessment (EA) stage by one or more of the proposed projects as being impacted by dust at a level requiring negotiated agreement or acquisition (see **Table 2.2**).

Table 2.2: Residences identified in proposed project EAs as requiring negotiated agreement or acquisition

Assessment ID	Ashton SEOC ID[a][b]	Ravensworth Operations ID[c]	Integra ID[d]	Ownership
117	-	-	105	McInerney
114	-	-	-	Richards B & R
34	-	-	91	Olofsson
32	-	-	-	Stapleton C
18	-	-	-	Turner
120	120	-	-	Ernst
81	-	-	153	Hall R
101A	-	-	-	Donnellan
129	129	-	-	Bowman W
130A	130A	-	-	Bowman A
130B	-	-	-	Bowman A
RavOps34	-	34	-	Stapleton B & D

a) PAEHolmes (2009a) "Air Quality Impact Assessment. Ashton South East Open Cut" prepared for Wells Environmental Services on behalf of Ashton Coal Operations Limited, October 2009.

b) Ashton Coal Operations Limited (2010) Response to submissions

c) PAEHolmes (2010) "Air Quality Impact Assessment. Ravensworth Operations Project", prepared for Umwelt (Australia) Pty Ltd, January 2010

d) Holmes Air Sciences (2009) "Air Quality Impact Assessment. Integra Open Cut Operation" Prepared for URS Australia Pty Ltd on behalf of Integra Coal, June 2009.

Due to the location of the residence RavOps34 outside the focal area of this study, and its proximity to other mining operations that have not been considered (for example Hunter Valley Operations), the assessment for RavOps34 is considered to be an under-estimation of the cumulative air quality impacts likely to be experienced at this location. Ravensworth Operations have committed to a negotiated agreement or acquisition of this residence should approval be granted.

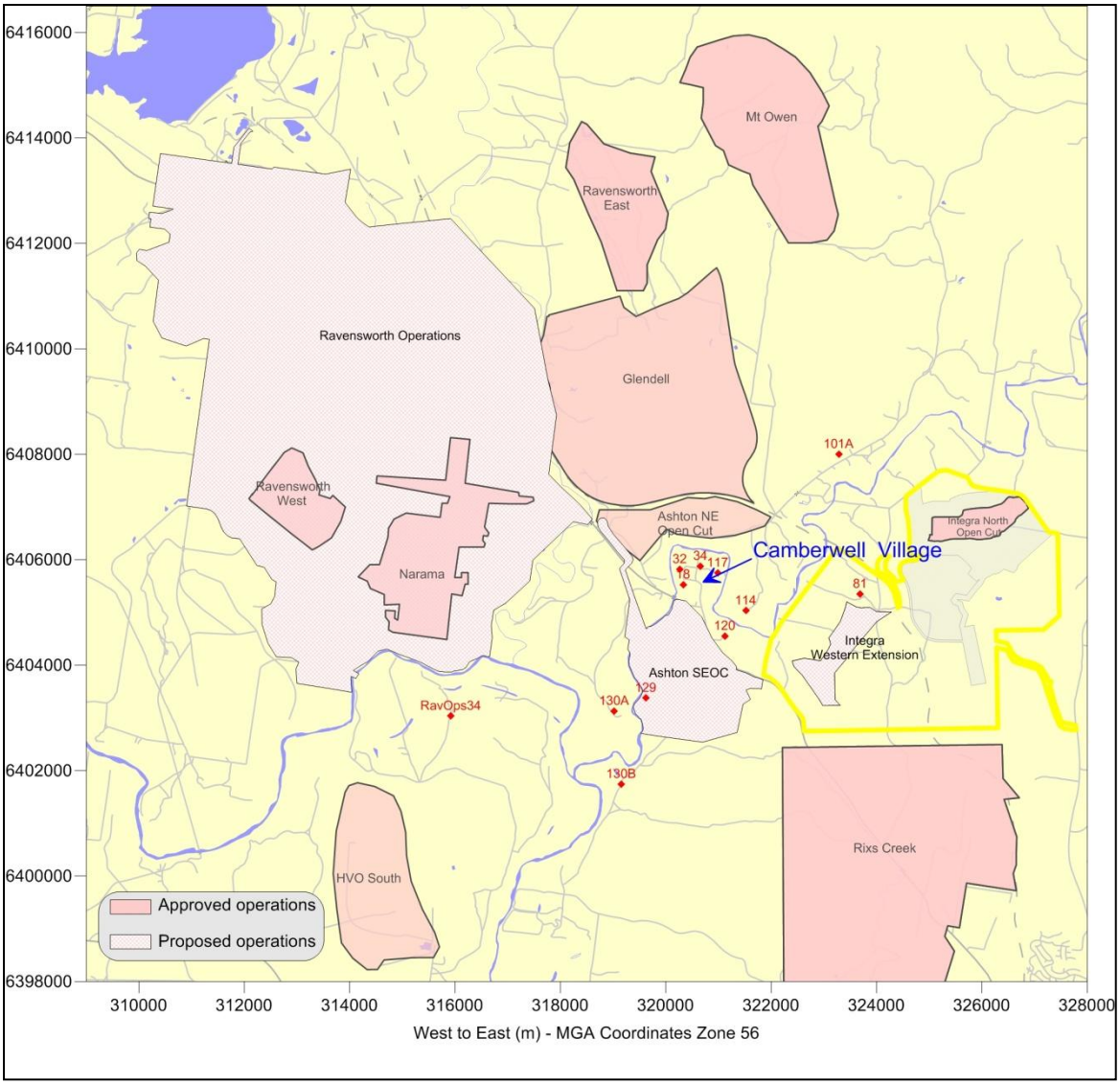

Figure 2.1: Location of residences identified by DoP for assessment

3 APPROACH TO ASSESSMENT

The approach taken to this assessment has been to sum the predicted impacts at the identified residences for each of the individual projects, both existing/historical and proposed, based on the available published information for the years 2007 to 2021.

For each residence identified in **Figure 2.1** the results are collated in a table and are also shown in a graph. All assumptions are listed and all original source data are provided in **Appendix A**.

This approach is considered appropriate for a range of reasons including;

1. Existing operations have "approval" to operate within the levels predicted in their respective EA documents, and this needs to be presented accurately in an assessment. A single model would not replicate the results of the various different models used in the past, even with the same inputs (which in itself is not always possible);

2. It removes many complicating issues and potential inaccuracies which would arise should a single model that incorporates all sources be developed. Key issues are:

    a. It uses predictions made using the local meteorology for each mine, providing more accuracy than a single model representing distant mines with meteorology sourced for example, near Camberwell. (Each detailed assessment used meteorological data that were considered representative for the site being assessed. This approach has been validated to provide accurate results in the vicinity of the mine. Applying meteorological data from a single station in one dispersion model would not be likely to represent the impacts from all mines accurately);

    b. It allows detailed modelling (from the EA) to be used, instead of having to simplify the mine plans to overcome the limitations of a single model. (Each of the projects identified has had detailed dispersion modelling completed for environmental assessment purposes, though some assessments, for example Rix's Creek are over 20 years old. Generally, the modelling for those projects took into account detailed activity at the project for specific years of operation, and this cannot be reasonably represented in a single model due a limit to the number of sources that can be modelled);

3. By design, approved regulatory models, overestimate actual impacts. Consequently, when the results are added it is shown that the predicted impacts overestimate actual emissions (see **Section 5.4**).

4. Presenting the predictions for recent past years has enabled a comparison between the modelled/predicted impacts and the actual measured concentrations to be made. This provides a good measure of the expected over-prediction that is inherent in regulatory models. A comparison of modelled ROM rates with actual ROM rates will also assist in interpreting the degree of any potential over-prediction in the past.

5. As the mine plan/calendar years modelled do not generally align for all mines, the proposed approach allows reasonable interpolation to be made between modelled years, allowing better presentation of future impacts

Other than emissions from mining operations, consideration was given to emissions from non-modelled sources (i.e. the "background"). The assumptions of "background" vary from project-to-project as the approach taken in the latest assessments for proposed mines is to compare predicted concentrations (i.e. all modelled sources but without any "background" added) with the available

annual average PM_{10} monitoring data. The difference between the two is then assumed to be the "background". This single figure is then added to all the predicted impacts to provide the cumulative assessment.

The comparison between predicted concentrations and actual data (e.g. for 2008 and 2009) provides an indication of any residual "non-modelled" sources that need to be considered and the level of "background" needed. To complete the assessment of "background level", the actual available non-modelled land in the prevailing wind axis around Camberwell was assessed. The greater the non-modelled land area (vs. modelled mines) the greater the background levels that would be added. In this case about 65% of the areas in the prevailing wind axis have been modelled and a conservative 5 $\mu g/m^3$ value was added to estimate background levels. Note that the value established for the proposed Ashton SEOC assessment was 2 $\mu g/m^3$, for the proposed Integra Open Cut Project assessment was 8 $\mu g/m^3$, and for the proposed Ravensworth Operations assessment was 5 $\mu g/m^3$.

4 RESULTS

4.1 Actual and Anticipated ROM

Table 4.1 and **Figure 4.1** present a summary of the actual historical and anticipated ROM removal rates for the period 2007 to 2021, for the existing approved and proposed operations included in this assessment.

The total combined ROM production from the 16 existing and proposed mines in the area surrounding Camberwell is anticipated to increase from approximately 36 Mtpa in 2010 to approximately 47 Mtpa in 2013. The anticipated ROM production remains relatively steady between 2013 and 2017 while between 2018 and 2021 the combined ROM production decreases from approximately 43 Mtpa to approximately 31 Mtpa.

The grey shaded areas with *italic* font in **Table 4.1** show years for which dispersion modelling has previously been completed as part of an environmental assessment for the operation. In the majority of cases the actual or anticipated ROM production is lower than the modelled ROM production. This may partially explain why the actual measured dust levels are lower than predicted, as presented in **Section 5.4**.

It is important to note that whilst an increase in ROM production will generally result in an increase in dust emissions from the operations, the increase is not directly proportional to predicted air quality impacts. The impact that any change in dust emissions will have on air quality at a particular point is dependent on a number of factors, including:

- The type of activity generating the dust;
- The location of the activity in relation to each residence; and
- The prevailing meteorological conditions in relation to the activity/residence.

Table 4.1: Actual historical and anticipated ROM 2007 to 2021 compared with modelled ROM (Mtpa)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Ashton NEOC	2.08	1.81	2.08	1.70											
Ashton Underground	2.44	2.71	3.11	3.19	2.98	2.93	3.05	3.22	3.13	2.95	2.99	3.17	3.13	2.92	2.99
Ashton SEOC (proposed)					3.00		3.00		3.00		3.00				
					2.93	3.00	*3.10*	3.00	*3.42*	3.00	*1.12*				
Integra South Pit	2.01	3.96	3.78	1.50	0.36										
Integra North Open Cut				1.28	1.07		1.19	1.18		1.08					
				0.20	*1.50*	1.15	*1.50*	*1.50*	1.01	*0.20*	0.76				
Integra Underground					3.50		3.50	3.50		3.50		3.50			
	2.62	2.84	1.49	3.50	*3.50*	3.50	*3.50*	*3.50*	3.50	*3.50*	3.50	*3.50*	3.50	3.50	3.50
Integra Western Extension Open Cut (proposed)					2.04		2.50	2.66		2.58		3.96			
					2.34	2.54	2.50	*3.50*	2.77	*3.50*	3.16	*4.20*	0.92		
Rix's Creek	2.10	2.10	2.34	2.55	2.55	2.55	2.55	2.55	2.55	2.55					
Mt Owen		8.80				8.30							10.00		
	6.20	*7.70*	8.80	8.40	8.20	*7.90*	7.90	8.60	10.00	10.00	10.00	10.00	*7.90*		
Ravensworth East	2.10	2.50	2.10	2.10	2.10	2.30	2.40	1.60							
Glendell		1.10		3.80			4.50			4.50			4.50		
		2.05	3.50	*1.85*	4.00	4.20	*3.60*	4.50	4.50	*4.35*	4.50	4.50	*3.28*	4.50	4.50
Ravensworth West	1.50	1.30	1.40	1.50											
Narama	2.50	3.00	3.20	2.70 *3.46*	3.00	2.50	2.20								
Cumnock	1.30	1.10		*0.85*											
Ravensworth Underground	0.81	1.65	3.07	3.73	3.26	4.27	3.87	4.25	3.39	4.29	4.06	3.46	3.84	4.07	4.04
Ravensworth Operations (proposed)							10.50		11.70					15.50	
					0.70	7.50	*12.76*	11.00	*11.74*	12.70	14.70	14.60	14.80	*15.57*	15.50
Total	**25.65**	**32.87**	**34.87**	**35.95**	**36.76**	**44.74**	**47.15**	**46.05**	**45.54**	**47.15**	**46.67**	**43.18**	**40.68**	**30.49**	**30.53**

*****_shaded italics show modelled ROM_

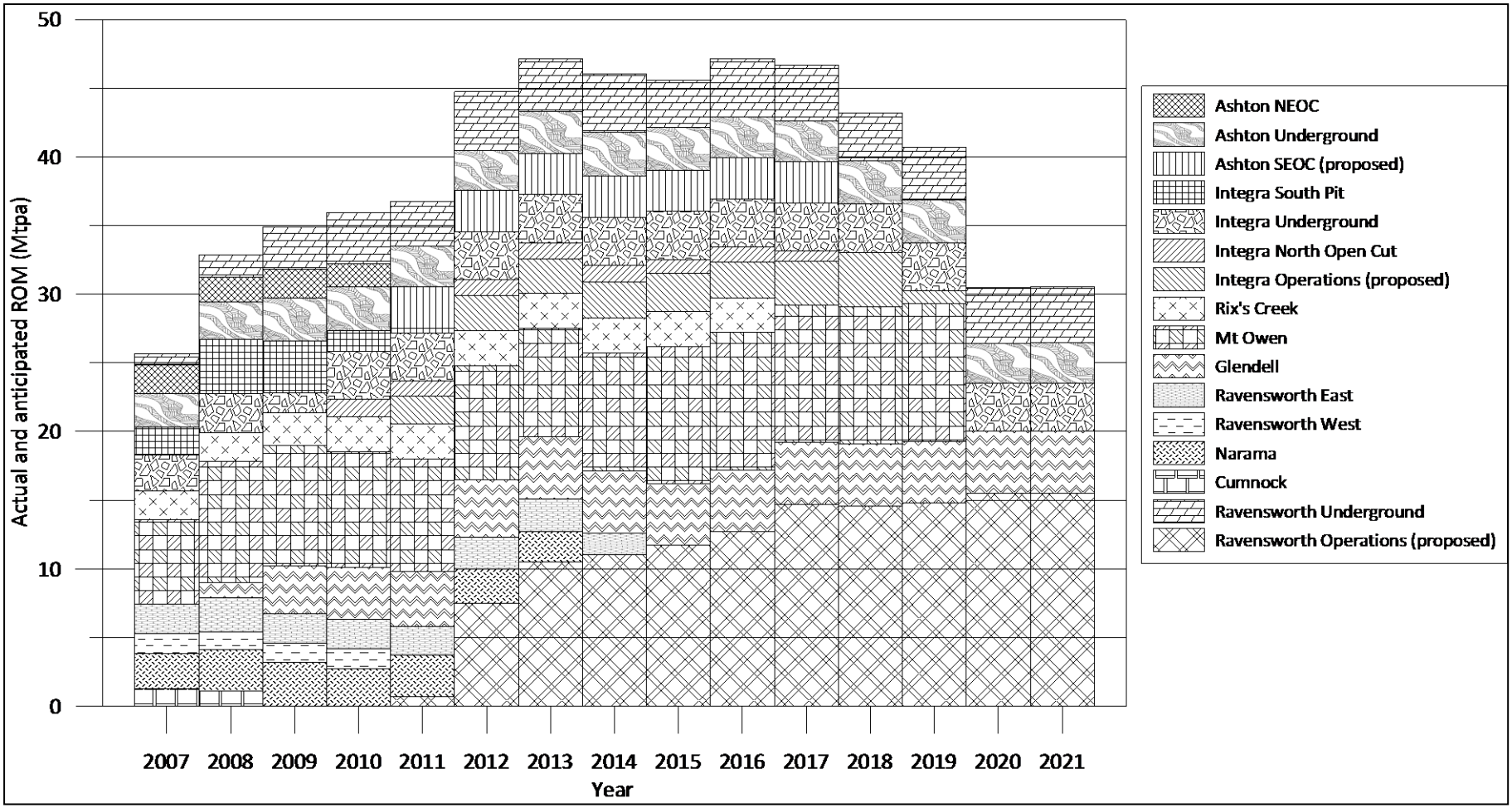

Figure 4.1: Actual historical and anticipated ROM 2007 to 2021 (Mtpa)

5 PREDICTED IMPACTS AT RESIDENCES

5.1 Introduction

As discussed in **Section 1**, in order to assess the cumulative impacts of the approved and proposed operations in the vicinity of the residences nominated by the Department of Planning for assessment, the approach taken has been to sum the predicted annual average PM_{10} concentrations at the identified residences for each of the individual projects, both existing/historical and proposed, based on the available published information for the year 2007 to 2021.

This report presents a detailed analysis of the annual average PM_{10} concentrations as it is not possible to accurately predict the cumulative 24-hour average PM_{10} concentrations using dispersion modelling for this many mines, spread spatially and temporally with the available data. Experience shows that these worst–case 24-hour average PM_{10} concentrations are strongly influenced by sources local to the area, or events such as bushfires and dust storms, which are essentially unpredictable, and can dominate the worst-case PM_{10} concentrations.

5.2 Data Sources

In order to simplify the presentation of the data and avoid repetition of references, a summary of the data references is given below:

5.2.1 Approved operations

- Ashton North East Open Cut (NEOC)
  - Holmes Air Sciences (2001) "Air Quality Assessment Proposed Ashton Mine near Camberwell, NSW" Prepared for White Mining Pty Ltd, October 2001.
  - Please note that the predicted impacts for the Ashton NEOC did not consider the impact of reactive dust management that is employed at the mine, and as such are considered to be an over-estimate of the actual impacts experienced at residences.
  - Open cut operations at Ashton NEOC will cease in the first quarter of 2011. Should the proposed Ashton SEOC (see below) be granted approval there would be a progressive transfer of plant and equipment from Ashton NEOC to Ashton SEOC.
- Integra South Pit
  - Epps & Associates Pty Ltd (1989) "Camberwell Coal Project, Glennies Creek, NSW, Camberwell Coal Joint Venture" Prepared by Epps & Associates Pty Ltd, 3 Julian Street, Mosman, NSW 2088.
  - Please note that at the time this assessment was completed there was no requirement to predict concentrations of PM_{10}. When TSP and PM_{10} concentration monitoring data are not available, it becomes difficult to quantify the existing air quality and to undertake a robust air quality assessment. There is, however, an approximate relationship between annual dust deposition and annual TSP concentrations. Monitoring data from areas in the Hunter Valley where co-located TSP and PM_{10} monitors have been operated for reasonably long periods of time indicate that long term average PM_{10} concentrations are approximately 40% of the corresponding long-term TSP concentration (**NSW Minerals Council, 2000**). It has therefore been assumed that annual average PM_{10} concentrations are 40% of the TSP predictions presented.
  - Open cut operations at Integra South Pit will cease in 2011.
- Integra North Open Cut (previously known as Glennies Creek Open Cut)

- Holmes Air Sciences (2007a) "Air Quality Assessment: Glennies Creek Open Cut Coal Mine" prepared for R.W. Corkery & Co. Pty Limited on behalf of Integra Coal Operations Pty Ltd. March 2007.

- Rix's Creek
  - Holmes Air Sciences (1994) "Proposed Rixs Creek Open Cut Mine, Near Singleton, NSW", Prepared for Environsciences Pty Ltd, November 1994.
  - Please note that at the time this assessment was completed there was no requirement to predict concentrations of PM_{10}. It has therefore been assumed that annual average PM_{10} concentrations are 40% of the TSP predictions presented (**NSW Minerals Council, 2000**).
- Mt Owen
  - Holmes Air Sciences (2003) "Air Quality Assessment: Mount Owen Operations" Prepared for Umwelt (Australia) Pty Ltd by Holmes Air Sciences, Suite 2B, 14 Glen Street, Eastwood, NSW 2122. December 2003.
- Ravensworth East
  - ERM Mitchell McCotter (1999) "Ravensworth East Mine Air Quality Impact Assessment" Prepared for Peabody Resources Ltd, February 1999.
- Glendell
  - Holmes Air Sciences (2007b) "Air Quality Assessment: Proposed Glendell Mine – Modification to Development Consent" Prepared for Umwelt (Australia) Pty Ltd by Holmes Air Sciences, Suite 2B, 14 Glen Street, Eastwood, NSW 2122. August 2007.
- Ravensworth West
  - ERM Mitchell McCotter (1997) "Extension of Mining Operations at Ravensworth Mine – Environmental Impact Statement", August 1997.
- Cumnock
  - Environ (2008) "Cumnock Wash Plant Mining and Rehabilitation Project Air Quality Assessment" Prepared for Umwelt (Australia) Pty Ltd on behalf of Cumnock No. 1 Colliery, December 2008
- Narama
  - PAEHolmes (2009b) "Air Quality Assessment for Narama Extended Project" prepared for Umwelt (Australia) Pty Ltd, June 2009.

5.2.2 Proposed operations

- Integra Operations (includes the proposed Western Extension and the approved operations at Integra NOC and Integra Underground):
  - Holmes Air Sciences (2009) "Air Quality Impact Assessment. Integra Open Cut Operation" Prepared for URS Australia Pty Ltd on behalf of Integra Coal, June 2009. Integra Operations proposed two pit designs (Full Pit Extent and Part Pit Extent). Should Integra wish to develop the Western Extension to the Full Pit Extent, Residence 81 would require acquisition in or prior to 2013, as the residence is located within the proposed open pit. For this reason two sets of results are presented.

- Please note that since the environmental assessment was submitted, in order to minimise the potential air quality impacts, significant modifications have been made to the Year 1 and Year 3 mine plans and the updated results have been used in this assessment.

- Ashton South East Open Cut (SEOC) (includes approved operations at Ashton Underground):
  - PAEHolmes (2009a) "Air Quality Impact Assessment. Ashton South East Open Cut" prepared for Wells Environmental Services on behalf of Ashton Coal Operations Limited, October 2009.
  - Please note that since the environmental assessment was submitted, in order to minimise the potential air quality impacts, significant modifications have been made to the Year 1 mine plans and the updated results have been used in this assessment.
  - The assessment of air quality impacts for Year 1 SEOC operations includes a period of overlap with Ashton NEOC as there will be a progressive reduction of activities and transfer of plant and equipment from Ashton NEOC to Ashton SEOC.
- Ravensworth Operations (includes approved operations at Narama, Cumnock and Ravensworth West):
  - PAEHolmes (2010) "Air Quality Impact Assessment. Ravensworth Operations Project", prepared for Umwelt (Australia) Pty Ltd, January 2010.

5.3 Air Quality Monitoring Data

Actual nearby monitoring data was compared to the summed values of predicted levels from the relevant environmental assessments to assess the potential over (or under) prediction at each residence.

As shown on **Figure 5.1**, Ashton operates seven Tapered Element Oscillating Microbalance (TEOMs) measuring PM_{10} concentrations in the vicinity of the Camberwell Village and Glendell operates one to the north-east. A summary of the annual average PM_{10} concentrations for the period 2007 to end May 2010 is presented in **Table 5.1**.

Table 5.1: Annual average PM_{10} concentration at each TEOM monitoring site ($\mu g/m^3$)

TEOM Site	2007	2008	2009	2010 (to 31 may)
Ashton1	28	26	29	24
Ashton 2	23	18	20	17
Ashton 3	24	23	27	21
Ashton 4	24	23	29	24
Ashton 7	24	21	24	22
Ashton 8	25	25	28	23
Glendell3	23	21	27	21

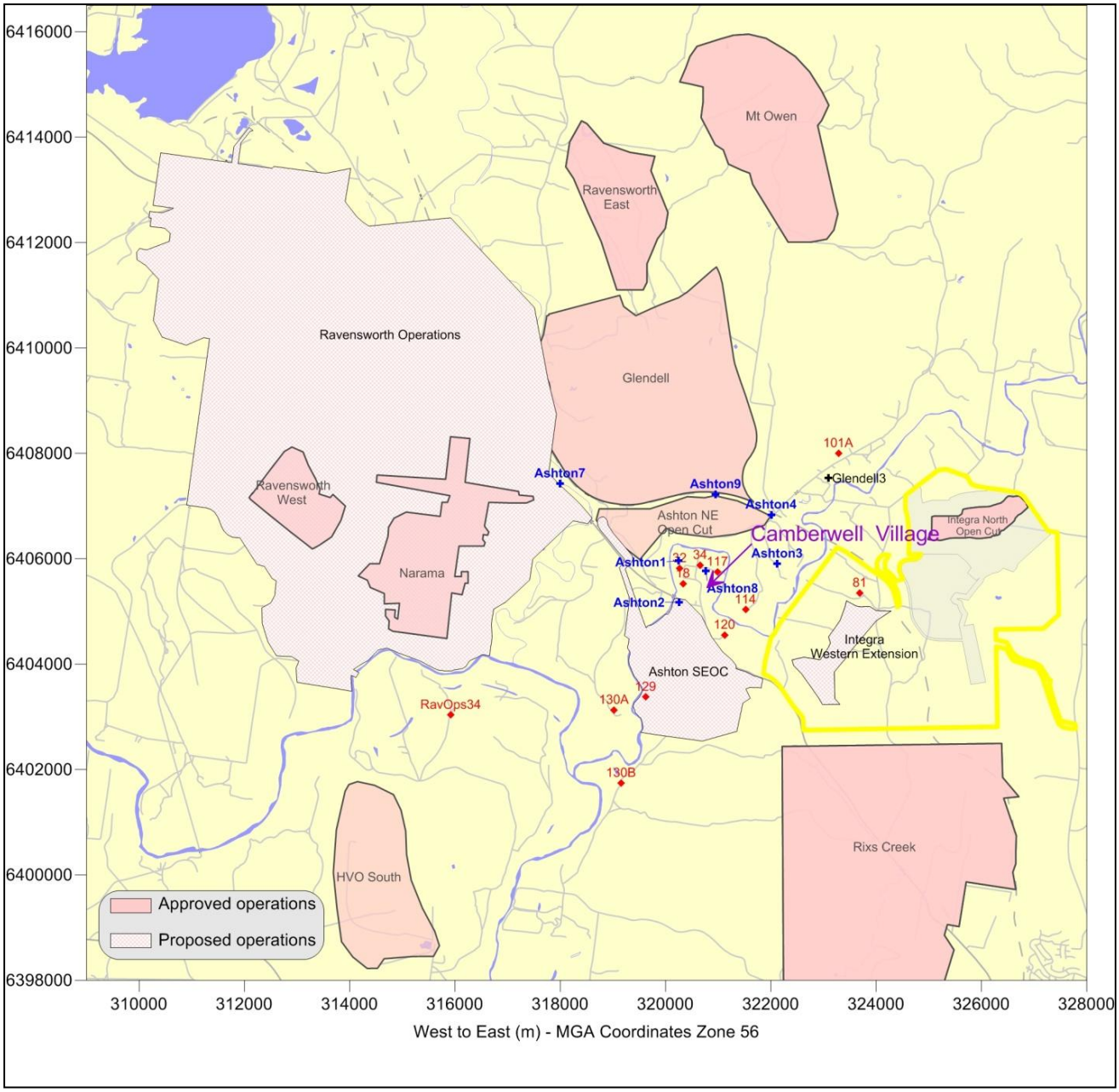

Figure 5.1: Location of PM_{10} TEOM monitors and residences assessed in detail

5.4 Results

5.4.1 Introduction

The following sections present the predicted impacts at each of the residences identified in **Section 2**.

When air quality modelling is completed as input to an environmental assessment (EA), key stages in the mine life are assessed and air quality predictions are made across a defined modelling "domain" (that is the area across which air quality predictions were made). As shown on **Figure 5.2**, and in **Table 5.2**, the modelled domains and years for the various EA's do not generally align well. The selection of the relevant "modelling domains' is based on project considerations including the identification of the relevant stage of each project with the increased likelihood of impacts on surrounding areas. This provides for the air quality assessment to be representative of the likely worst-case impacts for a proposed project. Therefore, wherever possible, the approach taken was to extract the predicted level at each receptor from the electronic model results (which are identical to those in published EA's). Where the electronic model results were not available it was necessary to analyse the contour plots of predicted annual average PM_{10} or TSP concentrations as presented in the historical air quality assessments identified in **Section 5.2.1**.

Copies of all relevant (or available) contour plots are presented in **Appendix A**. In addition, where possible, the contours have also been placed on a common map showing the location of the residences being assessed to assist the reader.

For the years outside of those modelled for each project, where predicted impacts are not available, the change in ROM production rates were used to interpolate or make assumptions about any gaps in the data. It is important to note that whilst an increase in ROM production will generally result in an increase in dust emission from the operations, the increase is not directly proportional to predicted air quality impacts. The impact that any change in dust emissions will have on air quality at a particular point is dependent on a number of factors, including:

- The type of activity generating the dust;
- The location of the activity in relation to each residence; and
- The prevailing meteorological conditions in relation to the activity/residence.

As shown in **Table 2.1**, the dispersion modelling for each of the proposed operations (that is, Ashton SEOC, Integra Operations and Ravensworth Operations) explicitly assessed the air quality impact at most of the residences identified by DoP. However, where a residence had not been included in the modelling, the dispersion modelling was repeated to predict the impact at that residence.

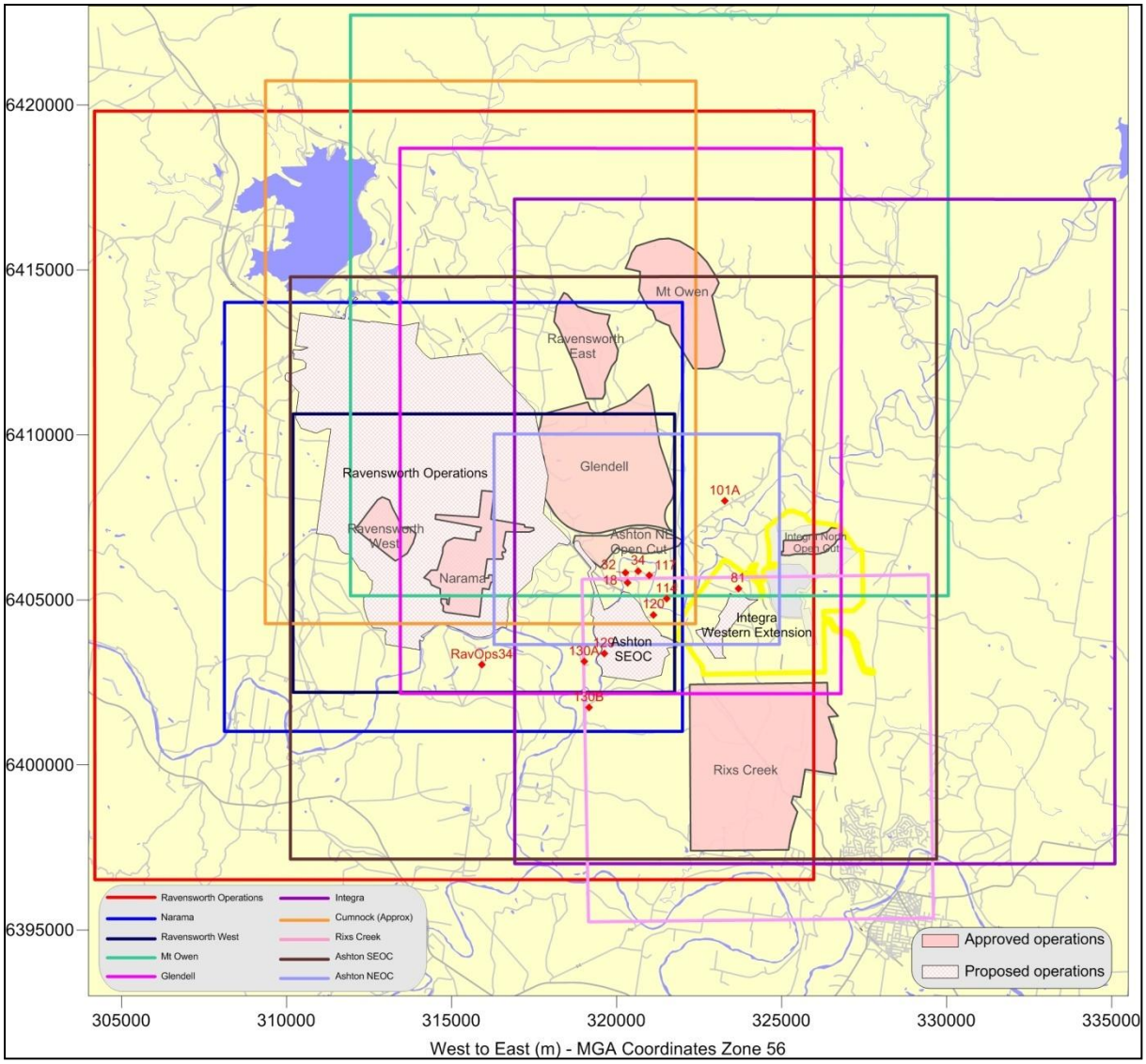

Figure 5.2: Modelling domains from environmental assessments

Table 5.2: Summary of years for which dispersion modelling is available

Mine	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC (inc. underground)															
Integra South Pit															
Integra North Open Cut (NOC)				Y1		Y3			Y6						
Rix's Creek				Y15						Consent expires	Y22				
Mt Owen		Y6				Y10							Y17		
Glendell		Y1		Y3			Y6			Y9			Y12		
Ravensworth East															
Ravensworth West															
Narama				Y1											
Cumnock				Y1											
PROPOSED OPERATIONS															
Ashton SEOC					Y1 (modified)		Y3		Y5		Y7	Project ends			
Integra Western Extension (includes NOC and underground_					Y1 (modified)		Y3 (modified)	Y4 (Full)		Y6 (Full/Part)		Y6 (Full)	Project ends		
Ravensworth Operations (includes Narama)							Y3		Y5					Y10	

5.4.2 Residence 117 (McInerney)

Table 5.3 and **Figure 5.3** present the predicted impacts at Residence 117 for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Ashton8 TEOM. Ashton8 TEOM is located approximately 200m west of Residence 117.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. However, the monitoring data from Ashton8 TEOM are all below the criteria. The main contribution to the cumulative impacts for this period is from Ashton NEOC. However, as noted in **Section 5.2.1**, the air quality assessment for Ashton NEOC did not take into account the reactive dust management that Ashton Coal Operations Limited (ACOL) apply to the site.

For the period 2011 to 2021, the predicted cumulative impacts are all below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.3: Predicted annual average PM_{10} concentrations at Residence 117 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	15	15	15	15											
Integra South Pit	4.0	4.0	4.0	4.0											
Integra North Open Cut				0.1											
Integra Underground	0.1	0.1	0.1	0.1											
Rix's Creek	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0					
Mt Owen	2.2	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		
Ravensworth East	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0							
Glendell		1.4	1.5	1.8	2.4	3.0	3.5	4.0	5.0	6.0	5.0	4.0	3.0	3.0	3.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	0.5	0.5	0.5	0.5											
Narama	0.7	0.7	0.7	0.7											
PROPOSED OPERATIONS															
Integra operations (part-pit)					4.0	3.5	3.0	3.3	3.6	4.0	4.0	4.0	4.0		
Integra operations (full-pit)					4.0	3.5	3.0	4.0	4.0	4.0	4.5	5.0	5.0		
Ashton SEOC					3.0	3.5	4.0	4.0	4.0	3.0	2.0				
Ravensworth Operations (includes Narama)					3.0	4.0	5.0	4.5	4.0	4.2	4.4	4.6	4.8	5.0	5.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*29*	*31*	*31*	*32*	*21*	*22*	*24*	*24*	*22*	*21*	*17*	*15*	*14*	*8*	*8*
Mines only cumulative (Integra full-pit)	*29*	*31*	*31*	*32*	*21*	*22*	*24*	*25*	*22*	*21*	*18*	*16*	*15*	*8*	*8*
Assumed "background"	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Total predicted annual average PM_{10} (Integra part-pit)	**34**	**36**	**36**	**37**	**26**	**27**	**29**	**29**	**27**	**26**	**22**	**20**	**19**	**13**	**13**
MONITORING DATA															
Annual average PM_{10} (Ashton8)	25	25	28	23											

* Shaded shows actual modelled years

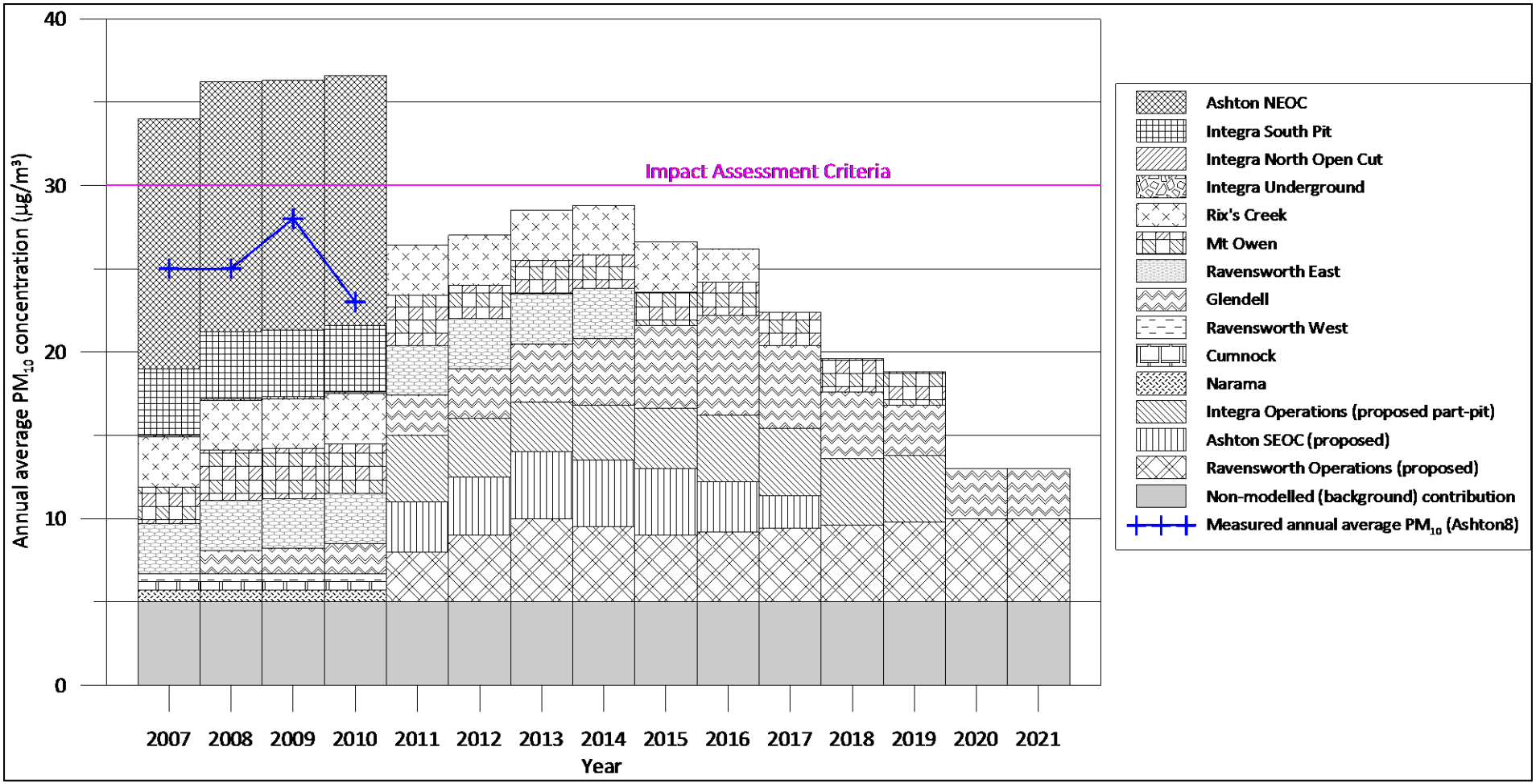

Figure 5.3: Predicted annual average PM_{10} concentrations at Residence 117 ($\mu g/m^3$)

5.4.3 Residence 114 (Richards)

Table 5.4 and **Figure 5.4** present the predicted impacts at Residence 114 for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Ashton8 TEOM. Ashton8 TEOM is located approximately 1.1 km north-west of Residence 114.

The data show that all predicted cumulative impacts for the period 2007 to 2010 were below the impact assessment criteria of 30 $\mu g/m^3$, but marginally greater than the monitoring data from Ashton8 TEOM which are all below the criteria.

For the period 2011 to 2021, the predicted cumulative impacts are all lower than the predicted impacts for the period 2007 to 2011 and below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.4: Predicted annual average PM_{10} concentrations at Residence 114 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	8.0	8.0	8.0	8.0											
Integra South Pit	6.0	6.0	6.0	6.0											
Integra North Open Cut				-											
Integra Underground	0.1	0.1	0.1	0.1											
Rix's Creek	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	2.8					
Mt Owen	2.2	3.0	2.8	2.5	2.3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		
Ravensworth East	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0							
Glendell		1.0	1.0	1.0	1.3	1.7	2.0	2.3	2.7	3.0	2.7	2.3	2.0	2.0	2.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	0.5	0.5	0.5	0.5											
Narama	0.8	0.8	0.8	0.8											
PROPOSED OPERATIONS															
Integra operations (part-pit)					5.0	5.0	4.0	5.0	6.0	7.0	7.0	7.0	7.0		
Integra operations (full-pit)					5.0	4.5	4.0	6.0	6.0	6.0	7.0	8.0	8.0		
Ashton SEOC					4.0	4.5	5.0	5.0	5.0	4.0	1.0				
Ravensworth Operations (includes Narama)					3.0	4.0	4.0	3.5	3.0	3.2	3.4	3.6	3.8	4.0	4.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*23*	*25*	*25*	*25*	*21*	*22*	*22*	*23*	*22*	*22*	*16*	*15*	*15*	*6*	*6*
Mines only cumulative (Integra full-pit)	*23*	*25*	*25*	*25*	*21*	*22*	*22*	*24*	*22*	*21*	*16*	*16*	*16*	*6*	*6*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**28**	**30**	**30**	**30**	**26**	**27**	**27**	**28**	**27**	**27**	**21**	**20**	**20**	**11**	**11**
MONITORING DATA															
Annual average PM_{10} (Ashton8)	25	25	28	23											

* Shaded shows actual modelled years

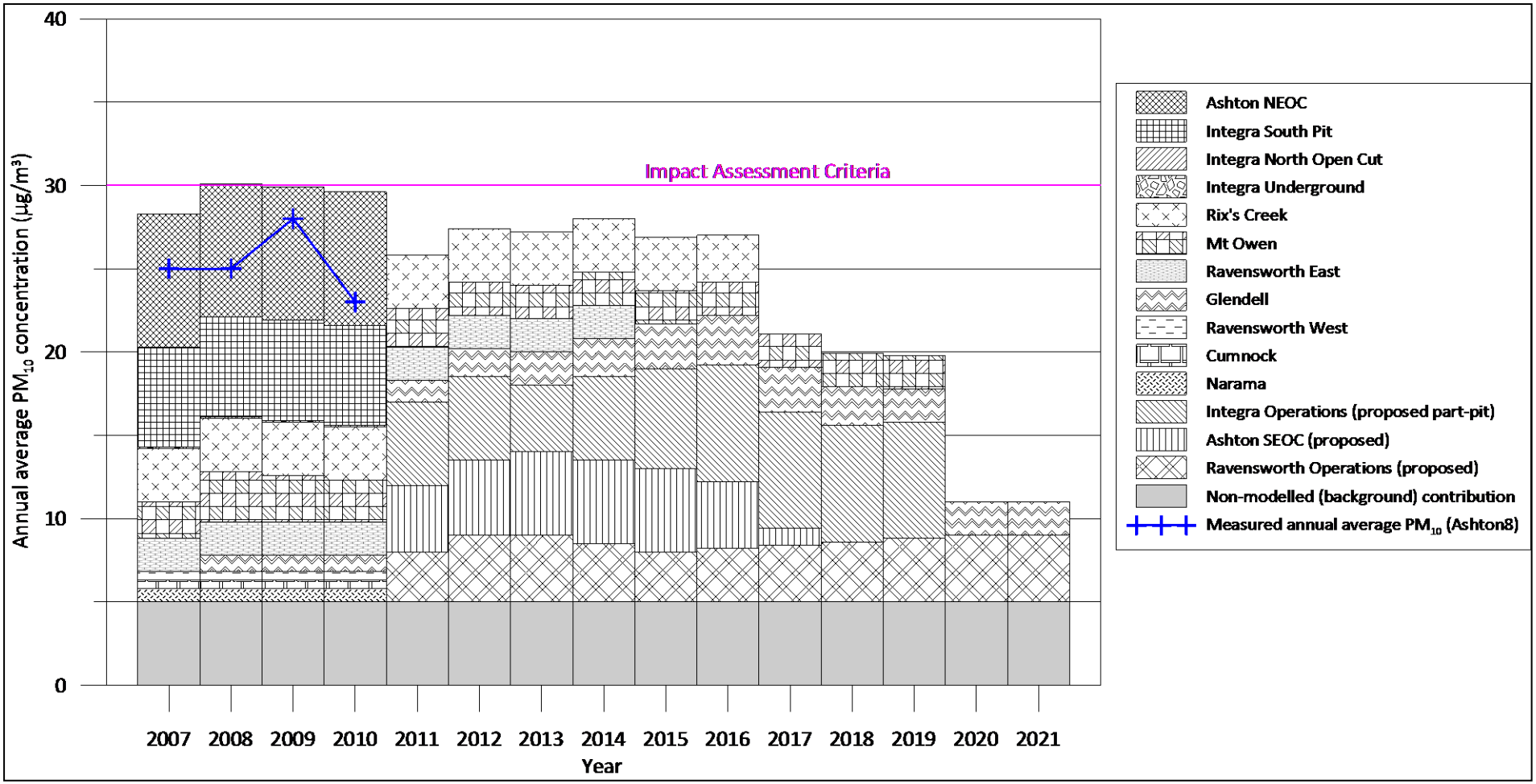

Figure 5.4: Predicted annual average PM_{10} concentrations at Residence 114 ($\mu g/m^3$)

5.4.4 Residence 34 (Olofsson)

Table 5.5 and **Figure 5.5** present the predicted impacts at Residence 34 for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Ashton8 TEOM. Ashton8 TEOM is located approximately 160m south-west of Residence 34.

Residence 34 was identified in the EA for the proposed Integra Extension (identified as Residence 91) as requiring negotiated agreement or acquisition should approval be granted.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. However, the monitoring data from Ashton8 TEOM are all below the criteria. The main contribution to the cumulative impacts for this period is from Ashton NEOC. However, as noted in **Section 5.2.1**, the air quality assessment for Ashton NEOC did not take into account the reactive dust management that ACOL apply to the site.

For the period 2011 to 2021, the predicted cumulative impacts are all lower than the predicted impacts for the period 2007 to 2011 and below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.5: Predicted annual average PM_{10} concentrations at Residence 34 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	29.0	29.0	29.0	29.0											
Integra South Pit	3.2	3.2	3.2	3.2											
Integra North Open Cut				0.3											
Integra Underground	0.1	0.1	0.1	0.1											
Rix's Creek	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.6					
Mt Owen	2.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		
Ravensworth East	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0							
Glendell		1.0	1.0	2.0	2.0	2.0	4.0	4.0	4.0	6.0	6.0	6.0	4.0	4.0	4.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	0.5	0.5	0.5	0.5											
Narama	0.8	0.8	0.8	0.8											
PROPOSED OPERATIONS															
Integra operations (part-pit)					3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0		
Integra operations (full-pit)					3.0	3.0	3.0	4.0	4.0	3.0	3.0	4.0	4.0		
Ashton SEOC					3.0	3.0	4.0	4.0	4.0	4.0	2.0				
Ravensworth Operations (includes Narama)					3.0	4.0	5.0	5.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*41*	*43*	*43*	*44*	*19*	*19*	*23*	*23*	*19*	*22*	*18*	*16*	*14*	*9*	*9*
Mines only cumulative (Integra full-pit)	*41*	*43*	*43*	*44*	*19*	*19*	*23*	*24*	*20*	*21*	*17*	*16*	*14*	*9*	*9*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**46**	**48**	**48**	**49**	**24**	**24**	**28**	**28**	**24**	**27**	**23**	**21**	**19**	**14**	**14**
MONITORING DATA															
Annual average PM_{10} (Ashton8)	25	25	28	23											

* Shaded shows actual modelled years

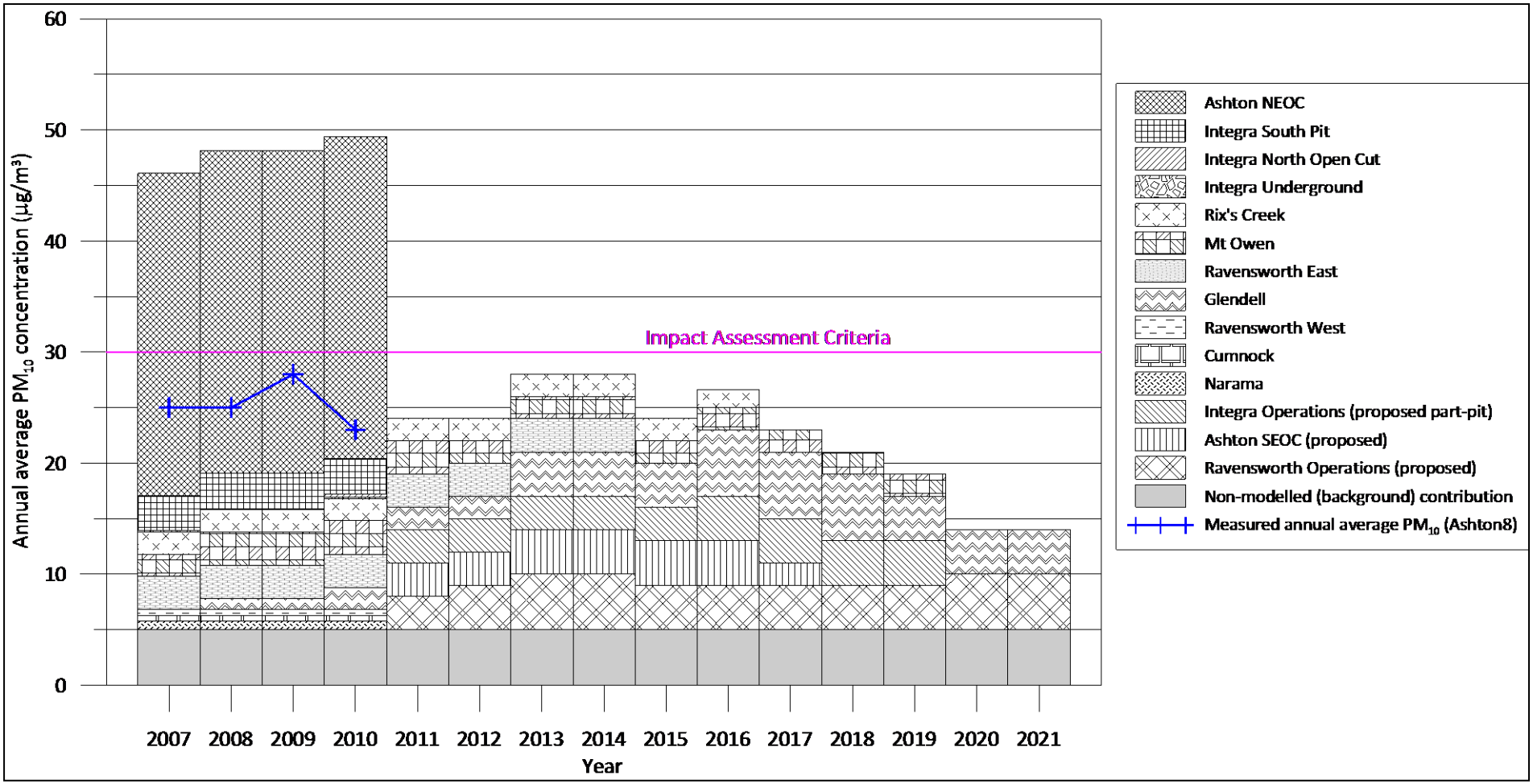

Figure 5.5: Predicted annual average PM_{10} concentrations at Residence 34 (µg/m³)

5.4.5 Residence 32 (Stapleton)

Table 5.6 and **Figure 5.6** present the predicted impacts at Residence 32 for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Ashton1 TEOM. Ashton1 TEOM is located approximately 150 m north of Residence 32.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. However, the monitoring data from Ashton1 TEOM are all below the criteria. The main contribution to the cumulative impacts for this period is from Ashton NEOC. However, as noted in **Section 5.2.1**, the air quality assessment for Ashton NEOC did not take into account the reactive dust management that ACOL apply to the site.

For the period 2011 to 2021, the predicted cumulative impacts are all lower than the predicted impacts for the period 2007 to 2011 and below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.6: Predicted annual average PM_{10} concentrations at Residence 32 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	58.0	58.0	58.0	58.0											
Integra South Pit	2.8	2.8	2.8	2.8											
Integra North Open Cut				0.3											
Integra Underground	0.1	0.1	0.1	0.1											
Rix's Creek	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.6					
Mt Owen	1.8	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0		
Ravensworth East	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0							
Glendell		1.0	1.0	1.0	1.6	2.4	3.0	4.0	5.0	6.0	5.4	4.6	4.0	4.0	4.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	0.5	0.5	0.5	0.5											
Narama	0.8	0.8	0.8	0.8											
PROPOSED OPERATIONS															
Integra operations (part-pit)					3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0		
Integra operations (full-pit)					3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0		
Ashton SEOC					3.0	4.0	5.0	5.0	4.0	3.0	2.0				
Ravensworth Operations (includes Narama)					3.0	4.0	5.0	5.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*70*	*71*	*71*	*71*	*18*	*19*	*21*	*22*	*18*	*19*	*15*	*13*	*13*	*9*	*9*
Mines only cumulative (Integra full-pit)	*70*	*71*	*71*	*71*	*18*	*19*	*21*	*23*	*19*	*19*	*15*	*13*	*13*	*9*	*9*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**75**	**76**	**76**	**76**	**23**	**24**	**26**	**27**	**23**	**24**	**20**	**18**	**18**	**14**	**14**
MONITORING DATA															
Annual average PM_{10} (Ashton8)	28	26	29	24											

* Shaded shows actual modelled years

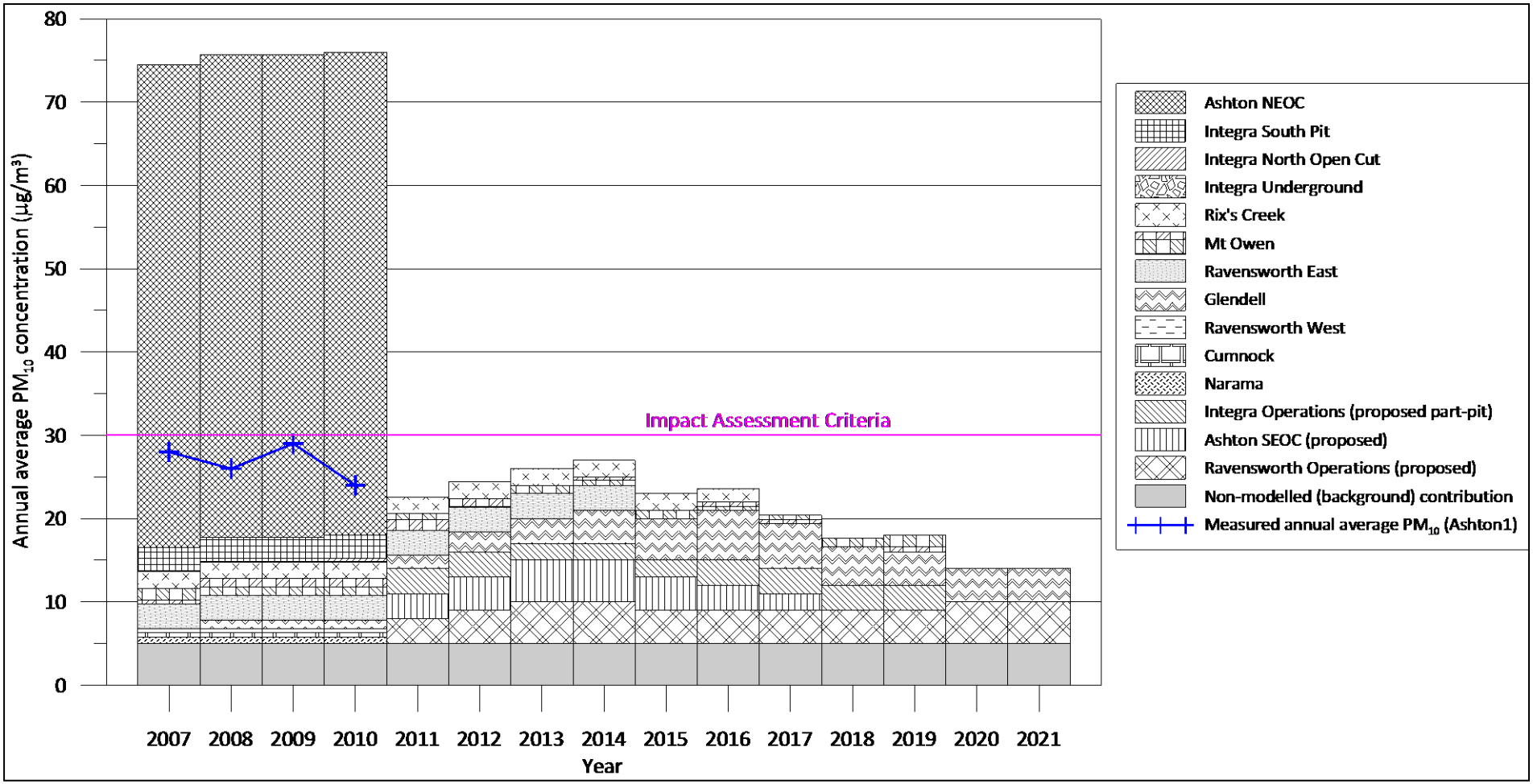

Figure 5.6: Predicted annual average PM_{10} concentrations at Residence 32 (µg/m³)

5.4.6 Residence 18 (Turner)

Table 5.7 and **Figure 5.7** present the predicted impacts at Residence 18 for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Ashton1 TEOM. Ashton1 TEOM is located approximately 450 m north of Residence 18.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. However, the monitoring data from Ashton1 TEOM are all below the criteria. The main contribution to the cumulative impacts for this period is from Ashton NEOC. However, as noted in **Section 5.2.1**, the air quality assessment for Ashton NEOC did not take into account the reactive dust management that ACOL apply to the site.

For the period 2011 to 2021, the predicted cumulative impacts are all lower than the predicted impacts for the period 2007 to 2011 and below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.7: Predicted annual average PM_{10} concentrations at Residence 18 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	37.0	37.0	37.0	37.0											
Integra South Pit	2.8	2.8	2.8	2.8											
Integra North Open Cut				0.3											
Integra Underground	0.1	0.1	0.1	0.1											
Rix's Creek	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	1.6					
Mt Owen	1.7	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0		
Ravensworth East	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0							
Glendell		1.0	1.0	1.0	1.0	1.0	3.0	4.0	5.0	5.0	5.0	5.0	3.0	3.0	3.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	1.0	1.0	1.0	1.0											
PROPOSED OPERATIONS															
Integra operations (part-pit)					3.0	3.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0		
Integra operations (full-pit)					3.0	3.0	2.0	3.0	3.0	3.0	3.0	4.0	4.0		
Ashton SEOC					4.0	4.0	5.0	5.0	5.0	4.0	2.0				
Ravensworth Operations (includes Narama)					4.0	5.0	6.0	5.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*50*	*51*	*51*	*51*	*19*	*19*	*22*	*22*	*19*	*19*	*15*	*13*	*12*	*8*	*8*
Mines only cumulative (Integra full-pit)	*50*	*51*	*51*	*51*	*19*	*19*	*22*	*23*	*20*	*19*	*15*	*14*	*13*	*8*	*8*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**55**	**56**	**56**	**56**	**24**	**24**	**27**	**27**	**24**	**24**	**20**	**18**	**17**	**13**	**13**
MONITORING DATA															
Annual average PM_{10} (Ashton1)	28	26	29	24											

* Shaded shows actual modelled years

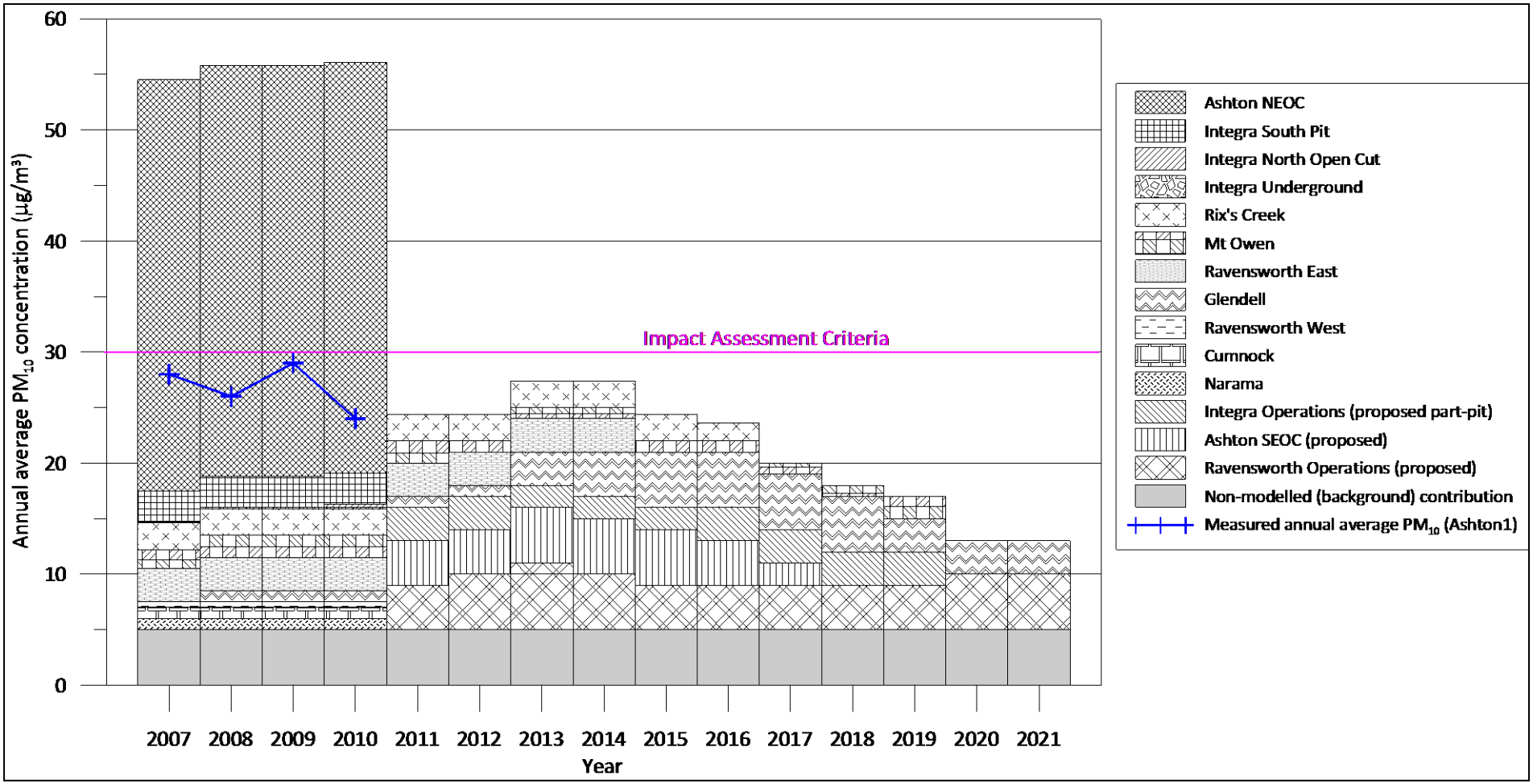

Figure 5.7: Predicted annual average PM_{10} concentrations at Residence 18 (µg/m³)

5.4.7 Residence 120 (Ernst)

Table 5.8 and **Figure 5.8** present the predicted impacts at Residence 120 for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Ashton2 TEOM. Ashton2 TEOM is located approximately 1.1 km north-west of Residence 120.

Residence 120 was identified in the EA for the proposed Ashton SEOC as requiring negotiated agreement or acquisition should approval be granted.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. However, the monitoring data from Ashton2 TEOM are all below the criteria, with a maximum measured annual PM_{10} concentration of 23 mg/m^3 in 2007. The main contribution to the cumulative impacts for this period is from Ashton NEOC. However, as noted in **Section 5.2.1**, the air quality assessment for Ashton NEOC did not take into account the reactive dust management that ACOL apply to the site.

For the period 2011 to 2014, the predicted cumulative impacts are higher than the predicted impacts for the period 2007 to 2011 and above the impact assessment criteria of 30 $\mu g/m^3$, with the main contribution from Ashton SEOC. From 2015 to 2021, the cumulative predicted impacts are all below the impact assessment criteria.

Table 5.8: Predicted annual average PM_{10} concentrations at Residence 120 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	11.0	11.0	11.0	11.0											
Integra South Pit	4.0	4.0	4.0	4.0											
Integra North Open Cut				0.4											
Integra Underground	0.1	0.1	0.1	0.1											
Rix's Creek	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2					
Mt Owen	1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0		
Ravensworth East	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0							
Glendell		1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	3.0	3.0	3.0	2.0	2.0	2.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	0.8	0.8	0.8	0.8											
PROPOSED OPERATIONS															
Integra operations (part-pit)					4.0	4.0	3.0	3.0	3.0	5.0	5.0	5.0	5.0		
Integra operations (full-pit)					4.0	4.0	3.0	4.0	4.0	4.0	4.0	5.0	5.0		
Ashton SEOC					11.0	11.0	11.0	10.0	8.0	6.0	2.0				
Ravensworth Operations (includes Narama)					3.0	4.0	5	5	4	4	4	4	4	5	5
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*24*	*26*	*26*	*26*	*26*	*27*	*28*	*27*	*22*	*23*	*16*	*14*	*13*	*7*	*7*
Mines only cumulative (Integra full-pit)	*24*	*26*	*26*	*26*	*26*	*27*	*28*	*28*	*23*	*22*	*15*	*14*	*13*	*7*	*7*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**29**	**31**	**31**	**31**	**31**	**32**	**33**	**32**	**27**	**28**	**21**	**19**	**18**	**12**	**12**
MONITORING DATA															
Annual average PM_{10} (Ashton2)	23	18	20	17											

* Shaded shows actual modelled years

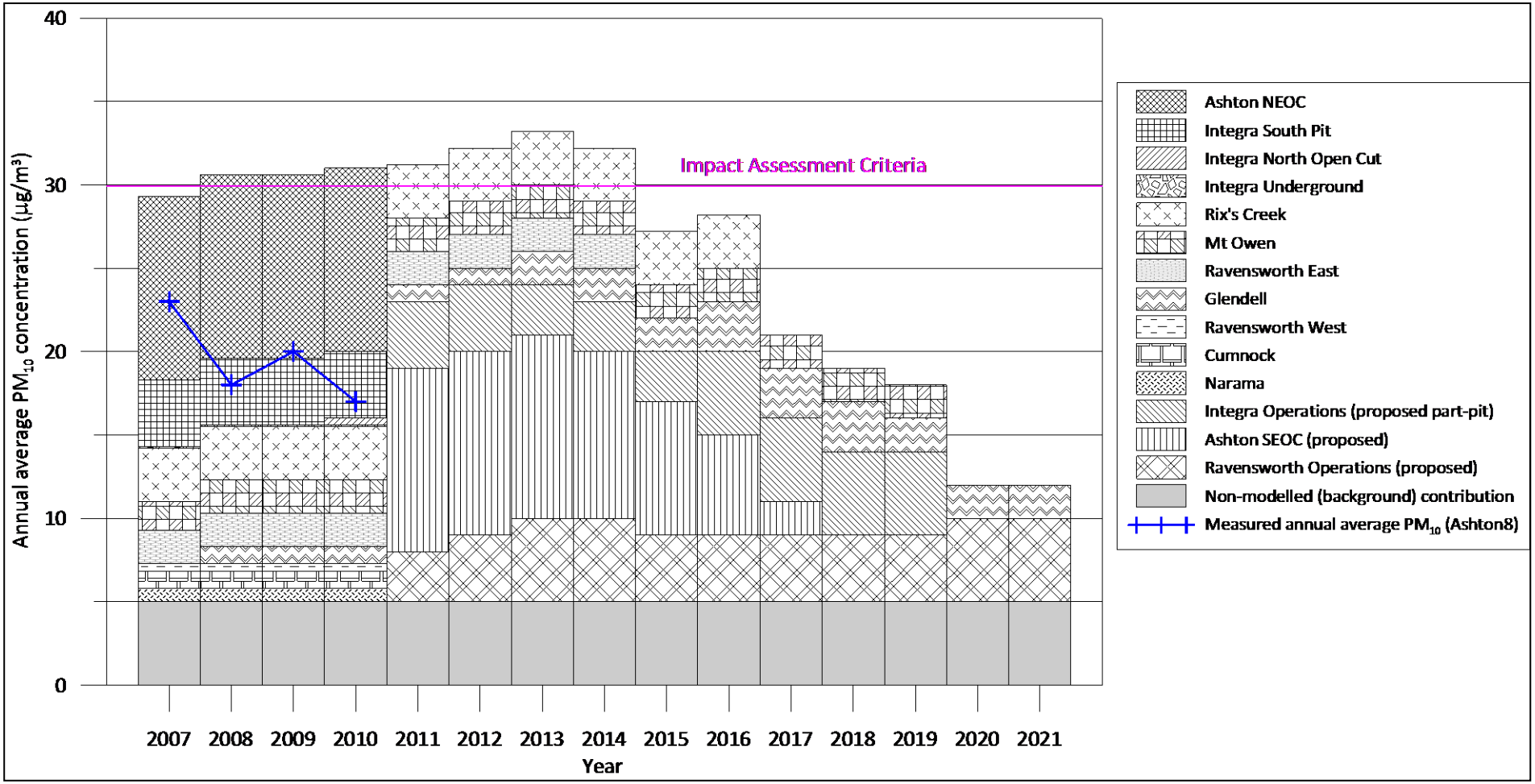

Figure 5.8: Predicted annual average PM_{10} concentrations at Residence 120 ($\mu g/m^3$)

5.4.8 Residence 81 (Hall)

Residence 81 was identified in the EA for the proposed Integra Extension (Residence 153) as requiring negotiated agreement or acquisition should approval be granted for both the Part Pit and Full Pit Extents.

5.4.8.1 Integra Proposed Part Pit

Table 5.9 and **Figure 5.9** present the predicted impacts at Residence 81 for 2007 to 2021. There are no real-time air quality monitors located within 2 km of the residence to determine the annual average PM_{10} concentrations.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. The main contribution to the cumulative impacts for this period is Integra South Pit.

For the period 2011 to 2015, the predicted cumulative impacts are similar to the predicted impacts for the period 2007 to 2011 and above the impact assessment criteria of 30 $\mu g/m^3$, with the main contribution from the proposed Integra Western Extension (Part Pit). From 2015 to 2021, the cumulative predicted impacts are all below the impact assessment criteria.

5.4.8.2 Integra Proposed Full Pit

Table 5.10 and **Figure 5.10** present the predicted impacts at Residence 81 for 2007 to 2013. There are no real-time air quality monitors located within 2 km of the residence to determine the annual average PM_{10} concentrations.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were greater than the impact assessment criteria of 30 $\mu g/m^3$. The main contribution to the cumulative impacts for this period is Integra South Pit.

For the period 2011 to 2013, the predicted cumulative impacts are similar to the predicted impacts for the period 2007 to 2011 and above the impact assessment criteria of 30 $\mu g/m^3$, with the main contribution from the proposed Integra Western Extension.

Should Integra wish to develop the Western Extension to the Full Pit Extent, Residence 81 would require acquisition in or prior to 2013, as the residence is located within the proposed open pit.

Table 5.9: Predicted annual average PM_{10} concentrations at Residence 81 – assuming Integra part pit ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	1.5	1.5	1.5	1.5											
Integra South Pit	22.0	22.0	22.0	22.0											
Integra North Open Cut				1.0											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	2.4					
Mt Owen	6.0	10.0	9.0	8.0	7.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		
Ravensworth East	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0							
Glendell		1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	0.5	0.5	0.5	0.5											
Narama	0.2	0.2	0.2	0.2											
PROPOSED OPERATIONS															
Integra operations (part-pit)					15.0	18.0	22.0	19.0	16.0	12.0	12.0	12.0	12.0		
Integra operations (full-pit)					15.0	18.0	22.0	Acquisition of property assumed							
Ashton SEOC					1.0	1.0	2.0	2.0	2.0	2.0	1.0				
Ravensworth Operations (includes Narama)					1.0	2.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*36*	*41*	*40*	*40*	*30*	*33*	*40*	*37*	*31*	*26*	*23*	*22*	*21*	*4*	*4*
Mines only cumulative (Integra full-pit)	*36*	*41*	*40*	*40*	*30*	*33*	*40*								
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**41**	**46**	**45**	**45**	**35**	**38**	**45**	**42**	**36**	**31**	**28**	**27**	**26**	**9**	**9**
MONITORING DATA															
No representative monitoring data available															

* Shaded shows actual modelled years

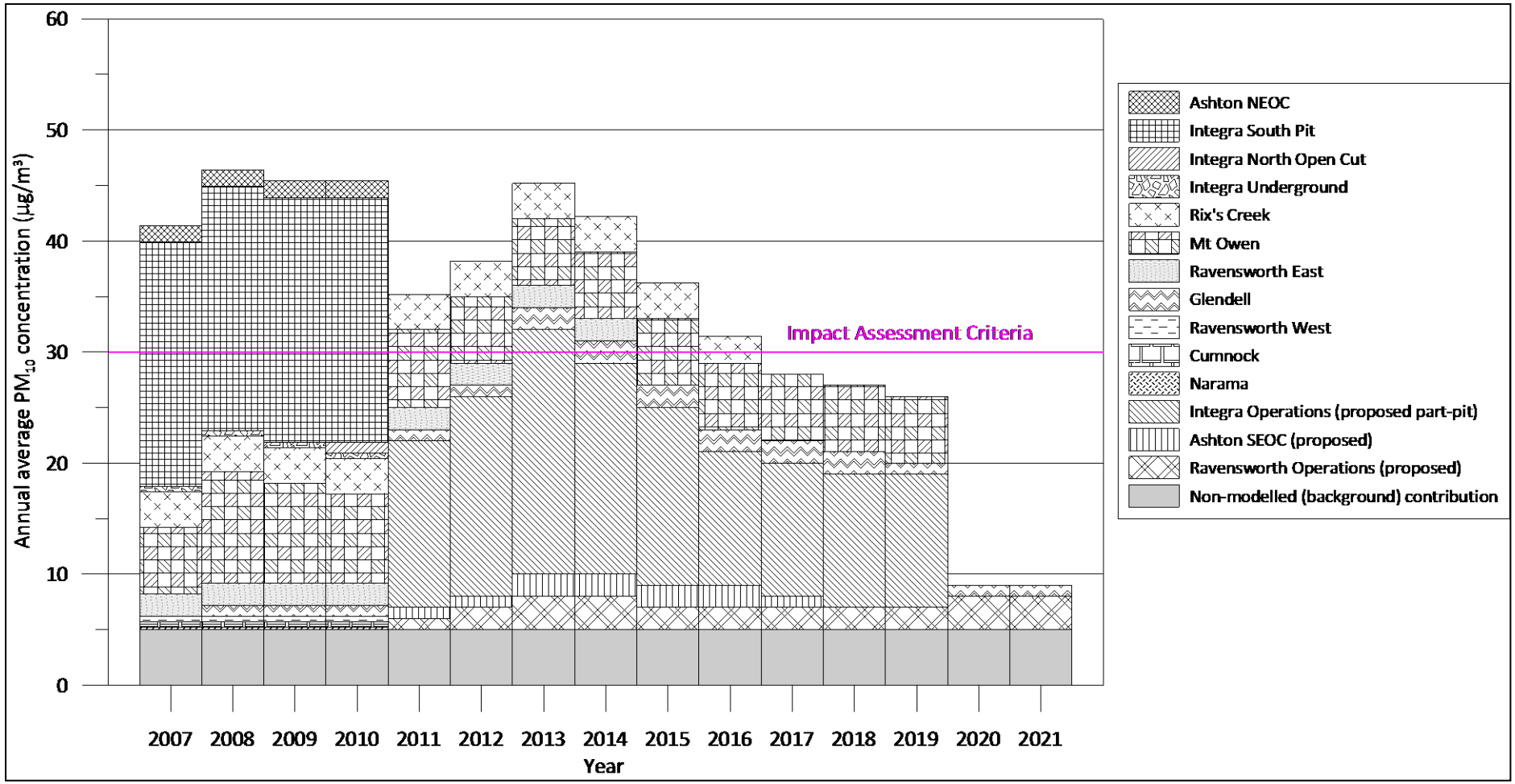

Figure 5.9: Predicted annual average PM_{10} concentrations at Residence 81 – assuming Integra part pit ($\mu g/m^3$)

Table 5.10: Predicted annual average PM_{10} concentrations at Residence 81 – assuming Integra full pit ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	1.5	1.5	1.5	1.5											
Integra South Pit	22.0	22.0	22.0	22.0											
Integra North Open Cut				1.0											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	3.2	3.2	3.2	3.2	3.2	3.2	3.2								
Mt Owen	6.0	10.0	9.0	8.0	7.0	6.0	6.0								
Ravensworth East	2.0	2.0	2.0	2.0	2.0	2.0	2.0								
Glendell		1.0	1.0	1.0	1.0	1.0	2.0								
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	0.5	0.5	0.5	0.5											
Narama	0.2	0.2	0.2	0.2											
PROPOSED OPERATIONS															
Integra operations (part-pit)					15.0	18.0	22.0								
Integra operations (full-pit)					15.0	18.0	22.0								
Ashton SEOC					1.0	1.0	2.0								
Ravensworth Operations (includes Narama)					1.0	2.0	3.0								
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*36*	*41*	*40*	*40*	*30*	*33*	*40*								
Mines only cumulative (Integra full-pit)	*36*	*41*	*40*	*40*	*30*	*33*	*40*								
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0								
Total predicted annual average PM_{10} (Integra part-pit)	**41**	**46**	**45**	**45**	**35**	**38**	**45**								
MONITORING DATA															
No representative monitoring data available															

Acquisition of property assumed

Acquisition of property assumed

* Shaded shows actual modelled years

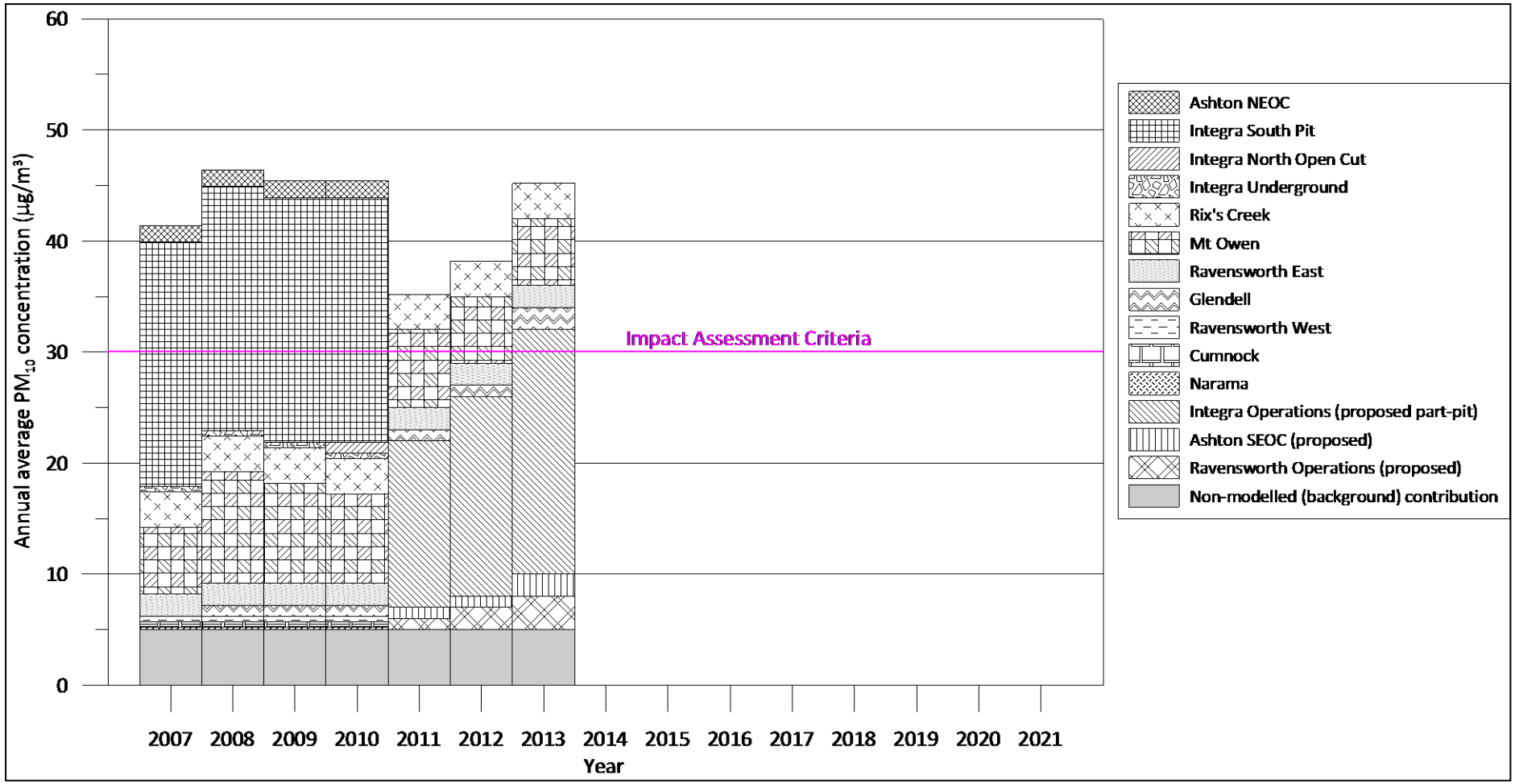

Figure 5.10: Predicted annual average PM_{10} concentrations at Residence 81 – assuming Integra full pit ($\mu g/m^3$)

5.4.9 Residence 101a (Donnellan)

Table 5.11 and **Figure 5.11** present the predicted impacts at Residence 101a for 2007 to 2021, compared with the annual average PM_{10} concentrations for 2007 to May 2010 collected at Glendell3 TEOM. Glendell3 TEOM is located approximately 500 m south-west of Residence 101a.

The data show that the predicted cumulative impacts for the period 2007 to 2010 were below the impact assessment criteria of 30 $\mu g/m^3$. The monitoring data from Glendell3 TEOM are all below the criteria. The main contribution to the cumulative impacts for this period is from Mt Owen.

For the period 2011 to 2021, the predicted cumulative impacts are all below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.11: Predicted annual average PM_{10} concentrations at Residence 101a ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	0.5	0.5	0.5	0.5											
Integra South Pit	4.0	4.0	4.0	4.0											
Integra North Open Cut				1.0											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4					
Mt Owen	12.0	12.0	11.0	10.0	9.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0		
Ravensworth East	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0							
Glendell		1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	-	-	-	-											
PROPOSED OPERATIONS															
Integra operations (part-pit)					4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		
Integra operations (full-pit)					4.0	4.0	4.0	7.0	6.5	6.0	5.0	4.0			
Ashton SEOC					0.3	0.5	1.0	1.0	1.0	0.5	0.3				
Ravensworth Operations (includes Narama)					0.5	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*24*	*25*	*24*	*24*	*20*	*20*	*22*	*22*	*17*	*17*	*16*	*16*	*16*	*4*	*4*
Mines only cumulative (Integra full-pit)	*24*	*25*	*24*	*24*	*20*	*20*	*22*	*25*	*20*	*19*	*17*	*16*	*12*	*4*	*4*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**29**	**30**	**29**	**29**	**25**	**25**	**27**	**27**	**22**	**22**	**21**	**21**	**21**	**9**	**9**
MONITORING DATA															
Annual average PM_{10} (Glendell3)	23	21	27	21											

* Shaded shows actual modelled years

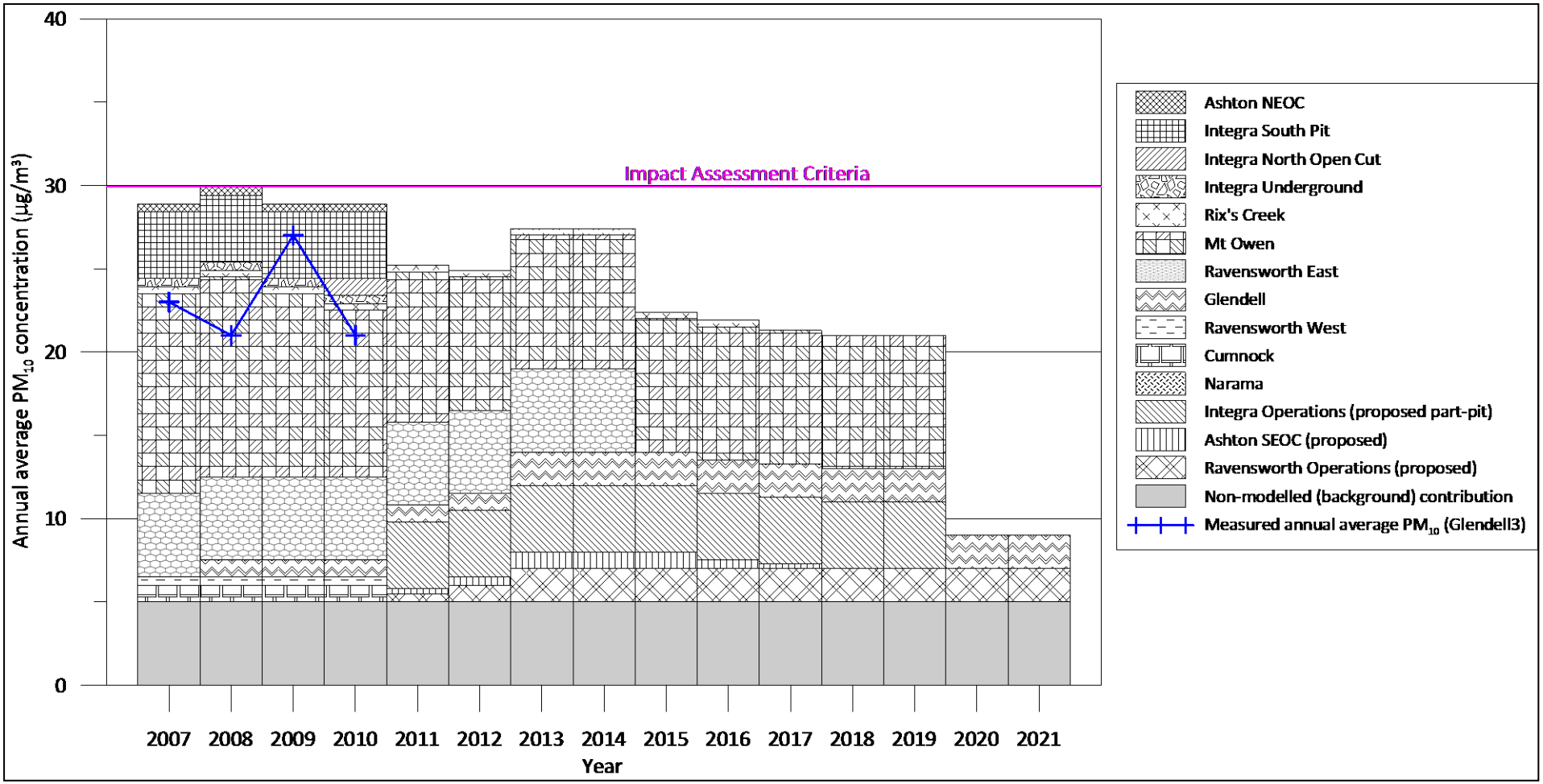

Figure 5.11: Predicted annual average PM_{10} concentrations at Residence 101a ($\mu g/m^3$)

5.4.10 Residence 129 (W Bowman)

Table 5.12 and **Figure 5.12** present the predicted impacts at Residence 129 for 2007 to 2021. There are no air quality monitors historically located within 2 km of the residence to determine the annual average PM_{10} concentrations.

Residence 129 was identified in the EA for the proposed Ashton SEOC as requiring negotiated agreement or acquisition should approval be granted.

The data show that all predicted cumulative impacts for the period 2007 to 2010 were below the impact assessment criteria of 30 $\mu g/m^3$.

For the period 2011 to 2012, the predicted cumulative impacts are lower than the impact assessment criteria, however, should Ashton SEOC and Ravensworth Operations applications be approved, the cumulative predicted impacts for 2013 and 2014 are above the assessment criteria due primarily to the impacts from these operations.

Should consent be granted to ACOL for the proposed Ashton SEOC to proceed, Residence 129 would require acquisition, as the residence would be located within the proposed open pit.

Table 5.12: Predicted annual average PM_{10} concentrations at Residence 129 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	10.0	10.0	10.0	10.0					Acquisition of property assumed						
Integra South Pit	2.0	2.0	2.0	2.0											
Integra North Open Cut				0.3											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4							
Mt Owen	1.0	1.5	1.5	1.5	1.5	1.0	1.0	1.0							
Ravensworth East	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0							
Glendell		-	-	1.0	1.0	1.0	1.0	1.0							
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	2.0	2.0	2.0	2.0											
PROPOSED OPERATIONS															
Integra operations (part-pit)					2.0	2.0	1.0	1.0	Acquisition of property assumed						
Integra operations (full-pit)					2.0	2.0	1.0	2.0							
Ashton SEOC					1.0	6.0	12.0	12.0							
Ravensworth Operations (includes Narama)							10.0	10.0							
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*21*	*22*	*22*	*23*	*10*	*14*	*29*	*29*							
Mines only cumulative (Integra full-pit)	*21*	*22*	*22*	*23*	*10*	*14*	*29*	*30*							
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0							
Total predicted annual average PM_{10} (Integra part-pit)	**26**	**27**	**27**	**28**	**15**	**19**	**34**	**34**							
MONITORING DATA															
No representative monitoring data available															

* Shaded shows actual modelled years

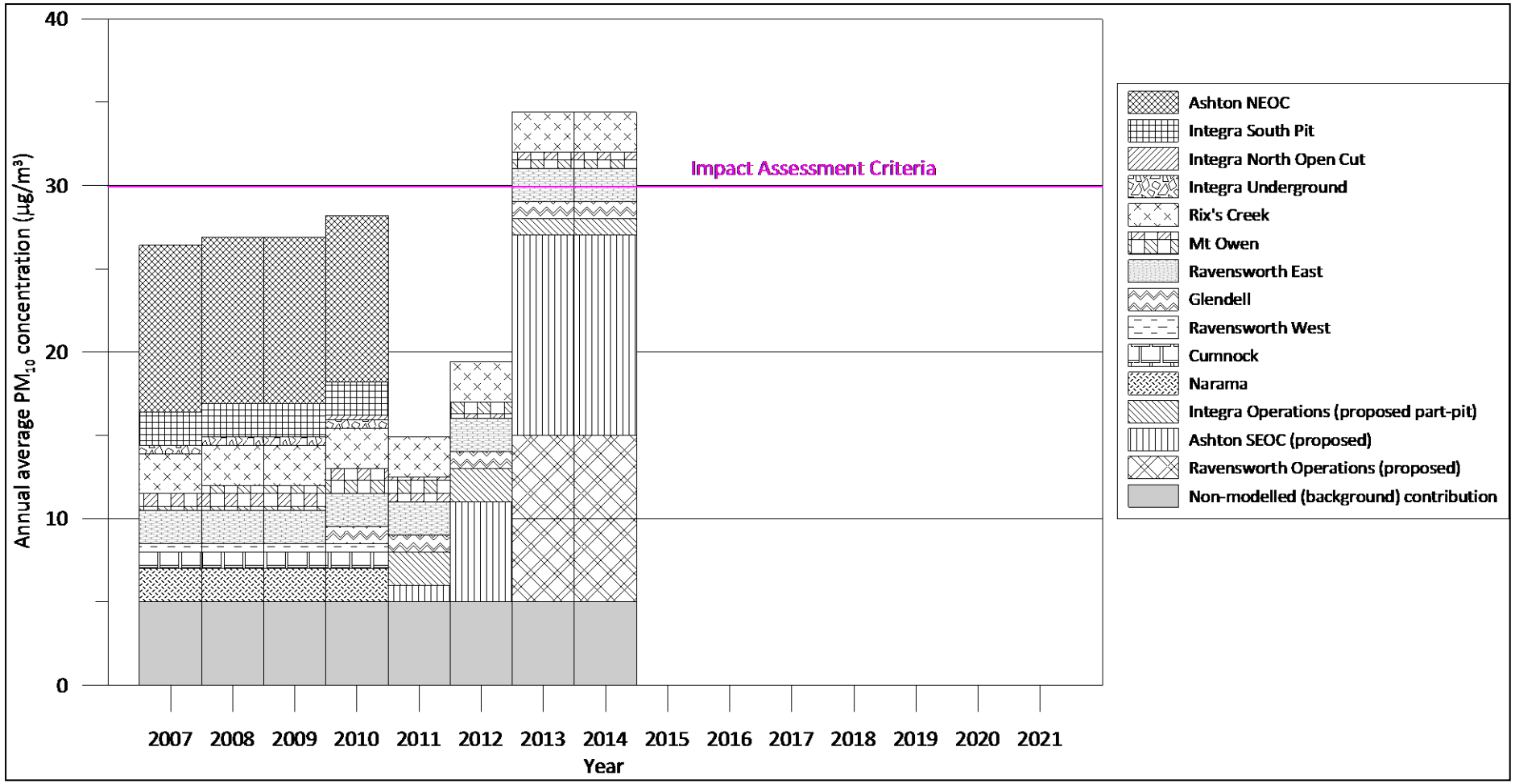

Figure 5.12: Predicted annual average PM_{10} concentrations at Residence 129 ($\mu g/m^3$)

5.4.11 Residence 130a (A Bowman)

Table 5.13 and **Figure 5.13** present the predicted impacts at Residence 130a for 2007 to 2021. There are no air quality monitors historically located within 2km of the residence to determine the annual average PM_{10} concentrations.

Residence 130a was identified in the EA for the proposed Ashton SEOC as requiring negotiated agreement or acquisition should approval be granted.

The data show that all predicted cumulative impacts for the period 2007 to 2010 were below the impact assessment criteria of 30 $\mu g/m^3$.

For the period 2011 to 2013, the predicted cumulative impacts are lower than the impact assessment criteria, however, should Ashton SEOC and Ravensworth Operations applications be approved, the cumulative predicted impacts for 2014 to 2017 are above the assessment criteria due primarily to the impacts from these operations.

For the period 2018 to 2021, the cumulative predicted impacts are all below the impact assessment criteria.

Table 5.13: Predicted annual average PM_{10} concentrations at Residence 130a ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	4.0	4.0	4.0	4.0											
Integra South Pit	-	-	-	-											
Integra North Open Cut				0.3											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.2	1.0					
Mt Owen	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
Ravensworth East	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0							
Glendell		0.5	0.5	0.5	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	3.0	3.0	3.0	3.0											
PROPOSED OPERATIONS															
Integra operations (part-pit)					1.0	1.0	1.0	1.0	1.5	2.0					
Integra operations (full-pit)					1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0			
Ashton SEOC					1.0	3.0	5.0	10.0	15.0	17.0	20.0				
Ravensworth Operations (includes Narama)							13.0	13.0	7.0	8.0	9.0	9.0	10.0	10.0	10.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*13*	*14*	*14*	*14*	*7*	*9*	*25*	*30*	*27*	*30*	*31*	*11*	*12*	*11*	*11*
Mines only cumulative (Integra full-pit)	*13*	*14*	*14*	*14*	*7*	*9*	*25*	*31*	*27*	*30*	*33*	*13*	*12*	*11*	*11*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**18**	**19**	**19**	**19**	**12**	**14**	**30**	**35**	**32**	**35**	**36**	**16**	**17**	**16**	**16**
MONITORING DATA															
No representative monitoring data available															

* Shaded shows actual modelled years

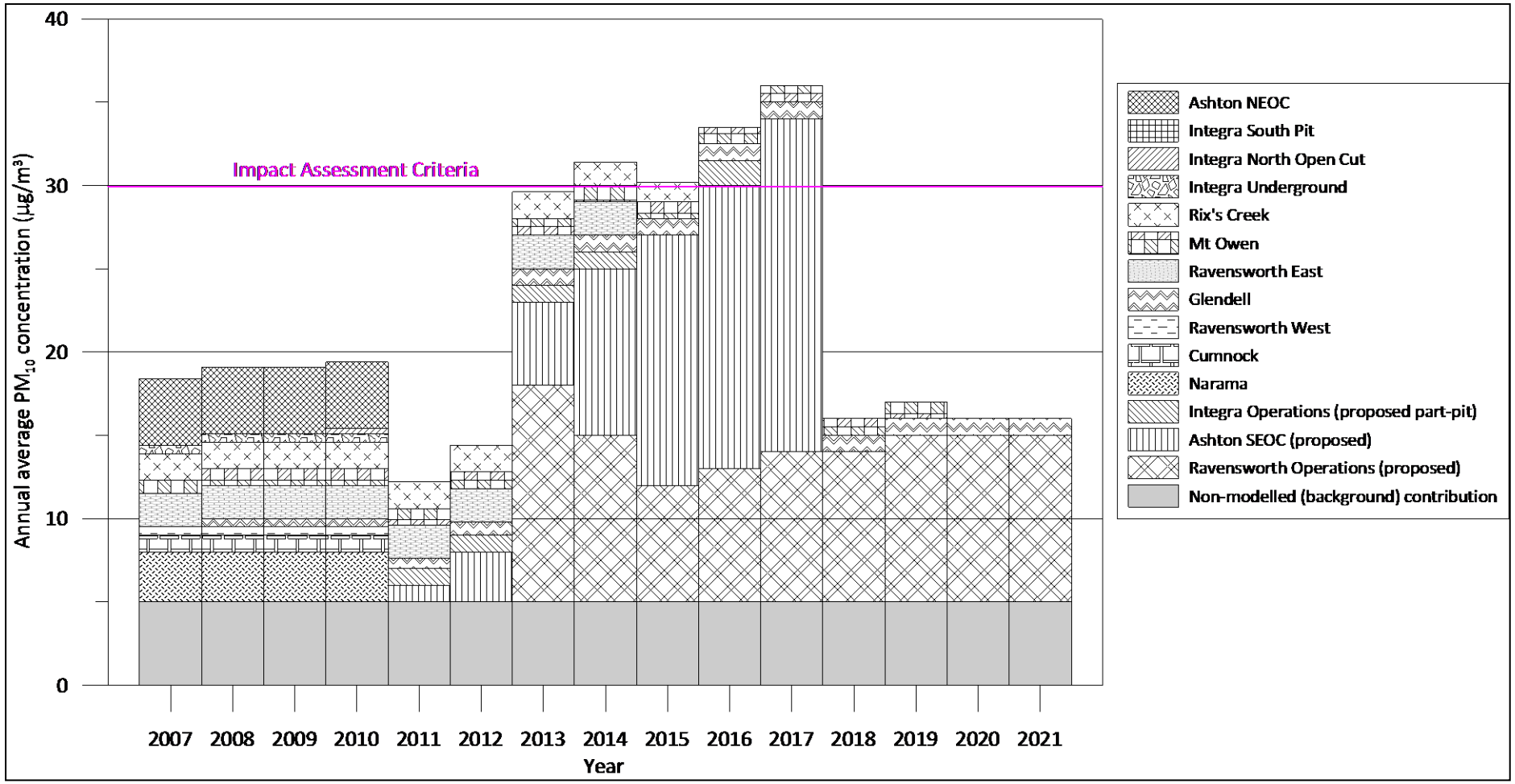

Figure 5.13: Predicted annual average PM_{10} concentrations at Residence 130a ($\mu g/m^3$)

5.4.12 Residence 130b (A Bowman)

Table 5.14 and **Figure 5.14** present the predicted impacts at Residence 130b for 2007 to 2021. There are no air quality monitors located within 2 km of the residence to determine the annual average PM_{10} concentrations.

The data show that all predicted cumulative impacts for the period 2007 to 2021 are below the impact assessment criteria of 30 $\mu g/m^3$.

Table 5.14: Predicted annual average PM_{10} concentrations at Residence 130b ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	2.0	2.0	2.0	2.0											
Integra South Pit	-	-	-	-											
Integra North Open Cut				-											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.2					
Mt Owen	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
Ravensworth East	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0							
Glendell		-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	2.0	2.0	2.0	2.0											
PROPOSED OPERATIONS															
Integra operations (part-pit)					1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0		
Integra operations (full-pit)					1.0	1.0	1.0	2.0		1.0		2.0			
Ashton SEOC					-	-	1.0	1.0	1.0	1.0	-				
Ravensworth Operations (includes Narama)					3.0	6.0	11.0	11.0	6.0	6.0	6.0	6.0	6.0	9.0	9.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*9*	*10*	*10*	*10*	*8*	*11*	*18*	*18*	*12*	*12*	*10*	*10*	*10*	*10*	*10*
Mines only cumulative (Integra full-pit)	*9*	*10*	*10*	*10*	*8*	*11*	*18*	*19*	*11*	*11*	*8*	*10*	*8*	*10*	*10*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10} (Integra part-pit)	**14**	**15**	**15**	**15**	**13**	**16**	**23**	**23**	**17**	**17**	**15**	**15**	**15**	**15**	**15**
MONITORING DATA															
No representative monitoring data available															

* Shaded shows actual modelled years

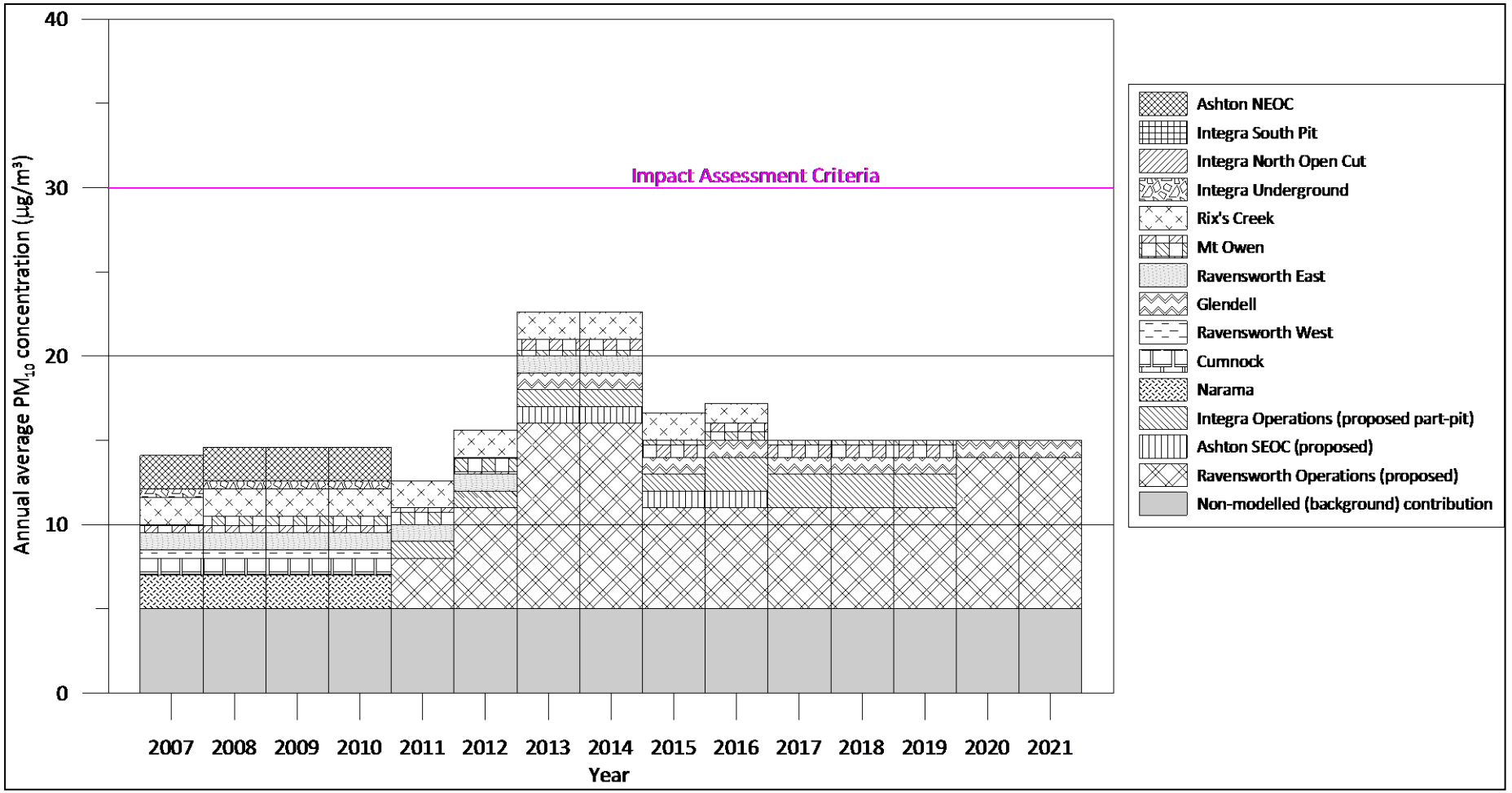

Figure 5.14: Predicted annual average PM_{10} concentrations at Residence 130b ($\mu g/m^3$)

5.4.13 Residence Ravops34 (B & D Stapleton)

Table 5.14 and **Figure 5.15** present the predicted impacts at Residence RavOps34 for 2007 to 2021. The monitoring data collected at this residence is conducted by mines not included in this study, and hence are not available to determine the annual average PM_{10} concentrations.

Residence RavOps34 was identified in the EA for the proposed Ravensworth Operations as requiring negotiated agreement or acquisition should approval be granted.

Due to the location of the residence RavOps34 outside the focal area of this study, and its proximity to other mining operations that have not been considered (for example Hunter Valley Operations), the assessment for RavOps34 is considered to be an under-estimation of the cumulative air quality impacts likely to be experienced at this location. Ravensworth Operations have committed to a negotiated agreement or acquisition of this residence should approval be granted.

Table 5.15: Predicted annual average PM_{10} concentrations at Residence RavOps34 ($\mu g/m^3$)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
APPROVED OPERATIONS															
Ashton NEOC	1.0	1.0	1.0	1.0											
Integra South Pit	-	-	-	-											
Integra North Open Cut				-											
Integra Underground	0.5	0.5	0.5	0.5											
Rix's Creek	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4					
Mt Owen	0.5	1.0	1.0	1.0	1.0	-	-	-	-	-	-	-	-		
Ravensworth East	-	-	-	-	-	-	-	-							
Glendell		-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Ravensworth West	0.5	0.5	0.5	0.5											
Cumnock	1.0	1.0	1.0	1.0											
Narama	3.0	3.0	3.0	3.0											
PROPOSED OPERATIONS															
Integra operations (part-pit)					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
Integra operations (full-pit)					1.0	1.0	1.0	1.0		1.0		1.0			
Ashton SEOC					1.0	1.0	3.0	3.0	4.0	4.0	2.0				
Ravensworth Operations (includes Narama)					10.0	16.0	21.0	17.0	13.0	14.0	16.0	18.0	20.0	22.0	22.0
CUMULATIVE IMPACTS															
Mines only cumulative (Integra part-pit)	*7*	*7*	*7*	*7*	*13*	*18*	*26*	*22*	*19*	*20*	*20*	*20*	*22*	*23*	*23*
Mines only cumulative (Integra full-pit)	*7*	*7*	*7*	*7*	*13*	*18*	*26*	*22*	*18*	*20*	*19*	*20*	*21*	*23*	*23*
Assumed "background"	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Total predicted annual average PM_{10}	**12**	**12**	**12**	**12**	**18**	**23**	**31**	**27**	**24**	**25**	**25**	**25**	**27**	**28**	**28**
MONITORING DATA															
No representative monitoring data available															

* Shaded shows actual modelled years

** **NB:** Due to the location of the residence RavOps34 outside the focal area of this study, and its proximity to other mining operations that have not been considered (for example Hunter Valley Operations), the assessment for RavOps34 is considered to be an under-estimation of the cumulative air quality impacts likely to be experienced at this location. Ravensworth Operations have committed to a negotiated agreement or acquisition of this residence should approval be granted.

Due to the location of the residence RavOps34 outside the focal area of this study, and its proximity to other mining operations that have not been considered (for example Hunter Valley Operations), the assessment for RavOps34 is considered to be an under-estimation of the cumulative air quality impacts likely to be experienced at this location. Ravensworth Operations have committed to a negotiated agreement or acquisition of this residence should approval be granted.

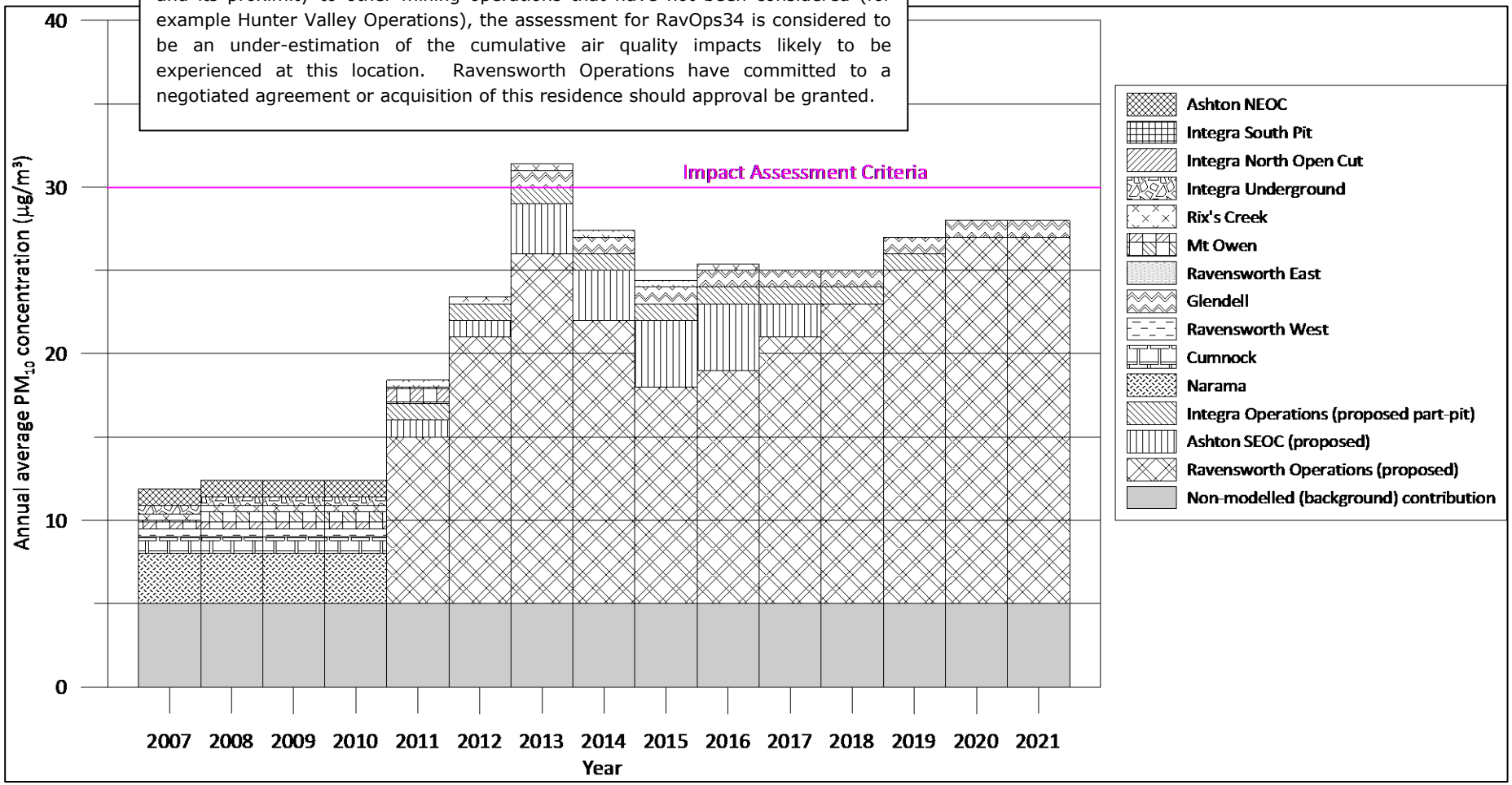

Figure 5.15: Predicted annual average PM_{10} concentrations at Residence RavOps34 ($\mu g/m^3$)

6 REFERENCES

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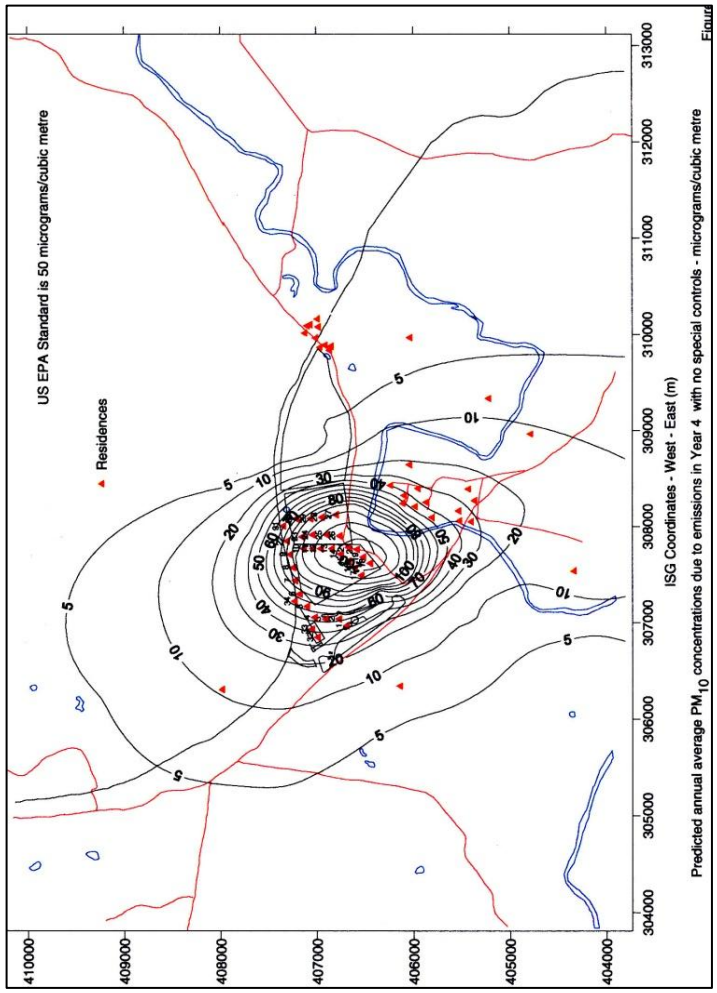
Appendix A: Contour plots



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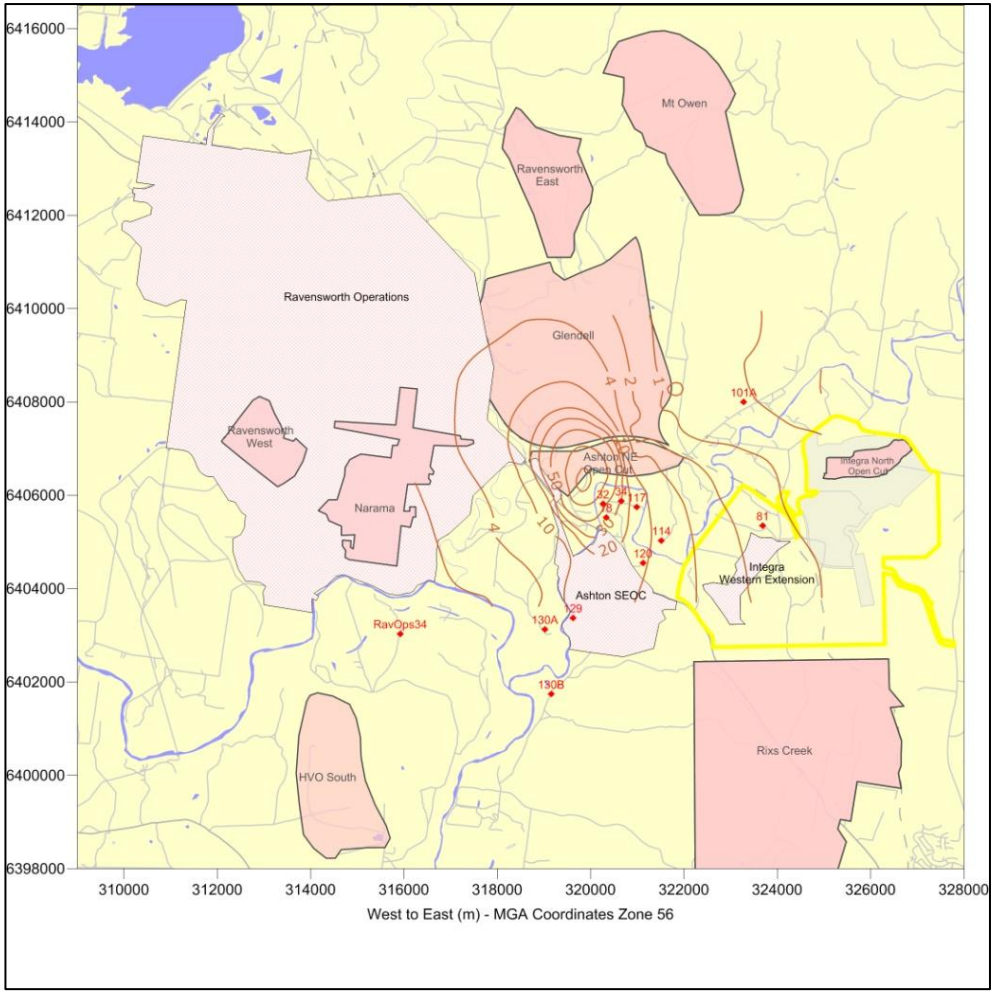

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Figure A.1: Ashton North East Open Cut (NEOC) – annual average PM_{10} concentration – Year 4 (2007) ($\mu g/m^3$)

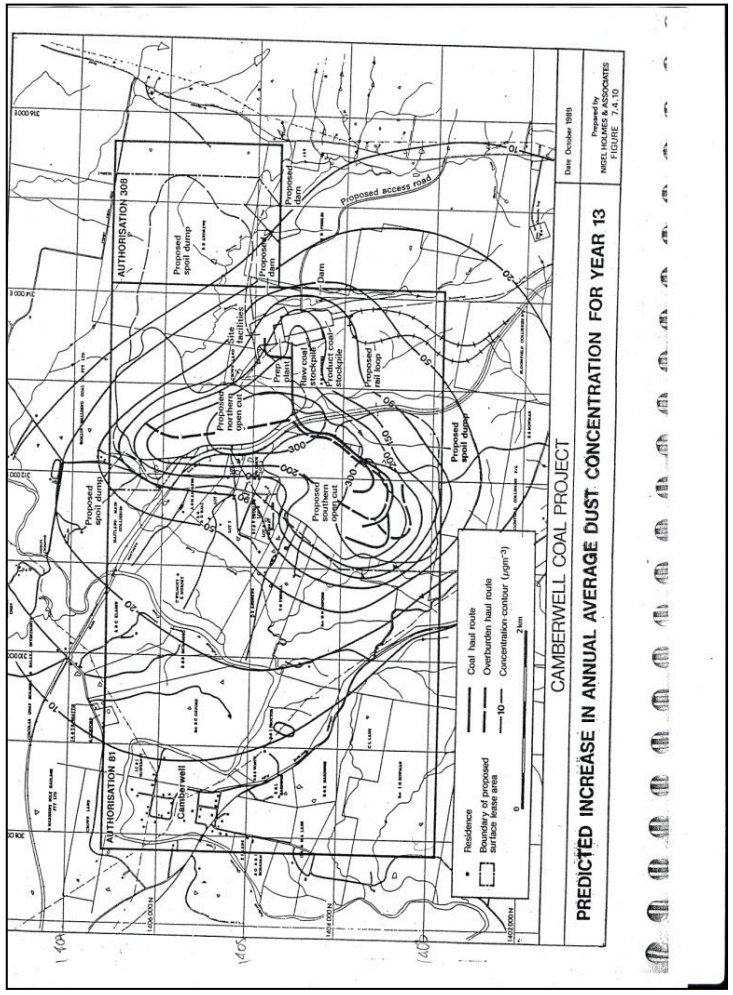

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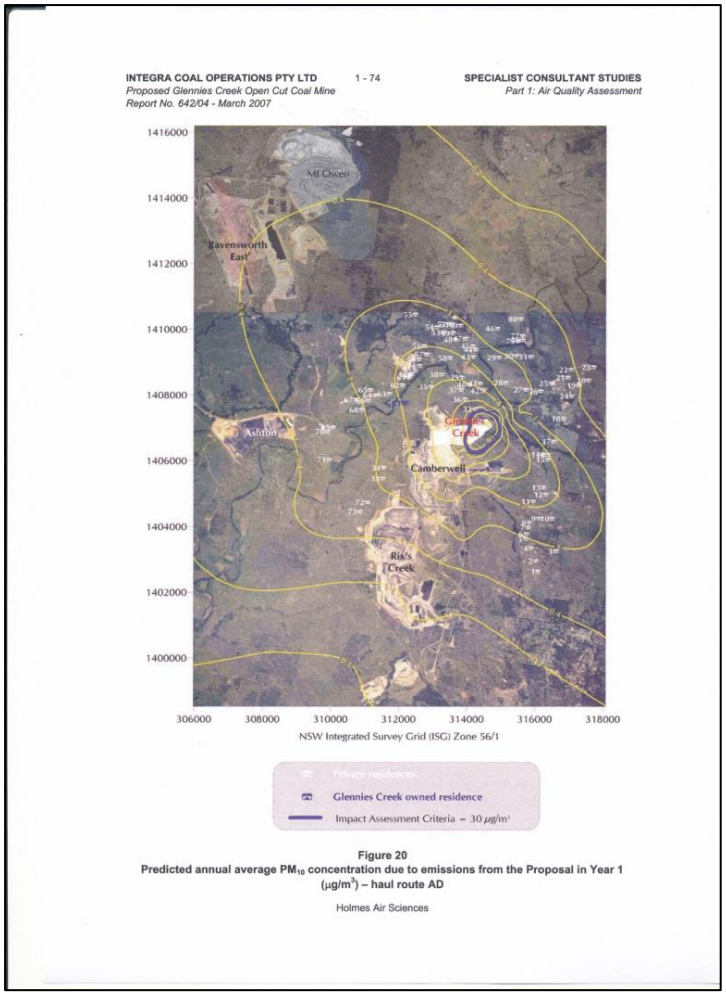
Figure A.2: Integra South Pit – annual average TSP concentration – Year 13 (2002) (µg/m^3)



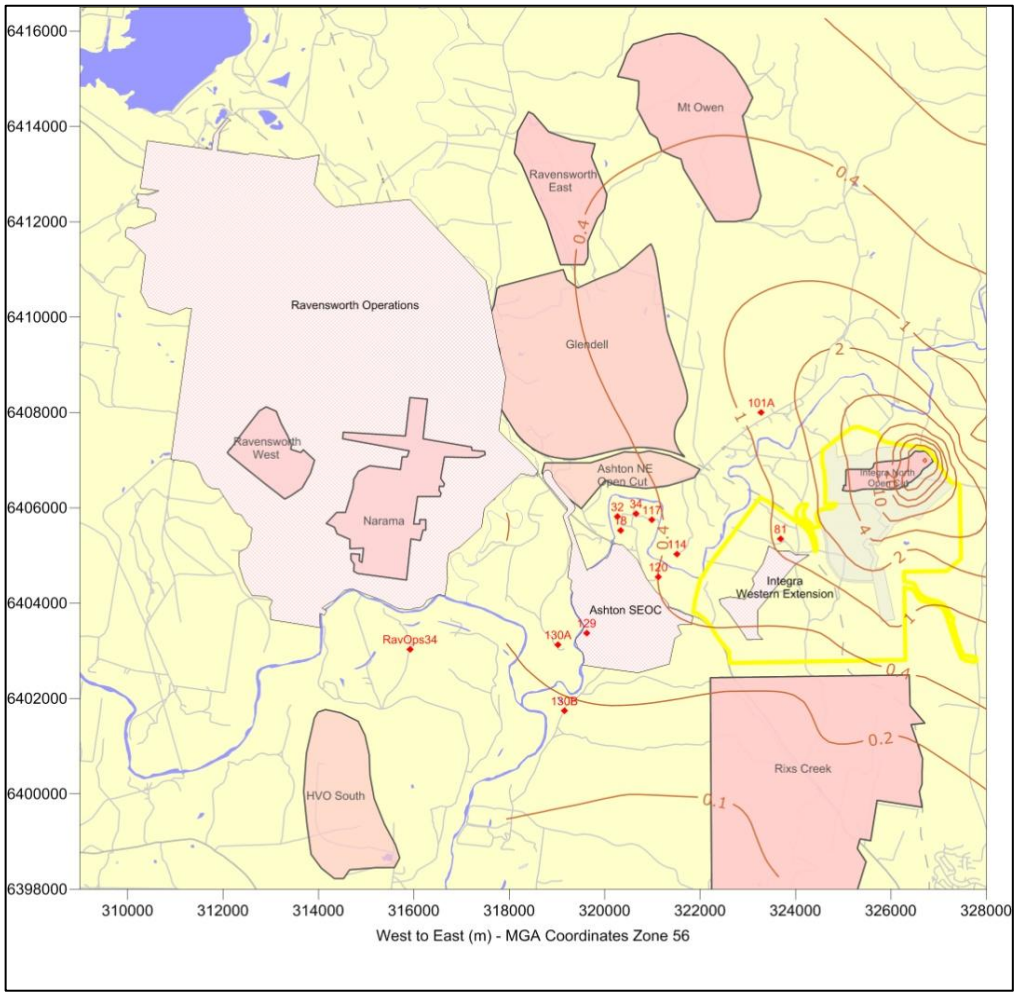


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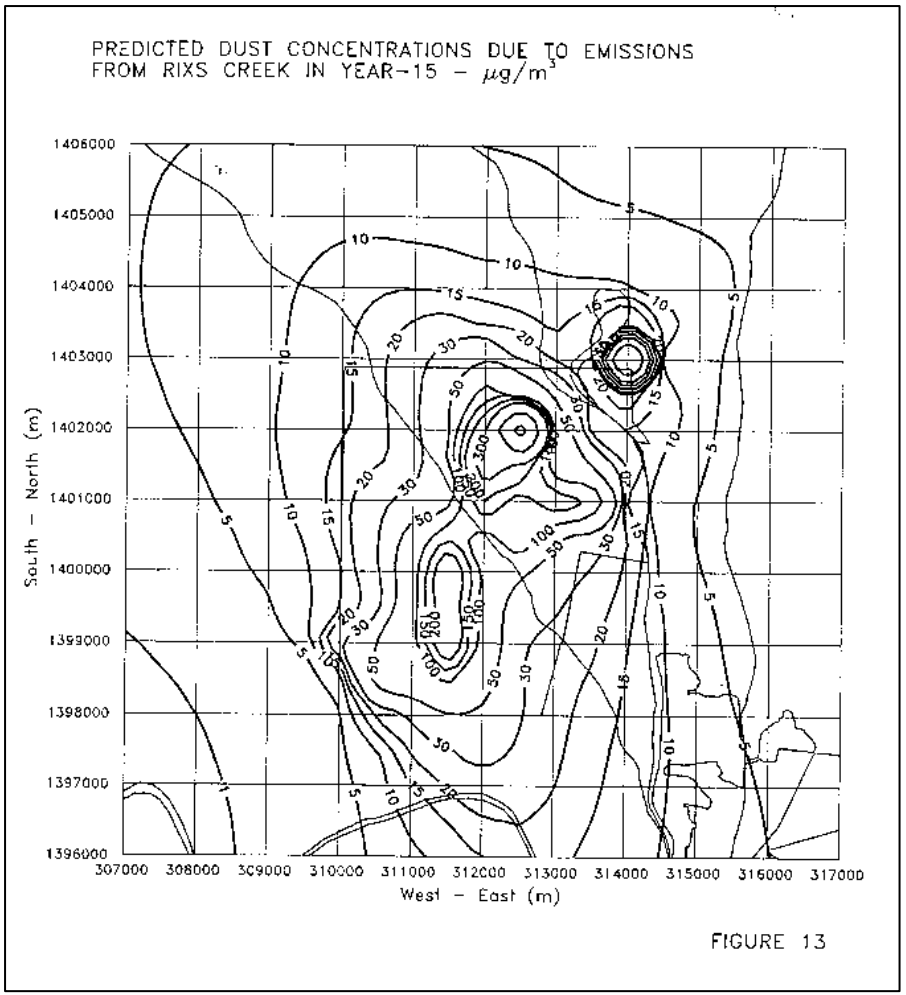
Figure A.3: Integra North Open Cut (NOC) – Route AD – annual average PM_{10} concentration – Year 1 (2010) (µg/m³)



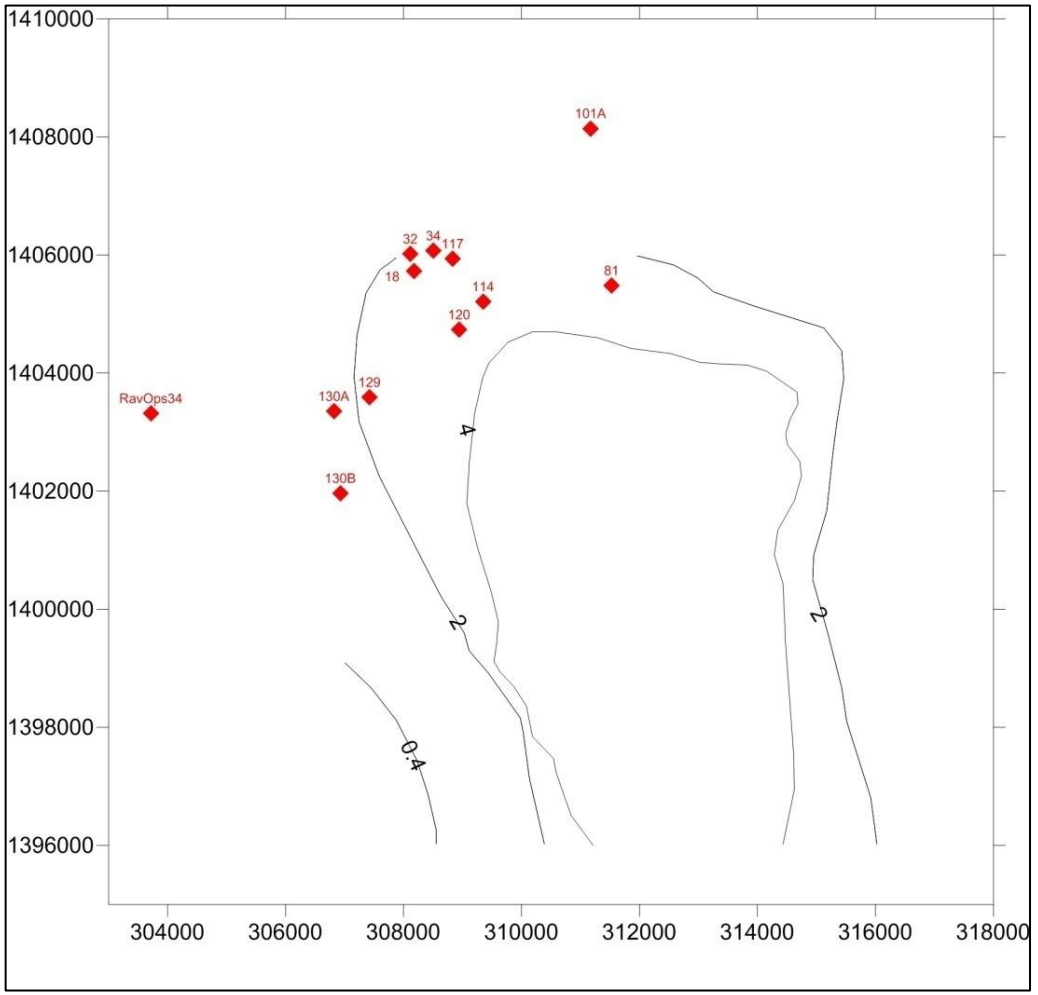


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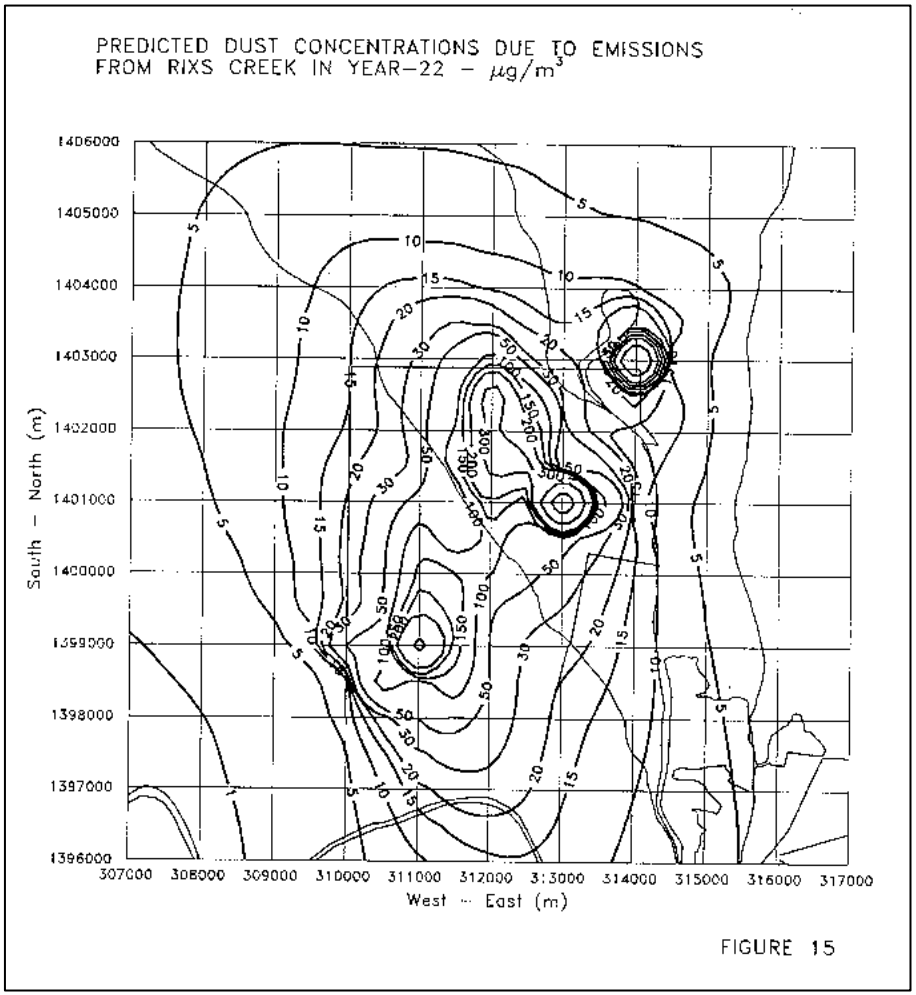
Figure A.4: Rix's Creek – annual average TSP concentration – Year 15 (2009) (µg/m³)



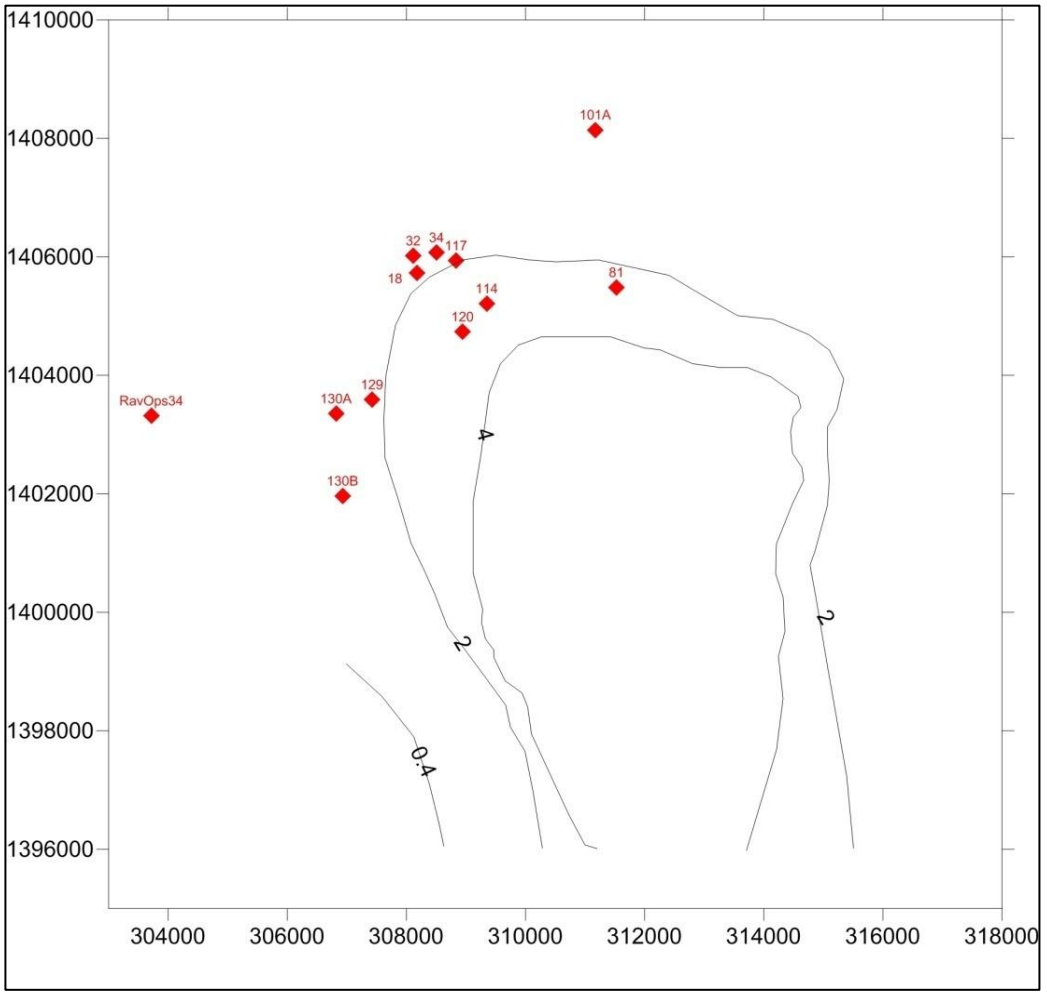


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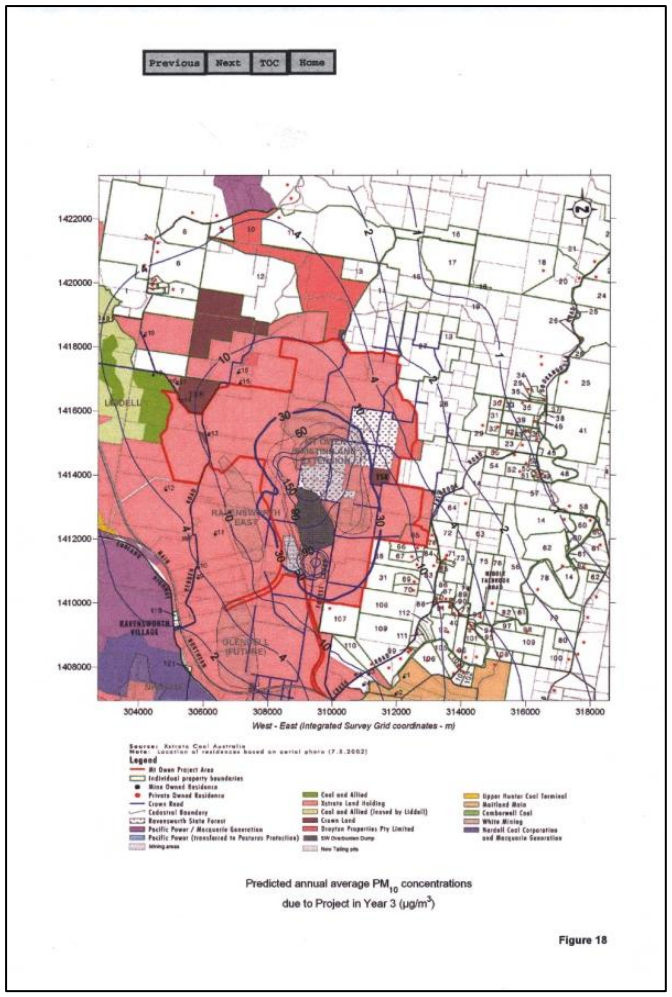
Figure A.5: Rix's Creek – annual average TSP concentration – Year 22 (2016) (µg/m³)



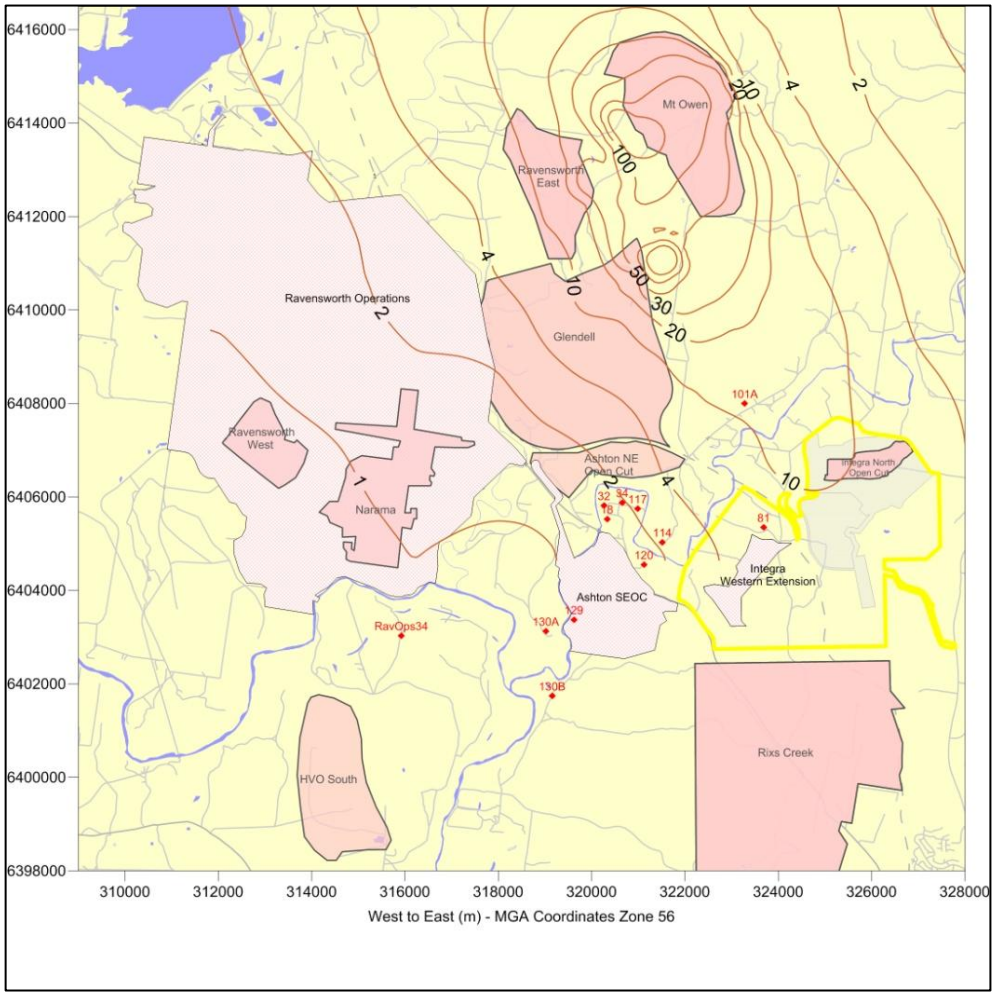


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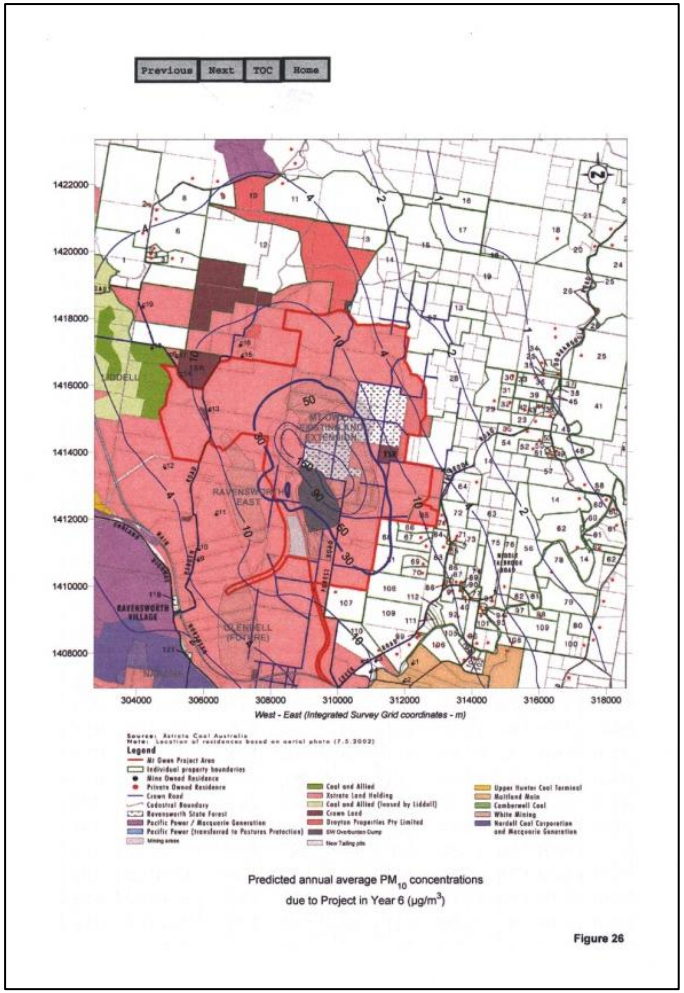
Figure A.6: Mt Owen – annual average PM_{10} concentration – Year 3 (2005) ($\mu g/m^3$)



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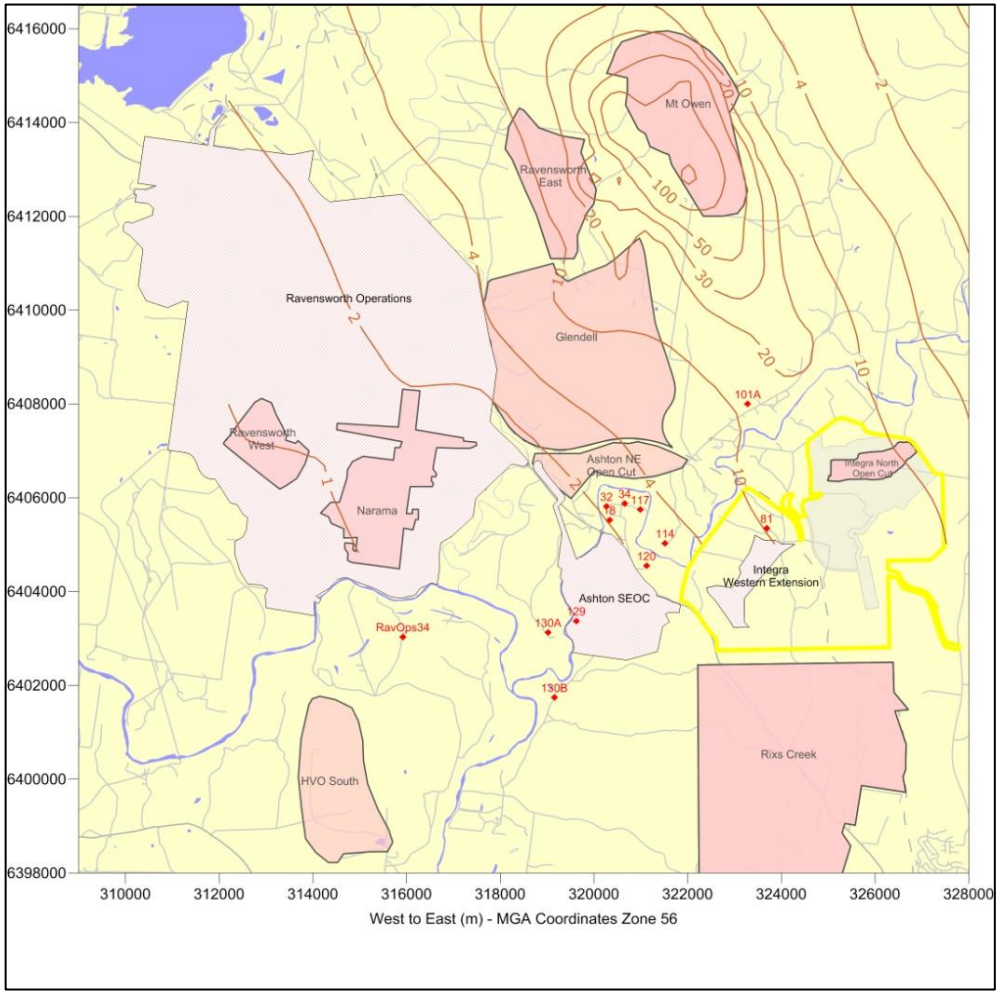

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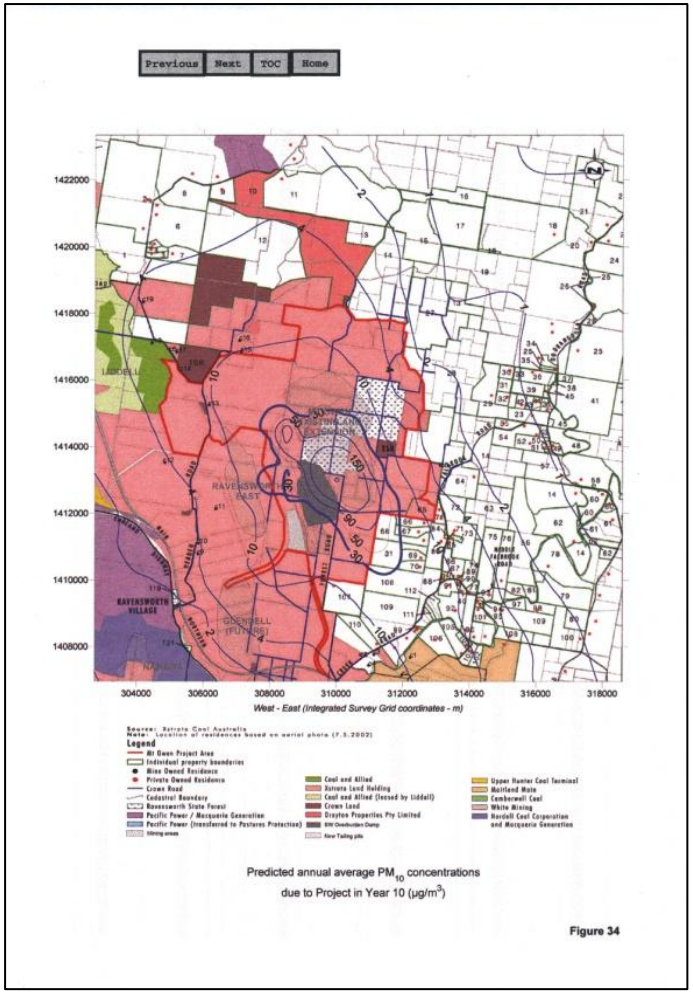
Figure A.7: Mt Owen – annual average PM_{10} concentration – Year 6 (2008) (µg/m³)



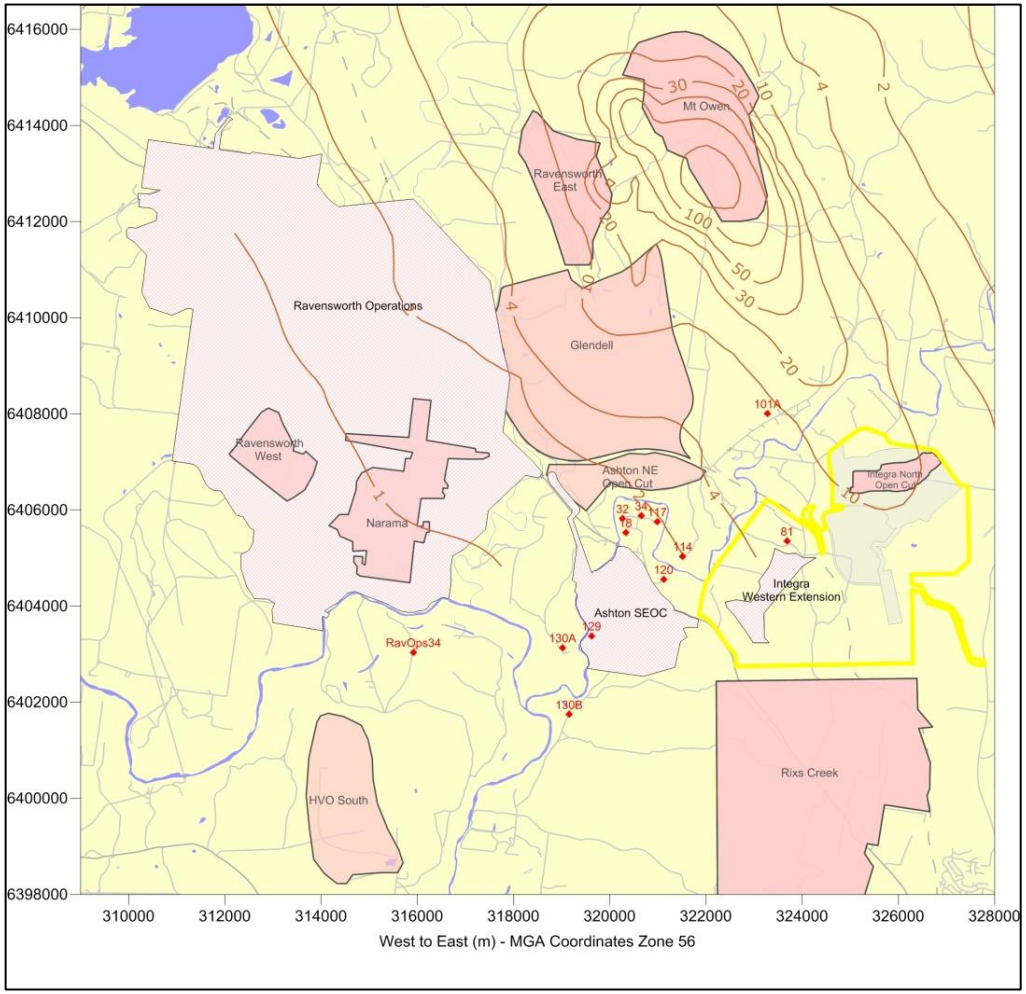


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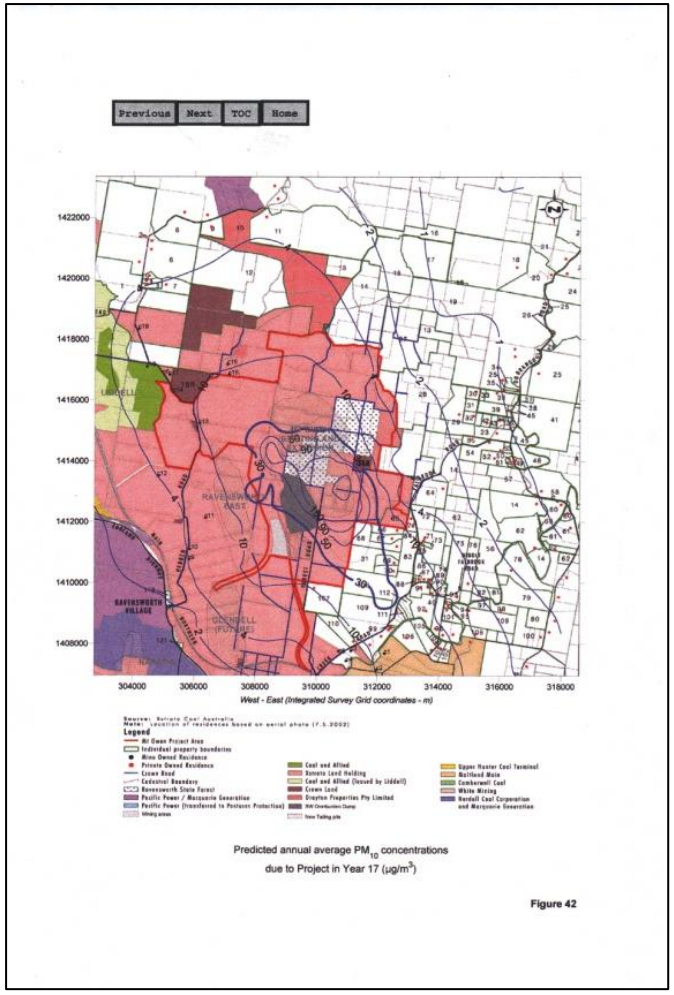
Figure A.8: Mt Owen – annual average PM_{10} concentration – Year 10 (2012) ($\mu g/m^3$)



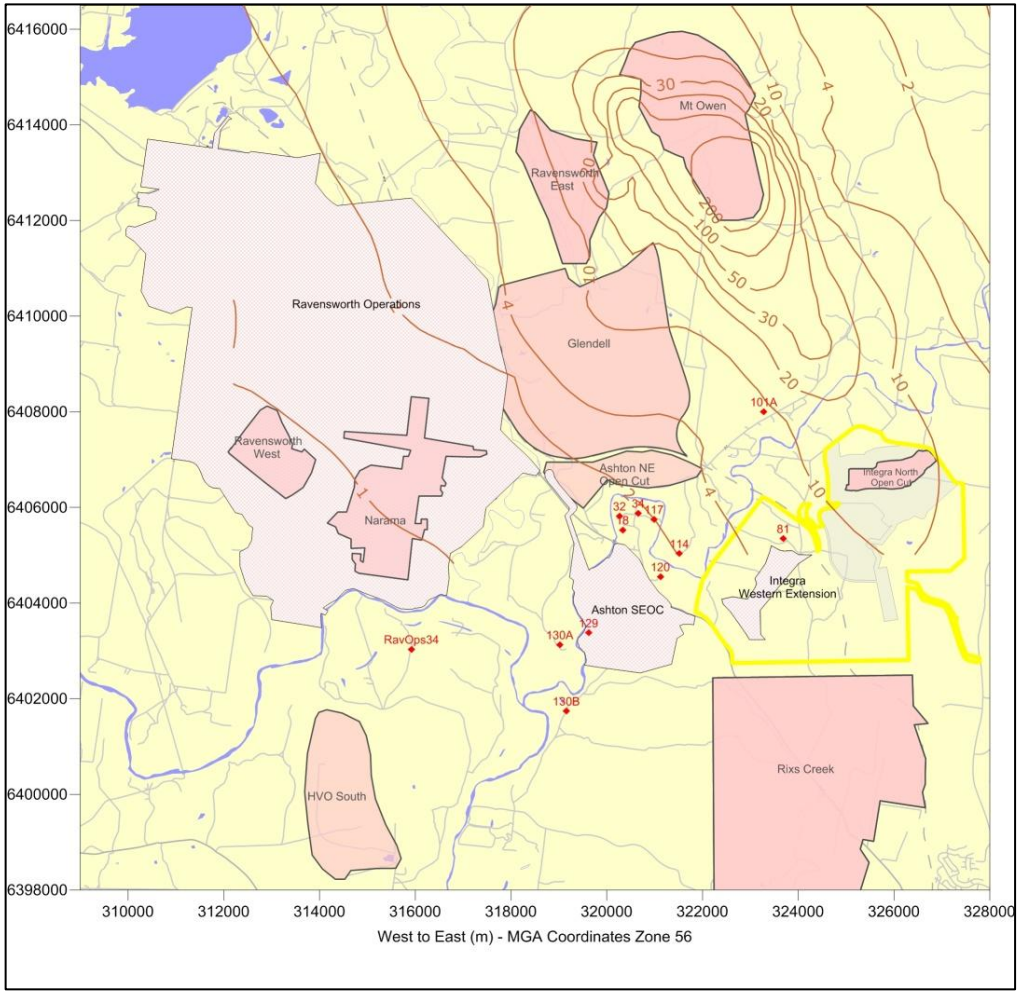


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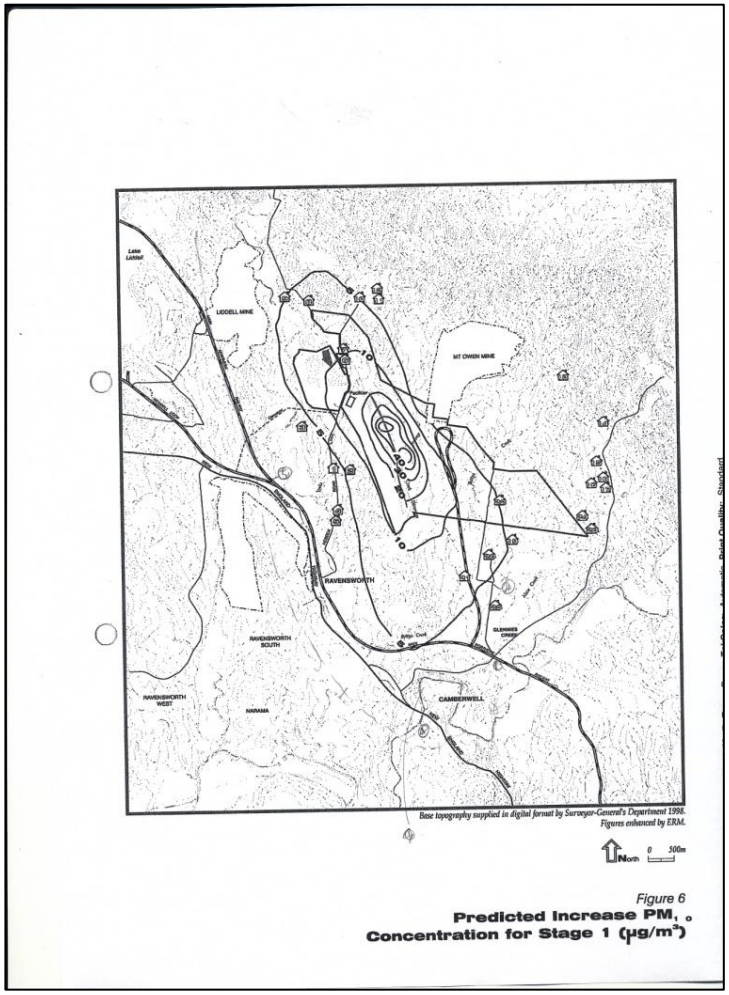
Figure A.9: Mt Owen – annual average PM_{10} concentration – Year 17 (2019) (µg/m^3)



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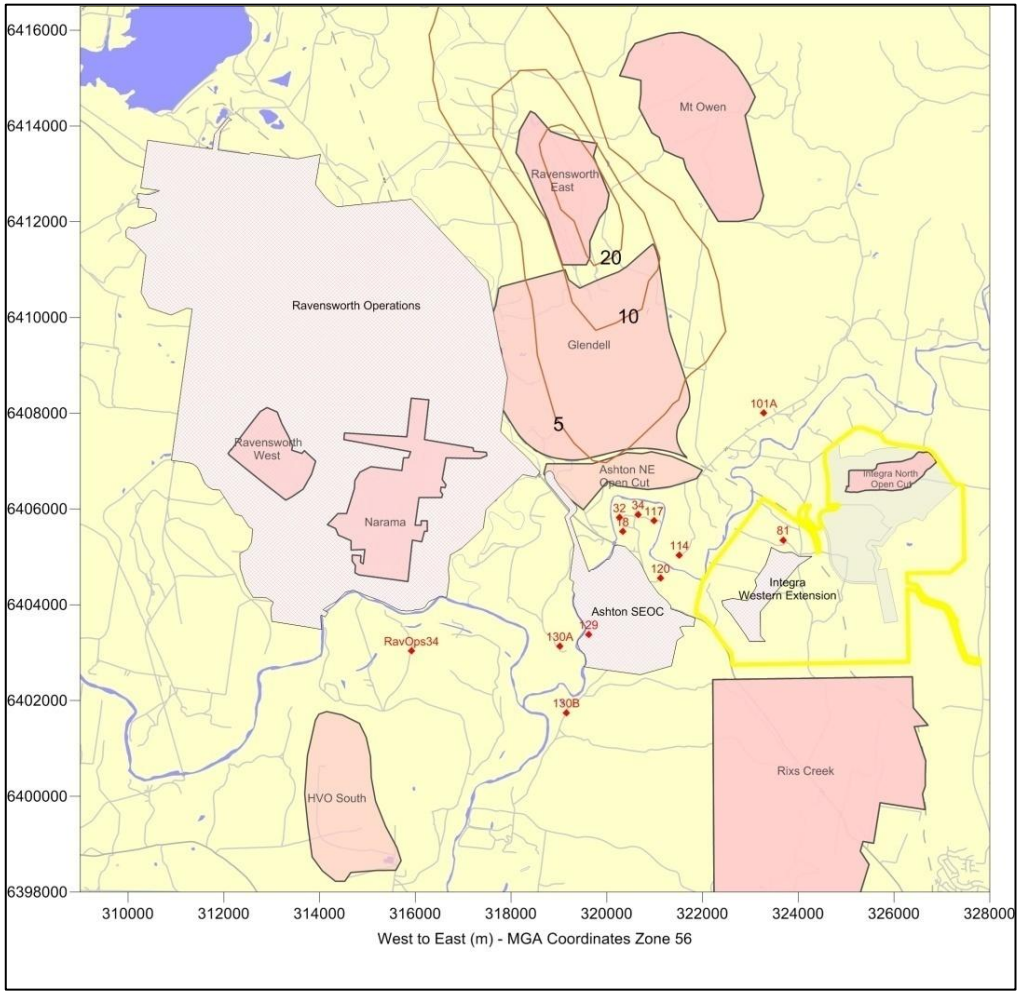

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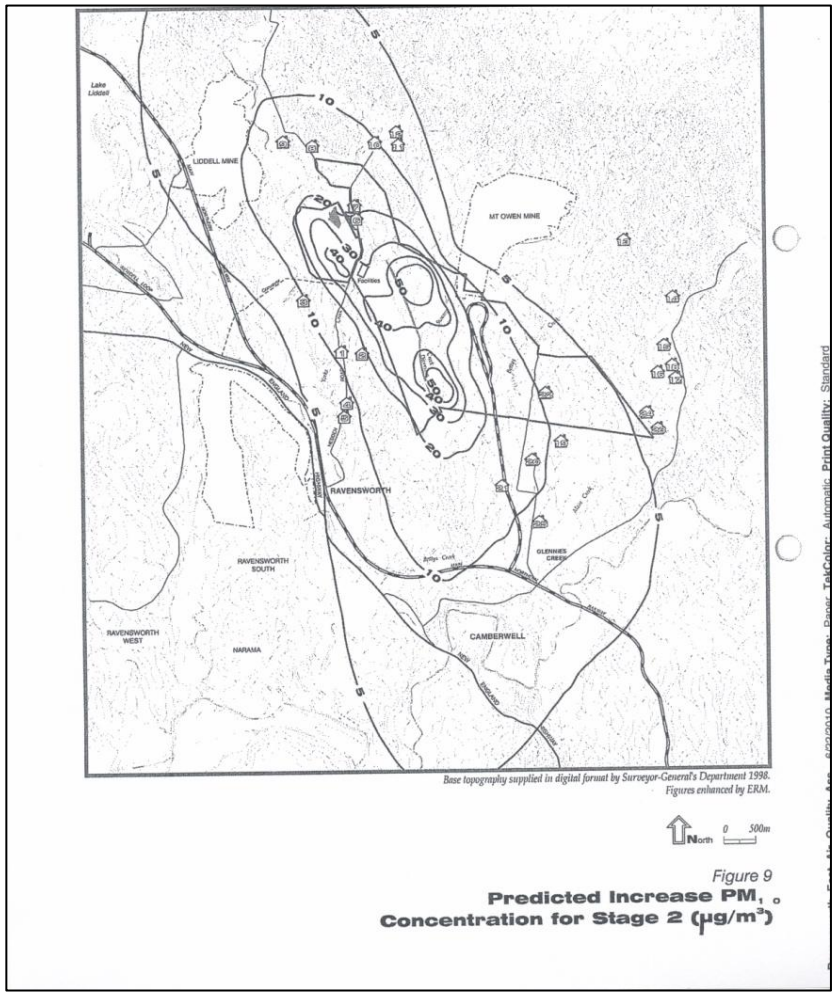
Figure A.10: Ravensworth East annual average PM_{10} concentration – Stage 1 (2000 to 2002) (µg/m³)



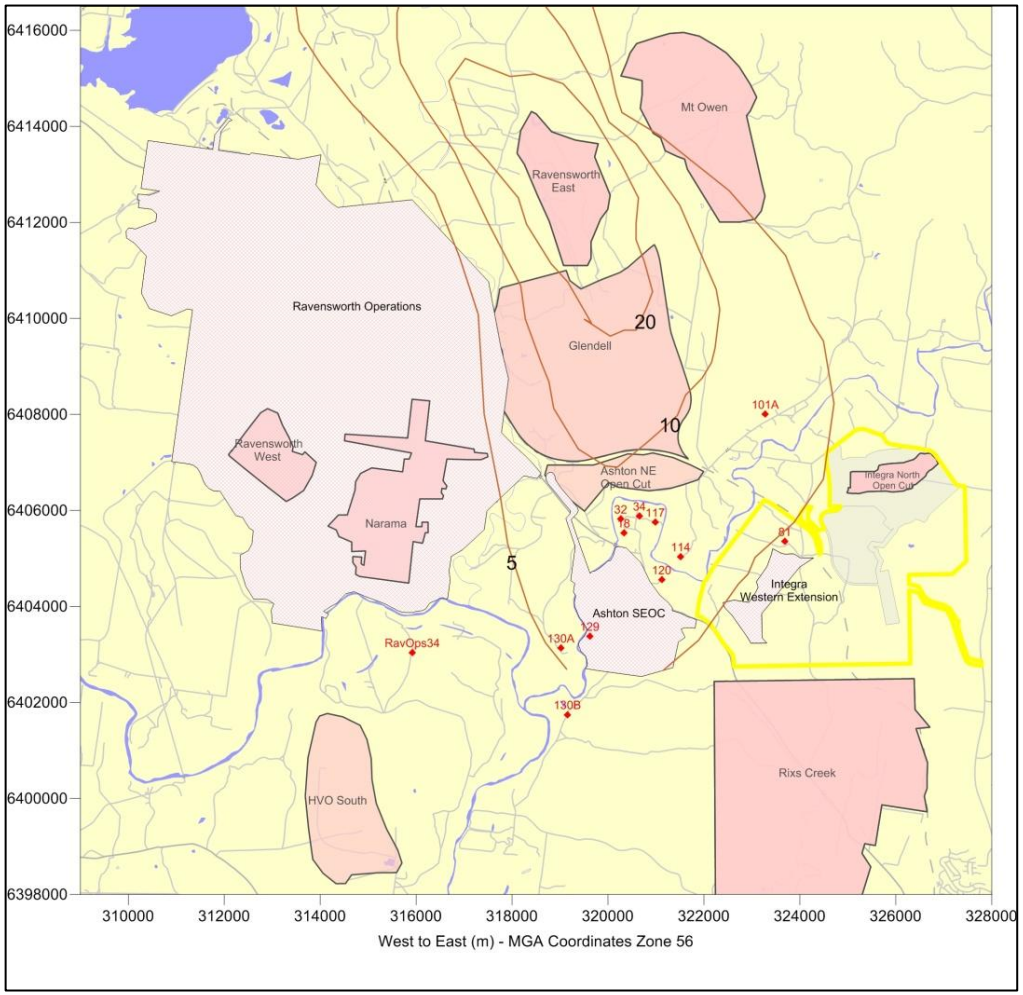


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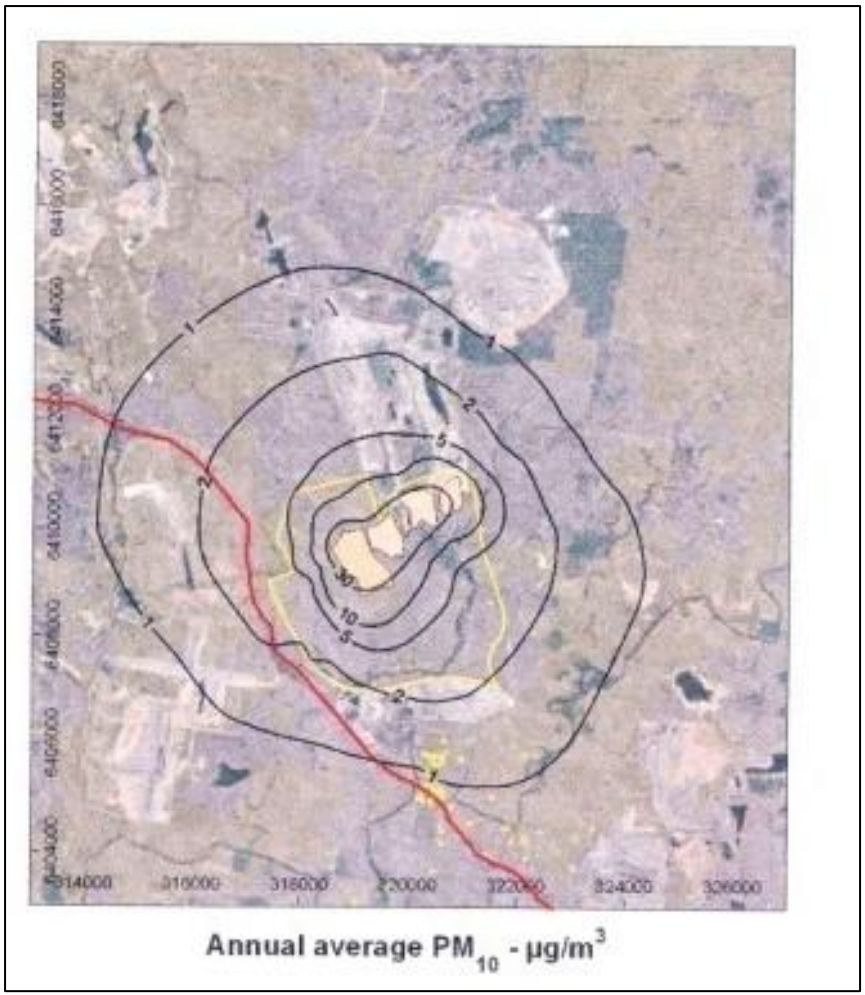
Figure A.11: Ravensworth East annual average PM_{10} concentration – Stage 2 (2003 to 2009) ($\mu g/m^3$)



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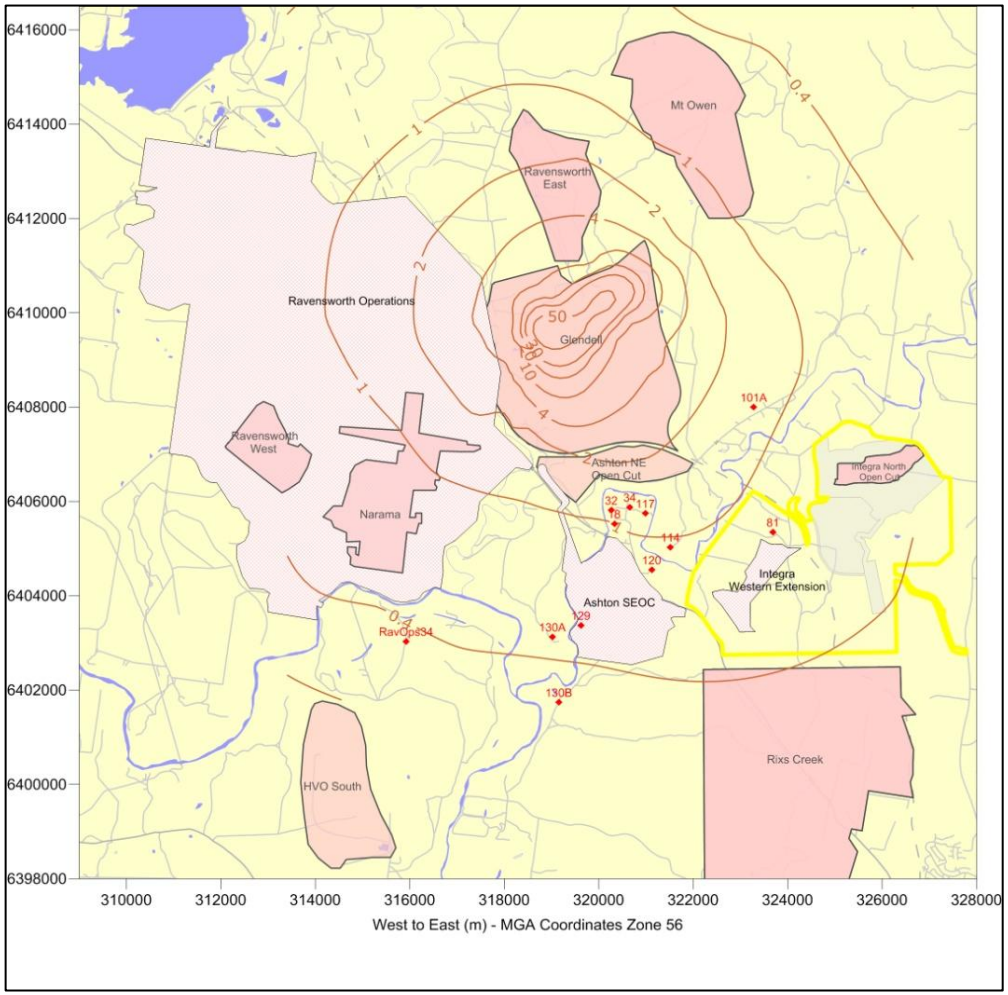

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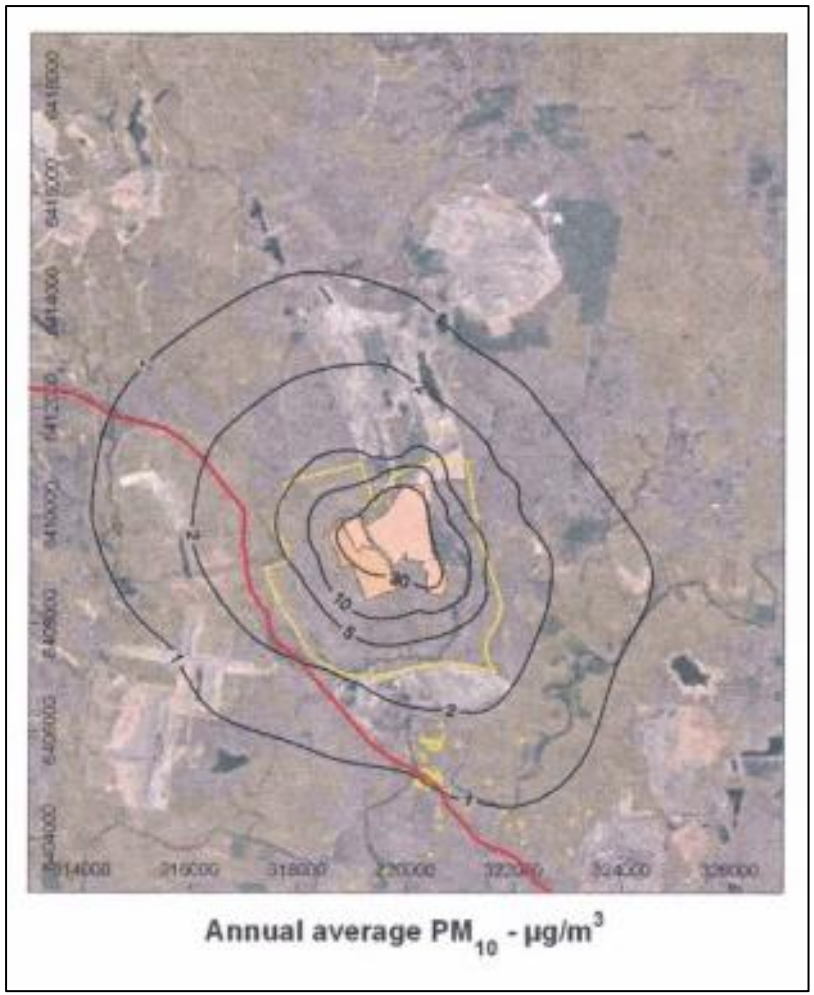
Figure A.12: Glendell annual average PM_{10} concentration – Year 1 (2008) (µg/m³)



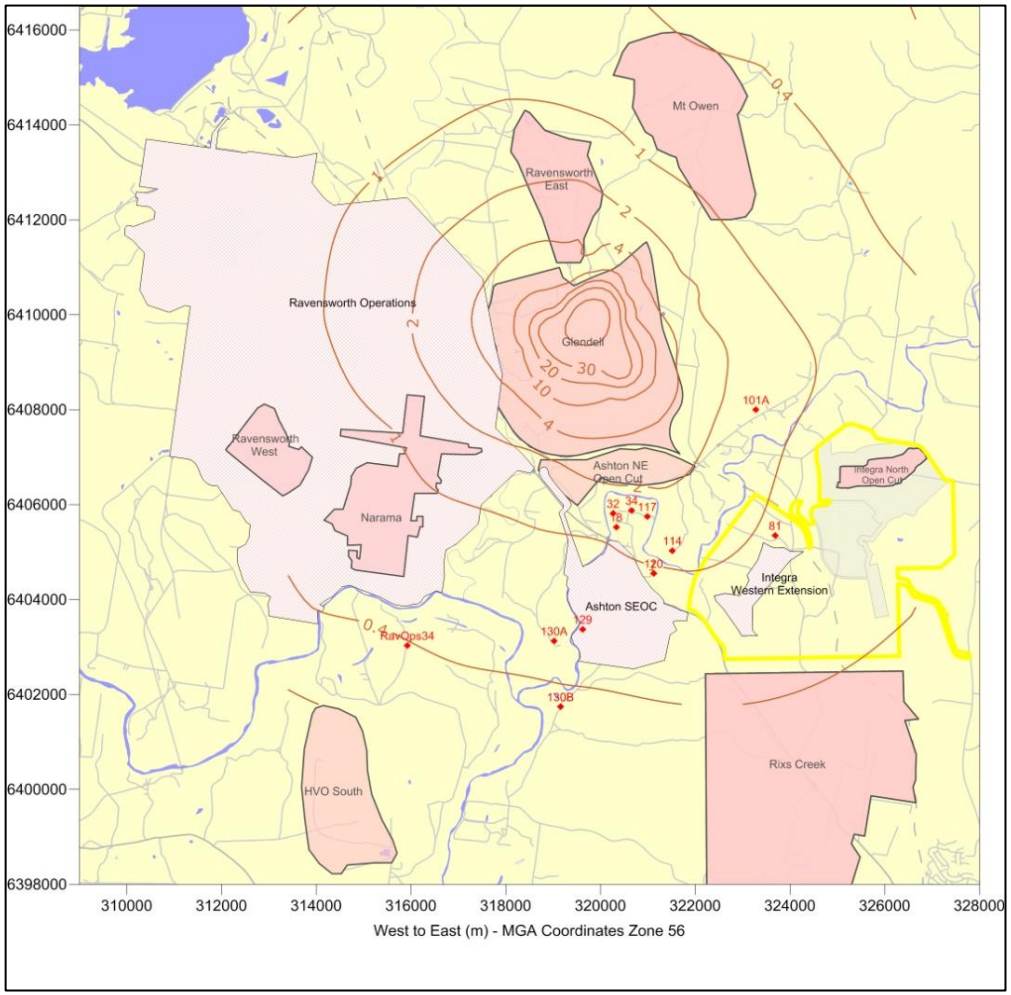


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Figure A.13: Glendell annual average PM_{10} concentration – Year 3 (2010) (µg/m³)

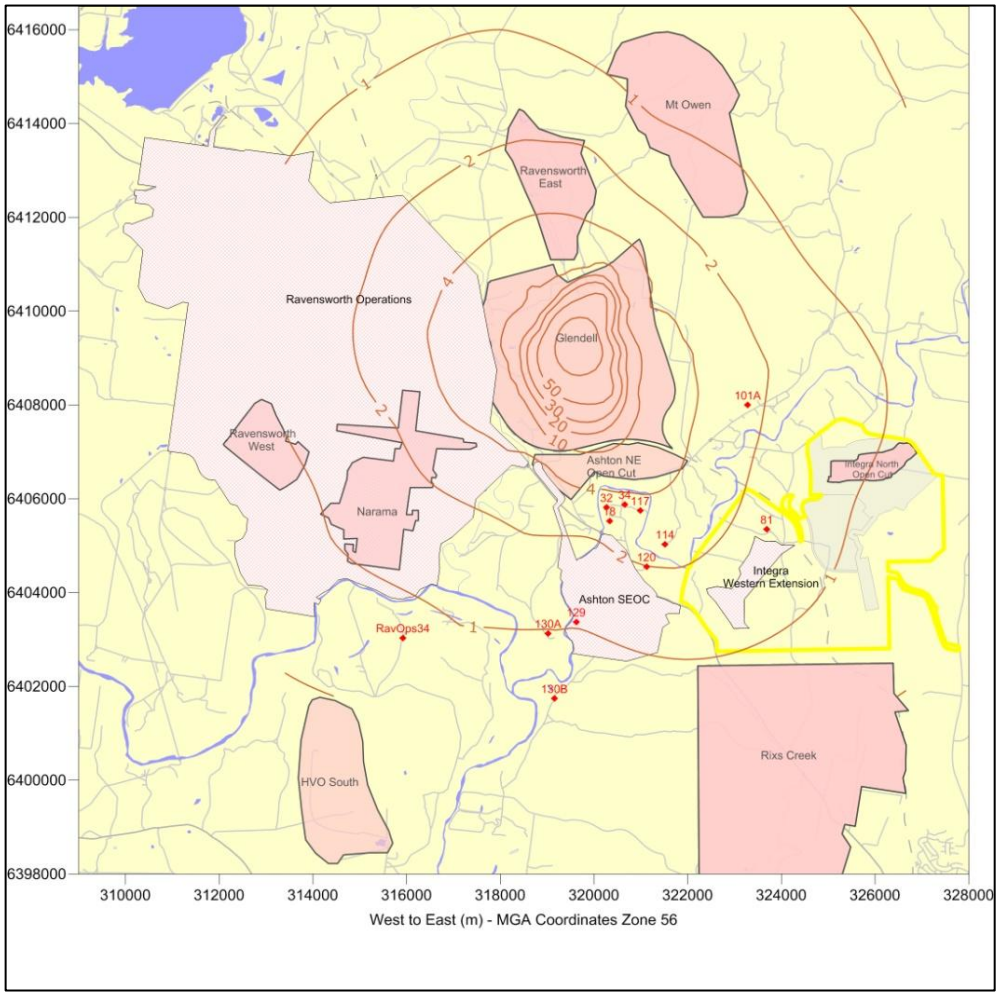

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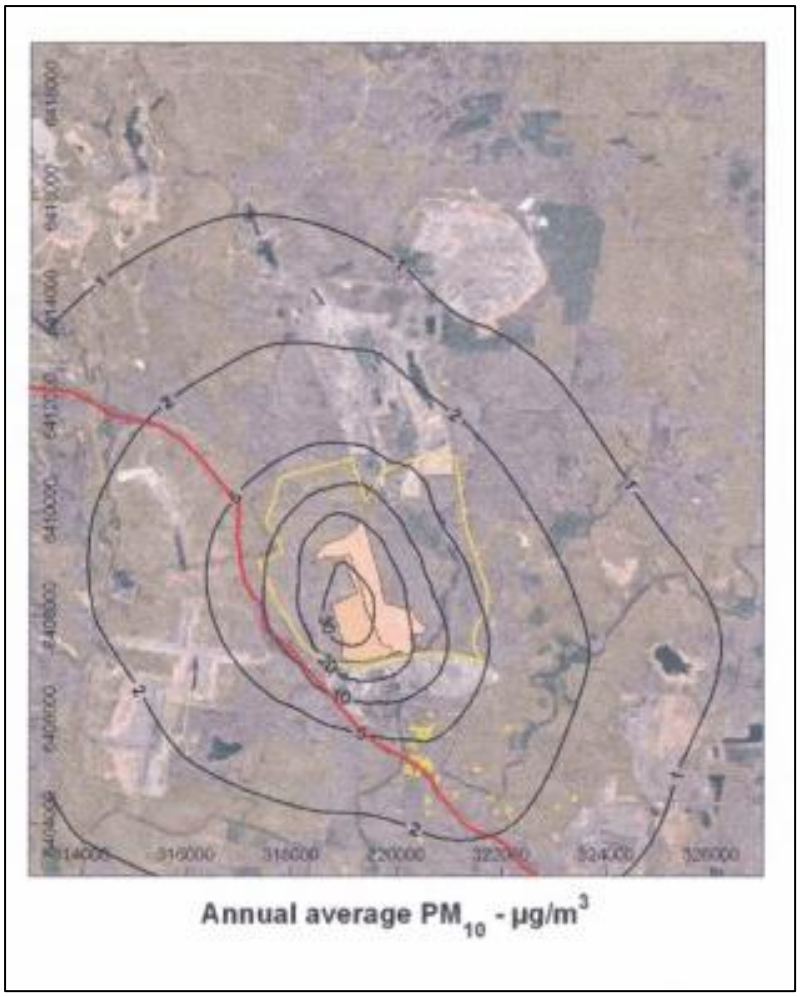
Figure A.14: Glendell annual average PM_{10} concentration – Year 6 (2013) (µg/m³)



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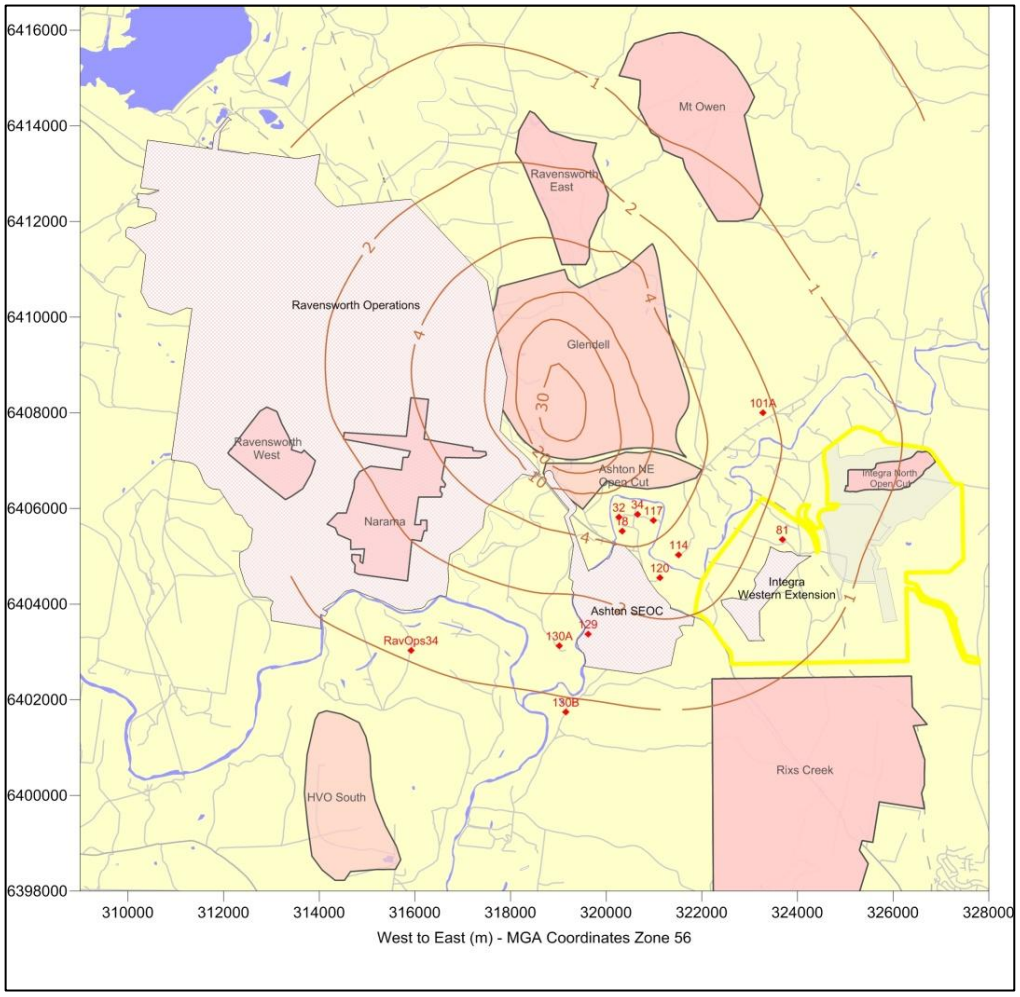

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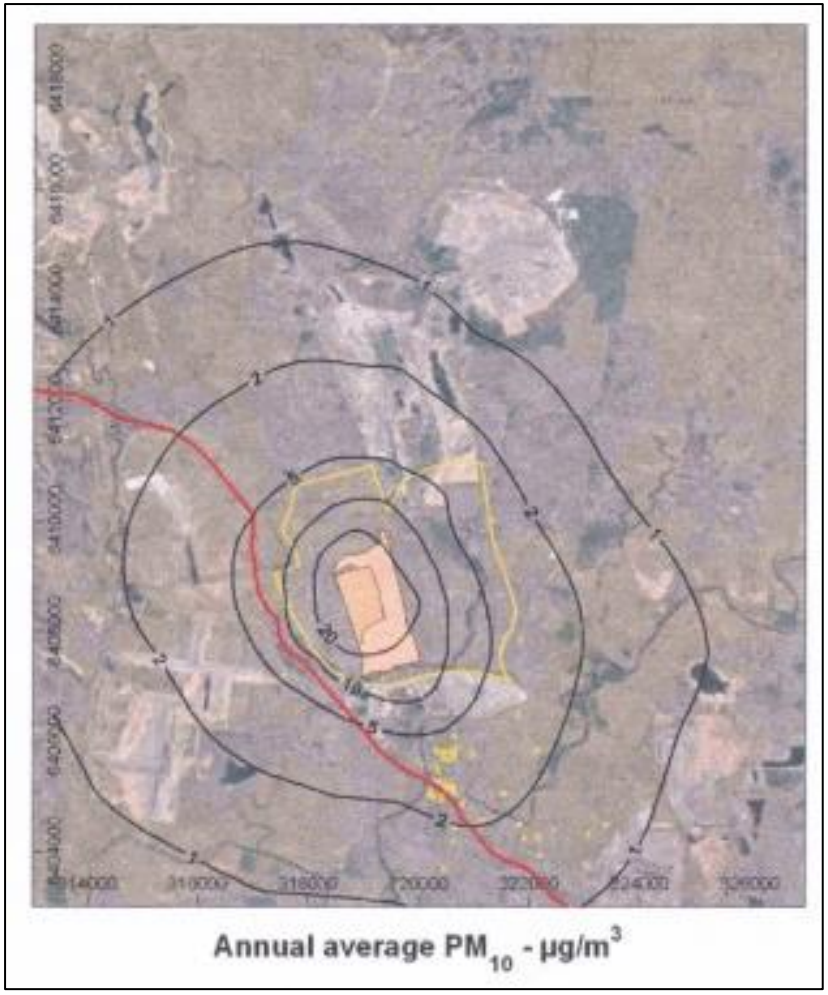
Figure A.15: Glendell annual average PM_{10} concentration – Year 9 (2016) (µg/m³)



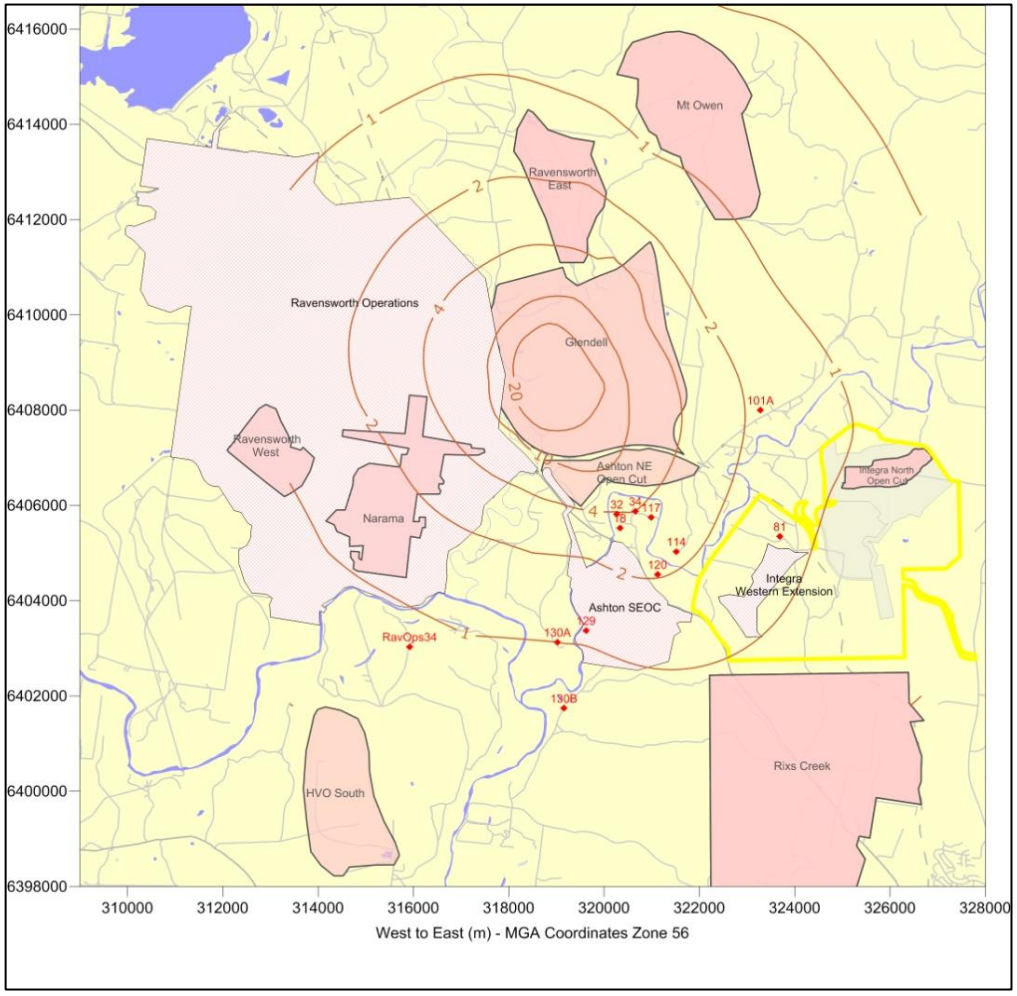


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Figure A.16: Glendell annual average PM_{10} concentration – Year 12 (2019) ($\mu g/m^3$)

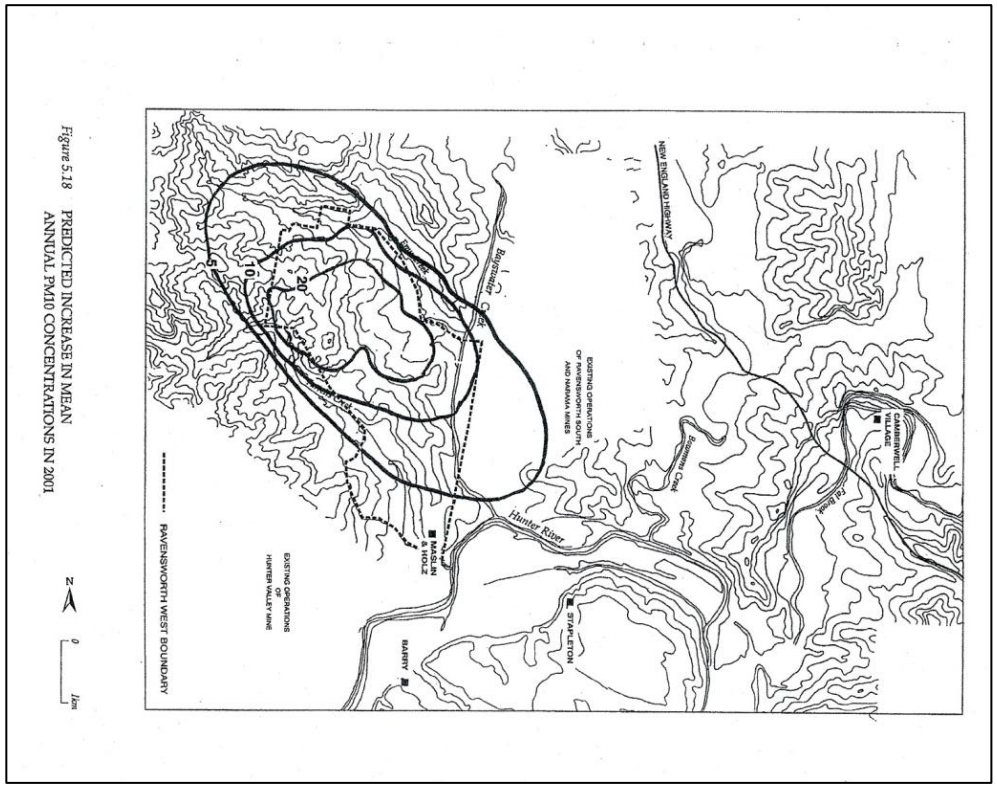

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Figure A.17: Ravensworth West annual average PM_{10} concentration – 2001 ($\mu g/m^3$)

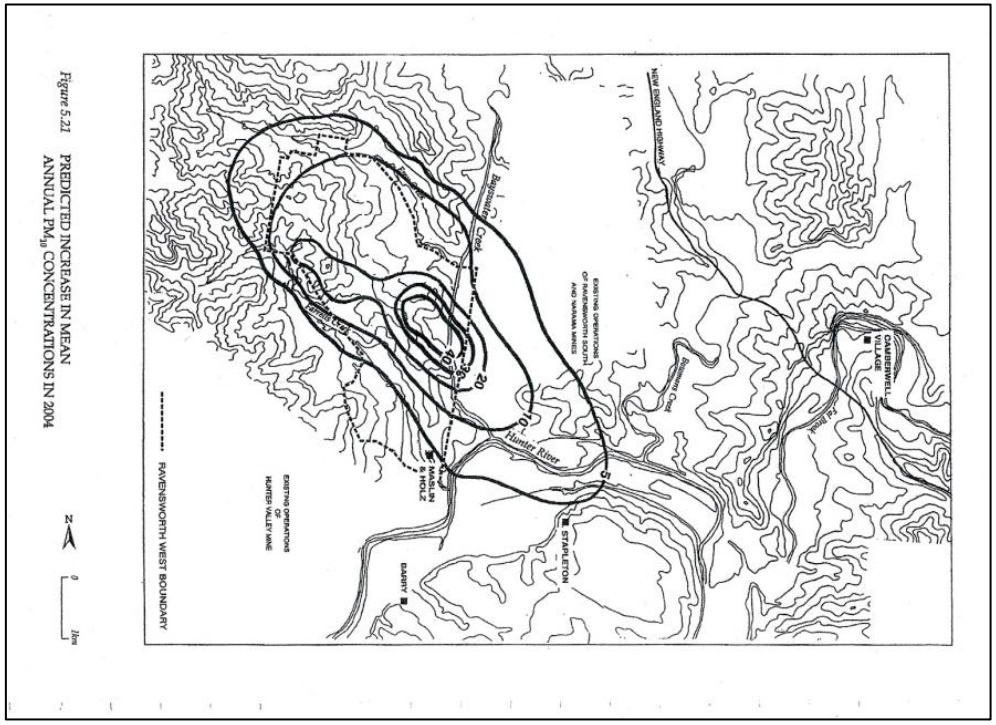

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Figure A.18: Ravensworth West annual average PM_{10} concentration – 2004 ($\mu g/m^3$)

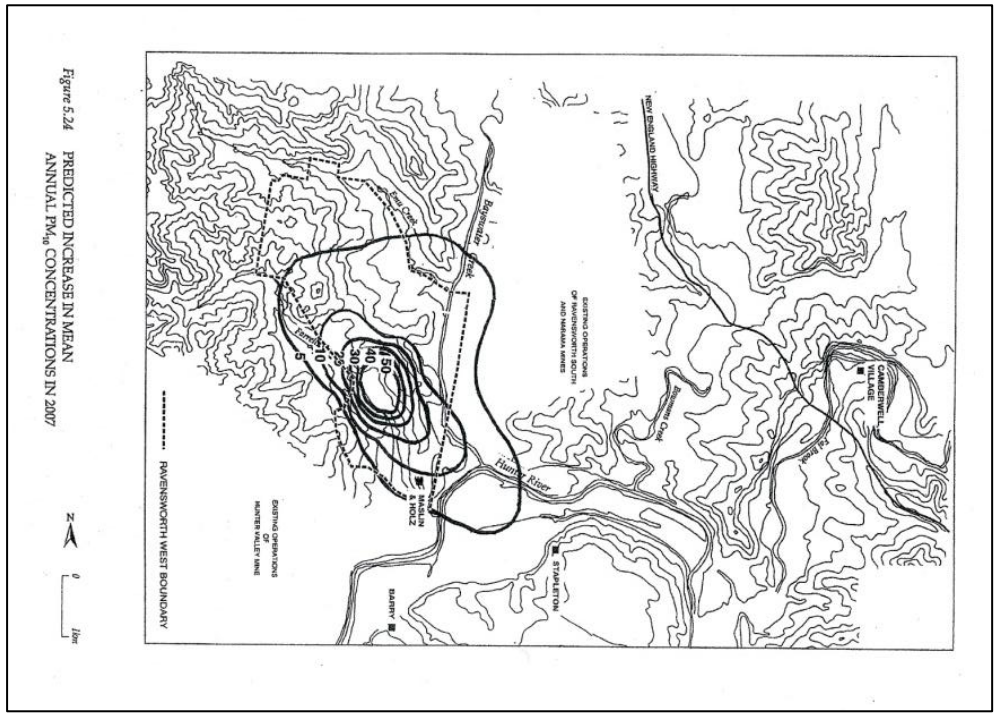

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Figure A.19: Ravensworth West annual average PM_{10} concentration – 2007 ($\mu g/m^3$)

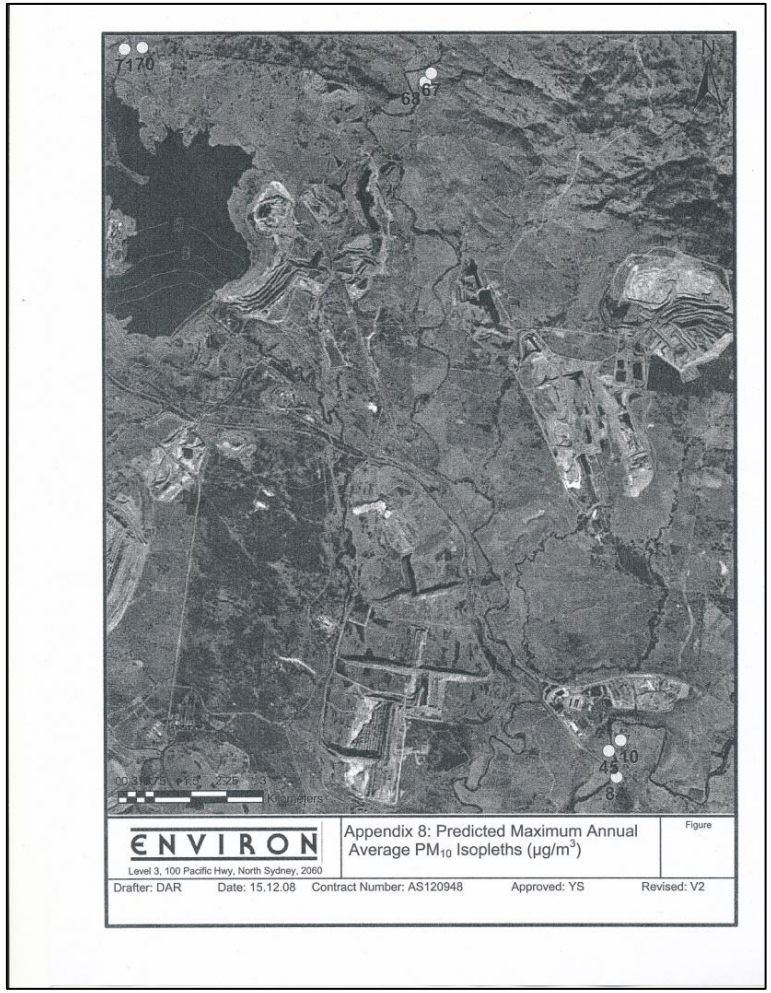

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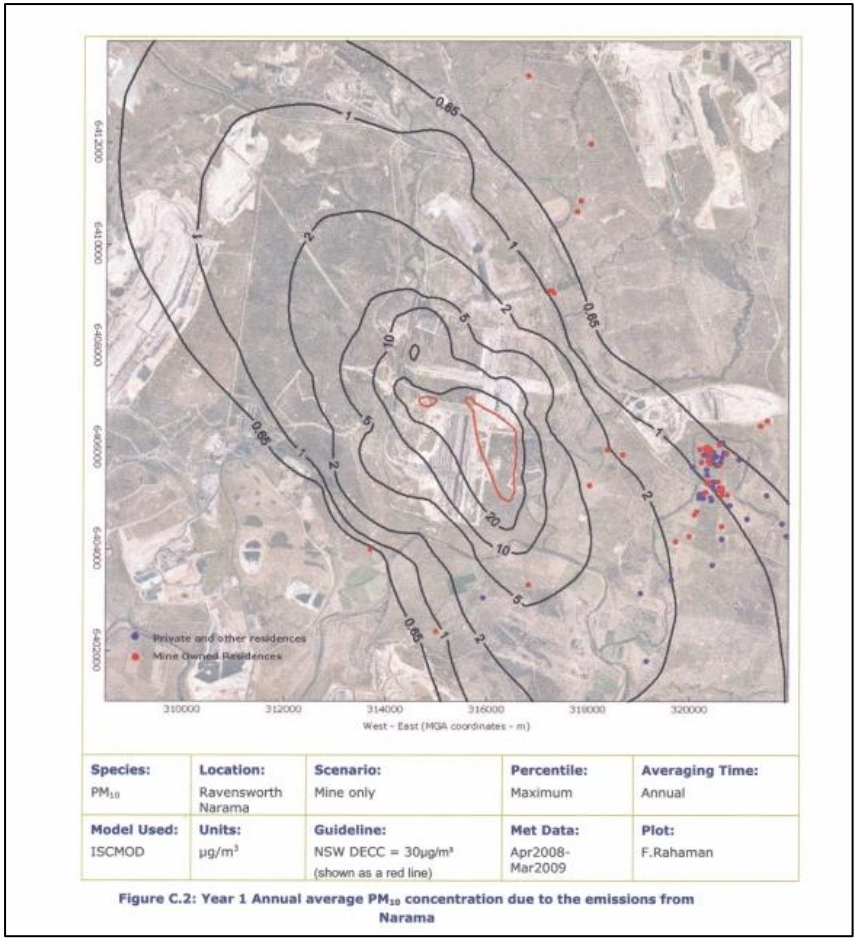
Figure A.20: Cumnock annual average PM_{10} concentration – 2010 ($\mu g/m^3$)



Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Ravensworth Narama	Mine only	Maximum	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
ISCMOD	$\mu g/m^3$	NSW DECC = 30$\mu g/m^3$ (shown as a red line)	Apr2008-Mar2009	F.Rahaman

Figure C.2: Year 1 Annual average PM_{10} concentration due to the emissions from Narama

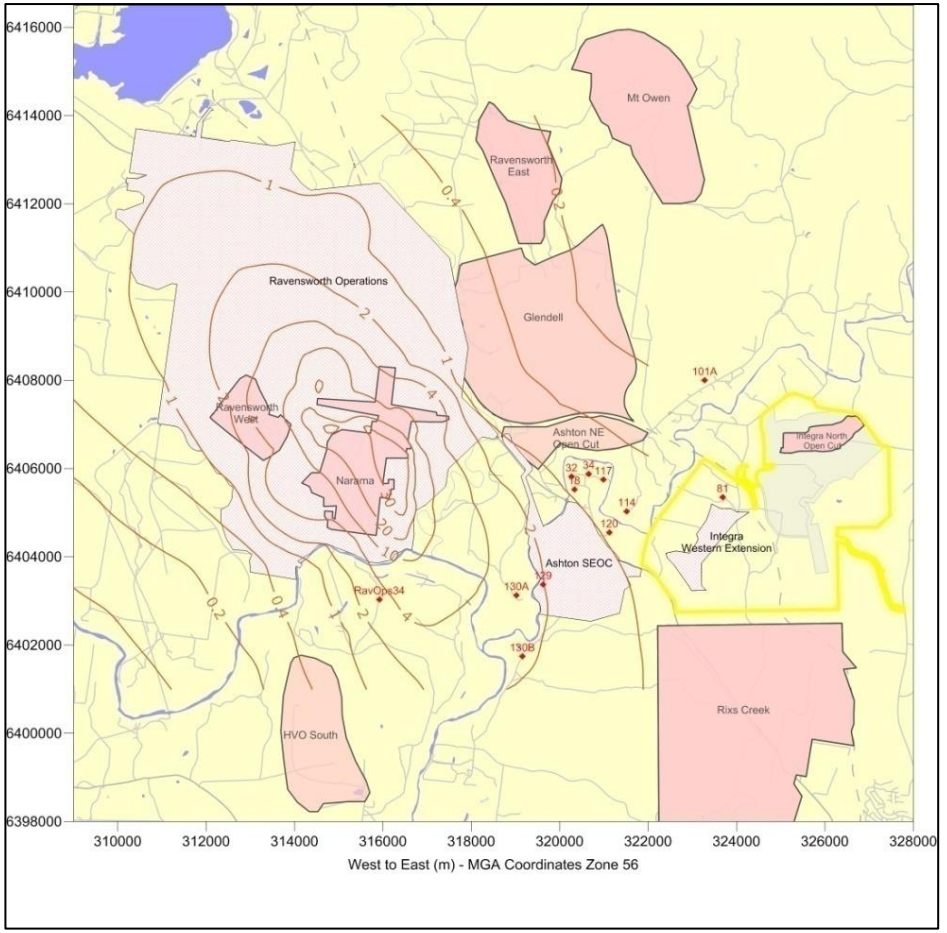


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Figure A.21: Narama annual average PM_{10} concentration – 2010 ($\mu g/m^3$)

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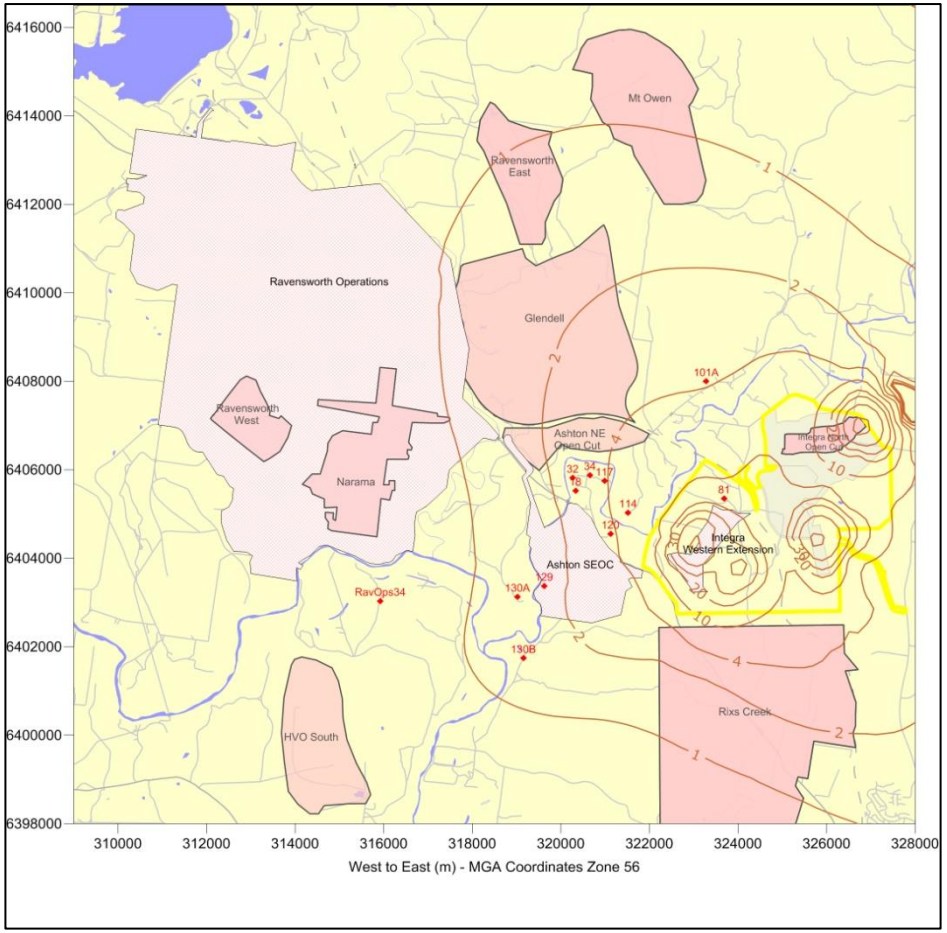

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Figure A.22: Integra Operations Part Pit annual average PM_{10} concentration – Year 1 modified (2011) ($\mu g/m^3$)

EA CONTOUR UPDATED

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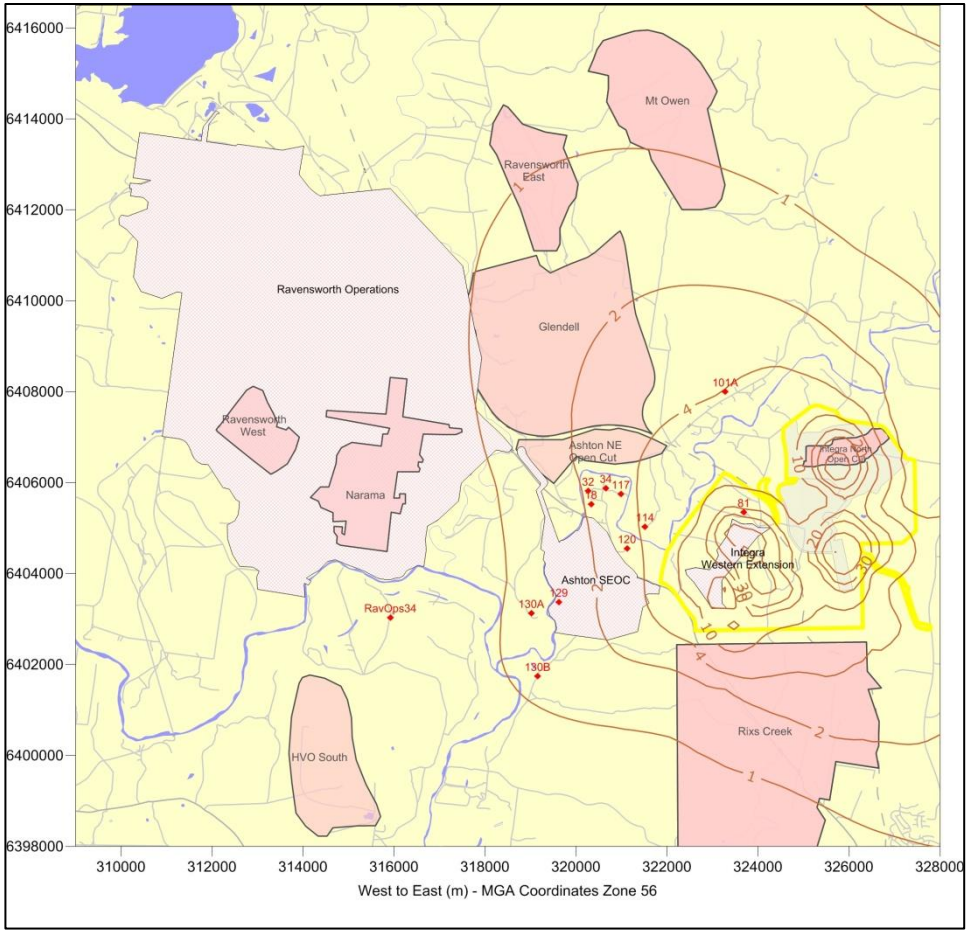

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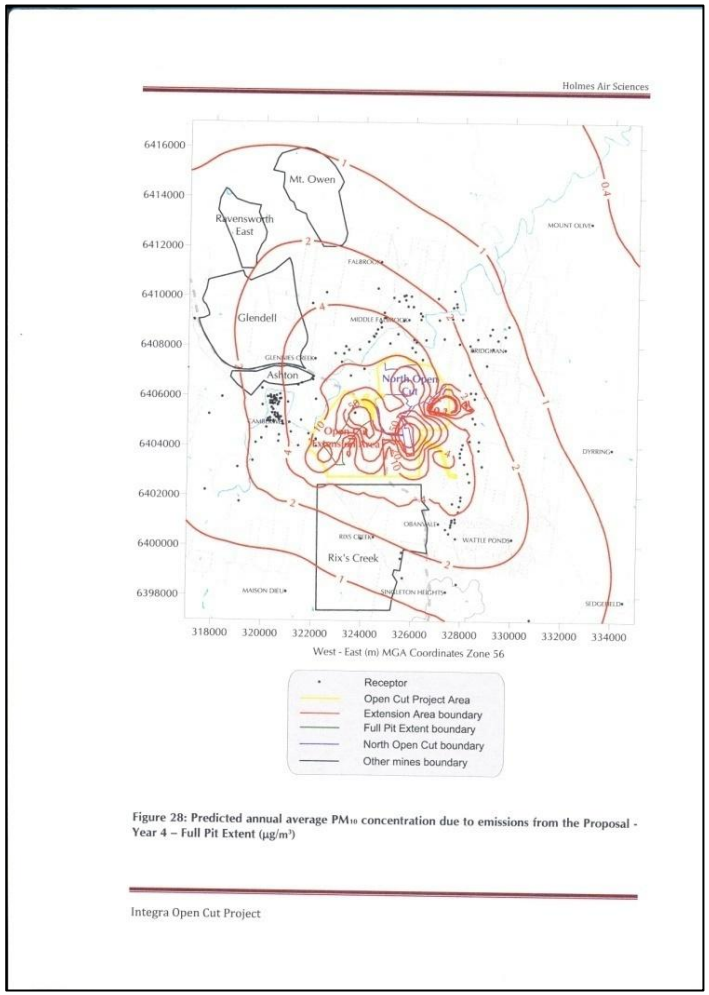
Figure A.23: Integra Operations Part Pit annual average PM_{10} concentration – Year 3 modified (2013) ($\mu g/m^3$)



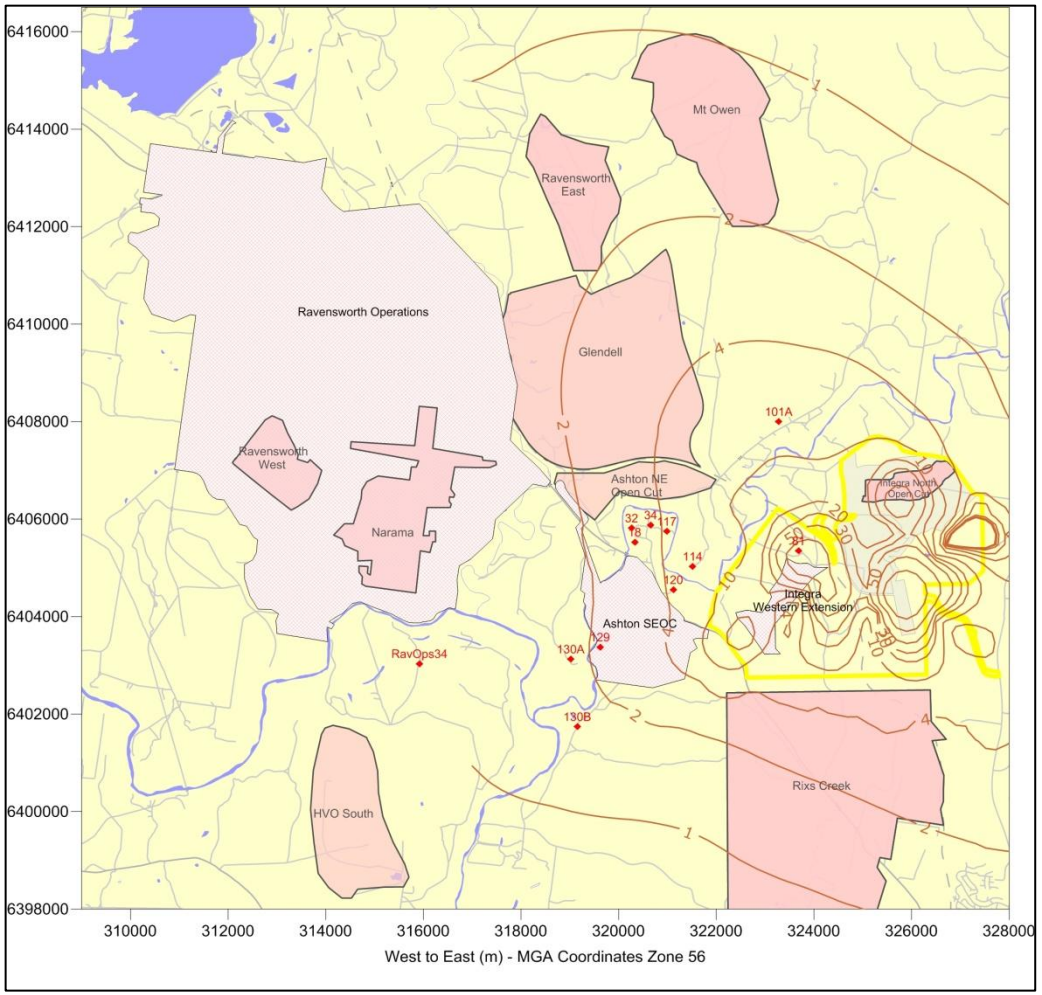


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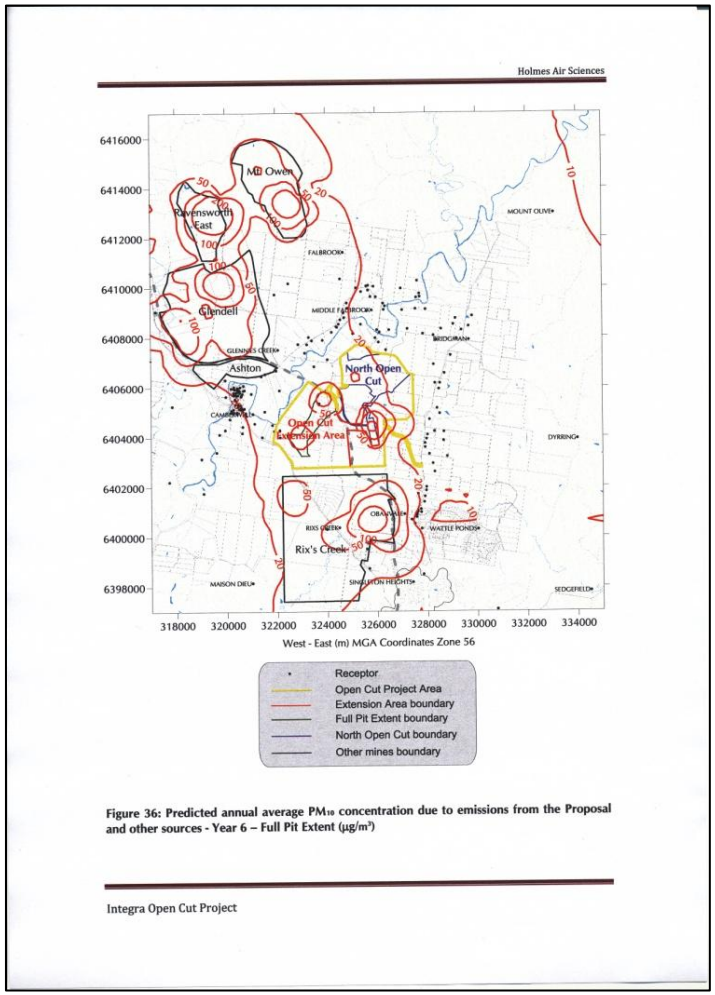
Figure A.24: Integra Operations Full Pit annual average PM_{10} concentration – Year 4 (2014) ($\mu g/m^3$)



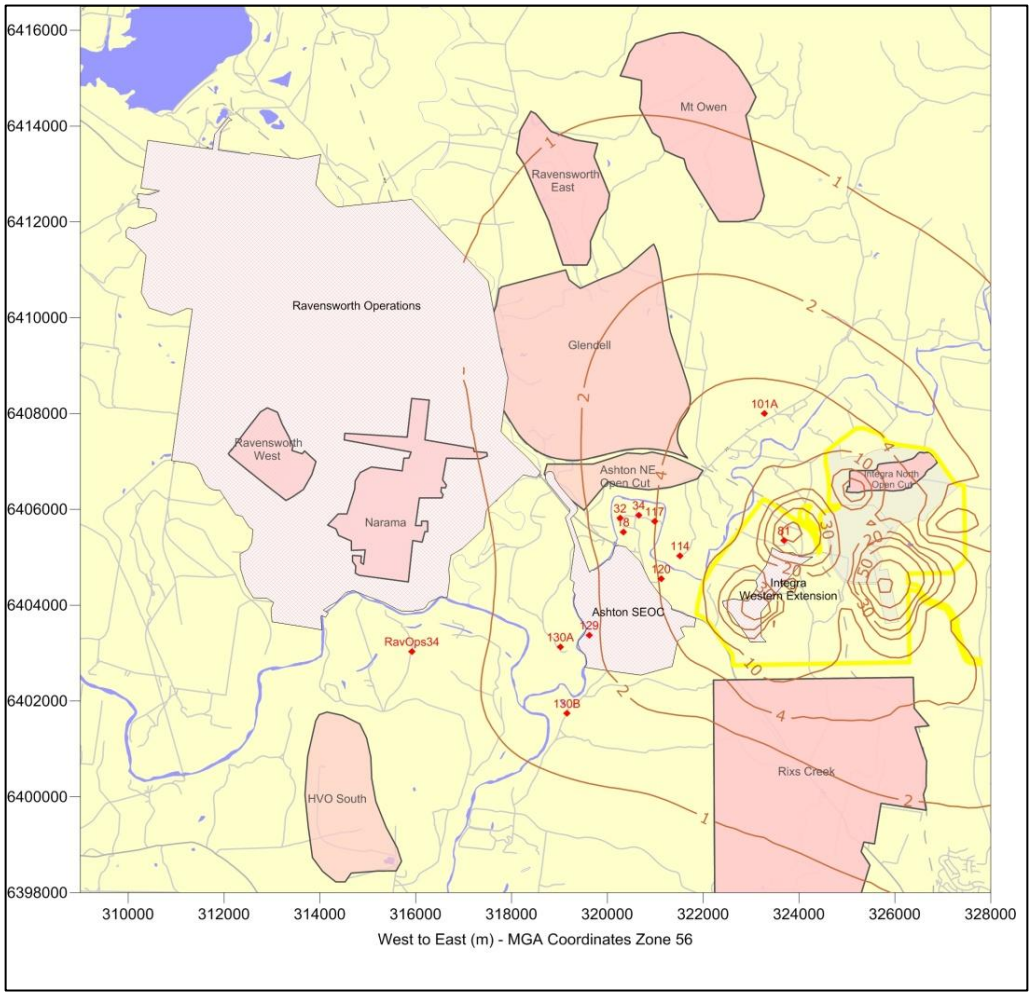


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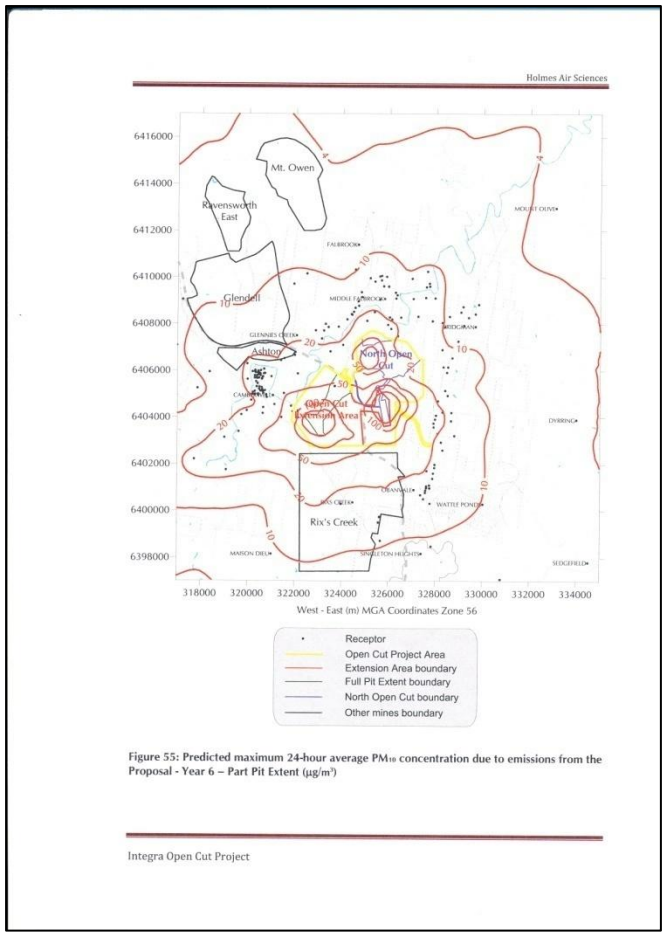
Figure A.25: Integra Operations Full Pit annual average PM_{10} concentration – Year 6 (2016) ($\mu g/m^3$)



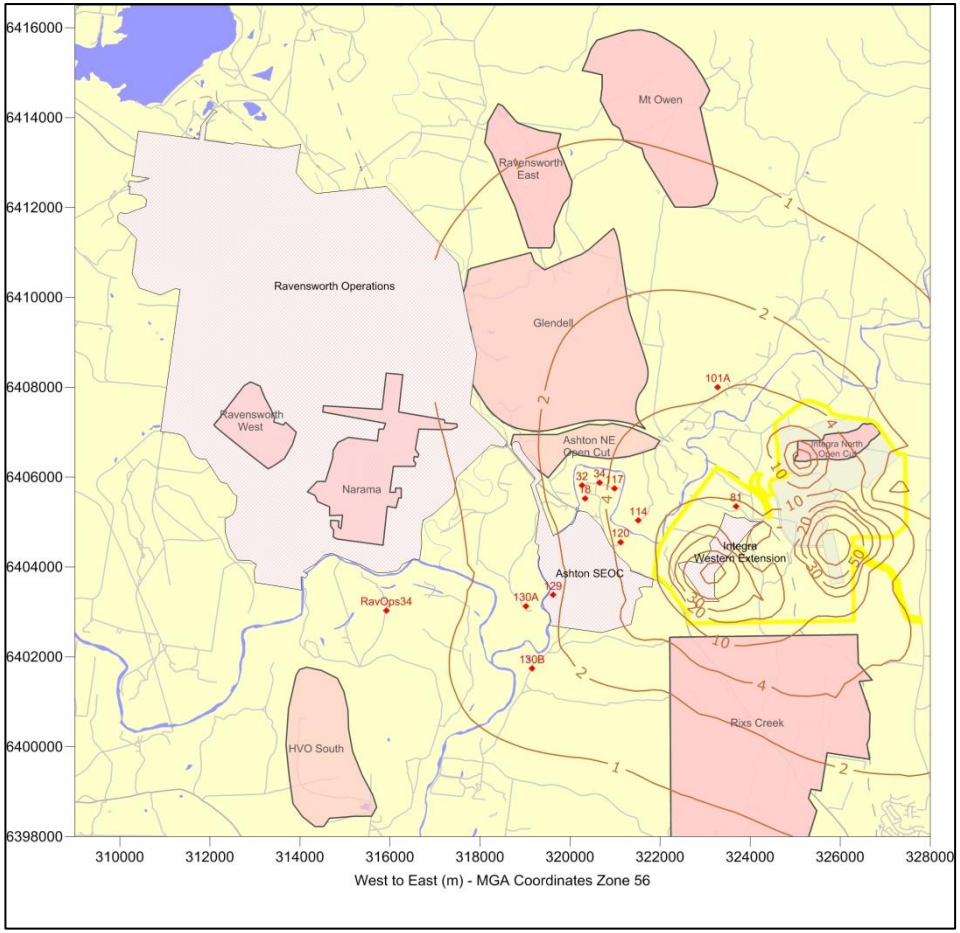


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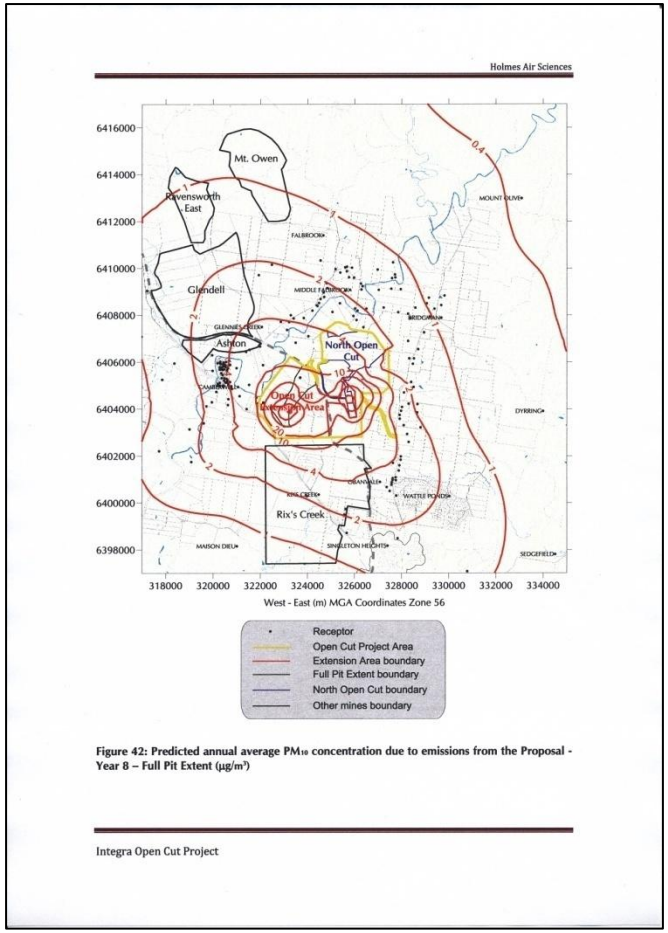
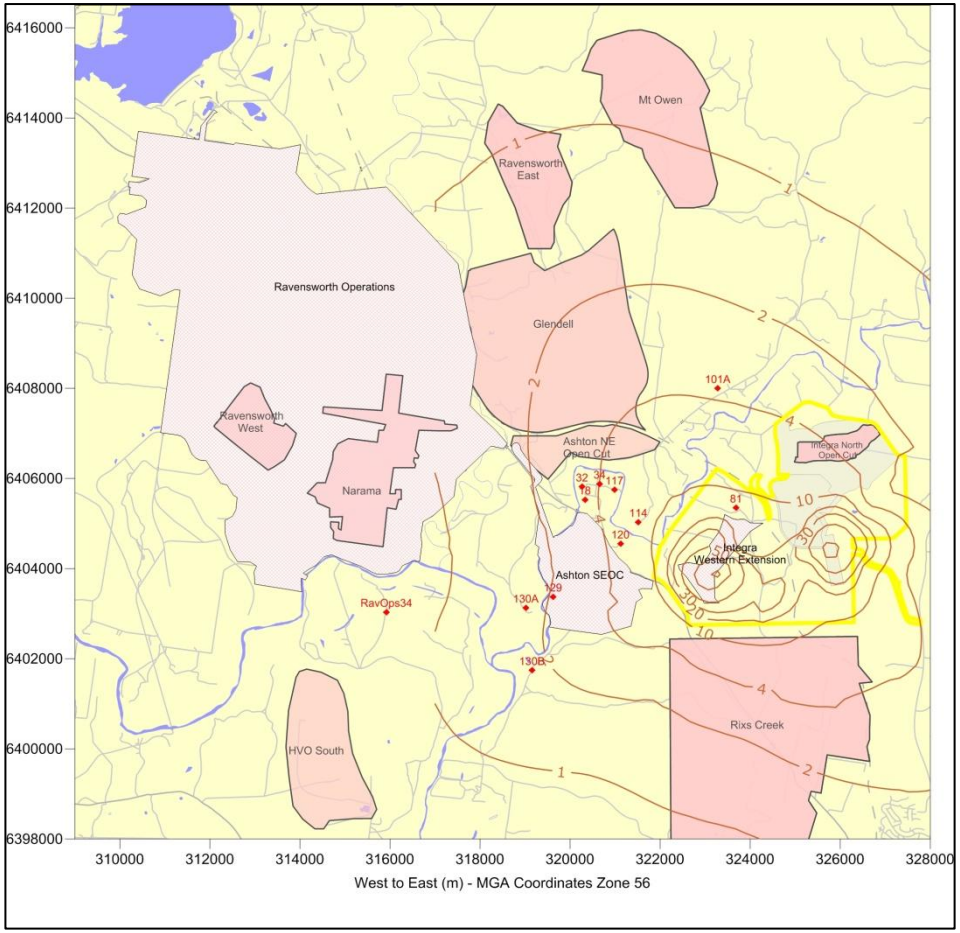
Figure A.26: Integra Operations Part Pit annual average PM_{10} concentration – Year 6 (2016) ($\mu g/m^3$)



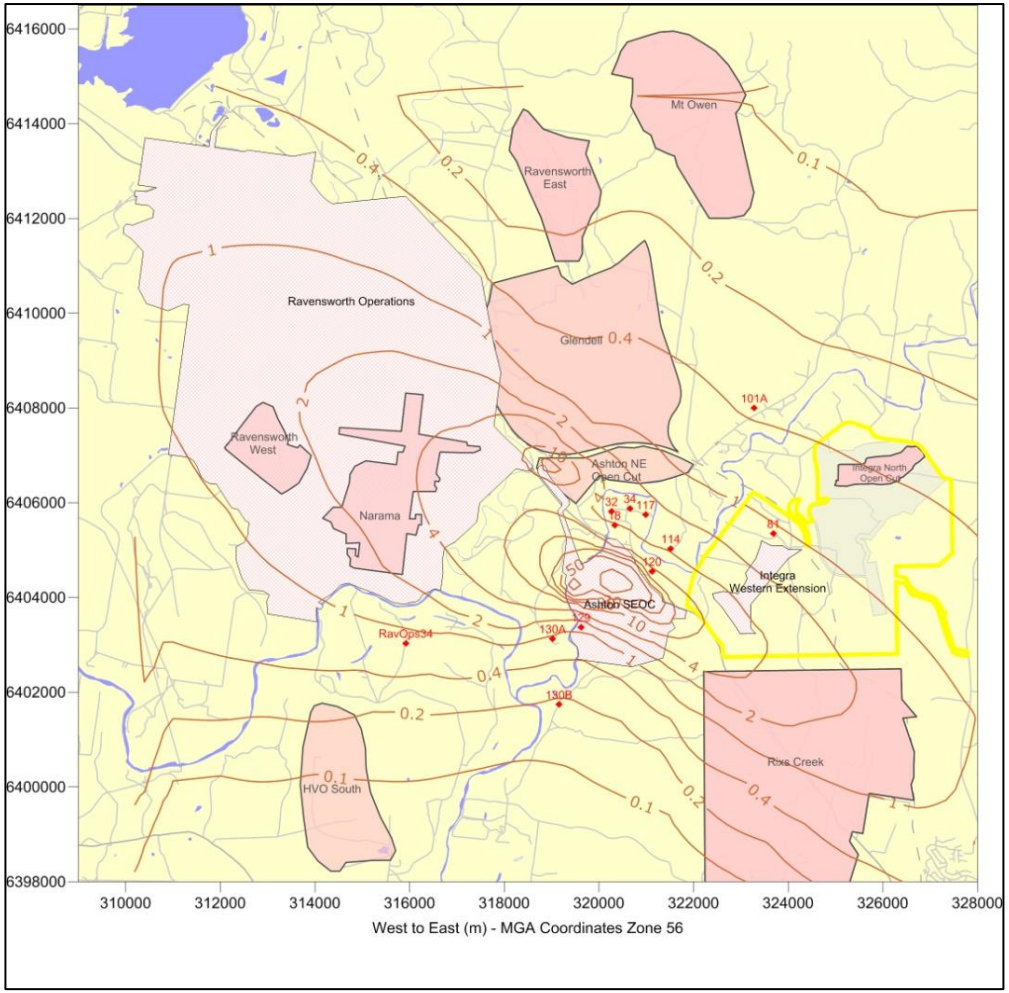


Contour from environmental assessment **Same contour on common map**

Figure A.27: Integra Operations Full Pit annual average PM_{10} concentration – Year 8 (2018) (µg/m³)

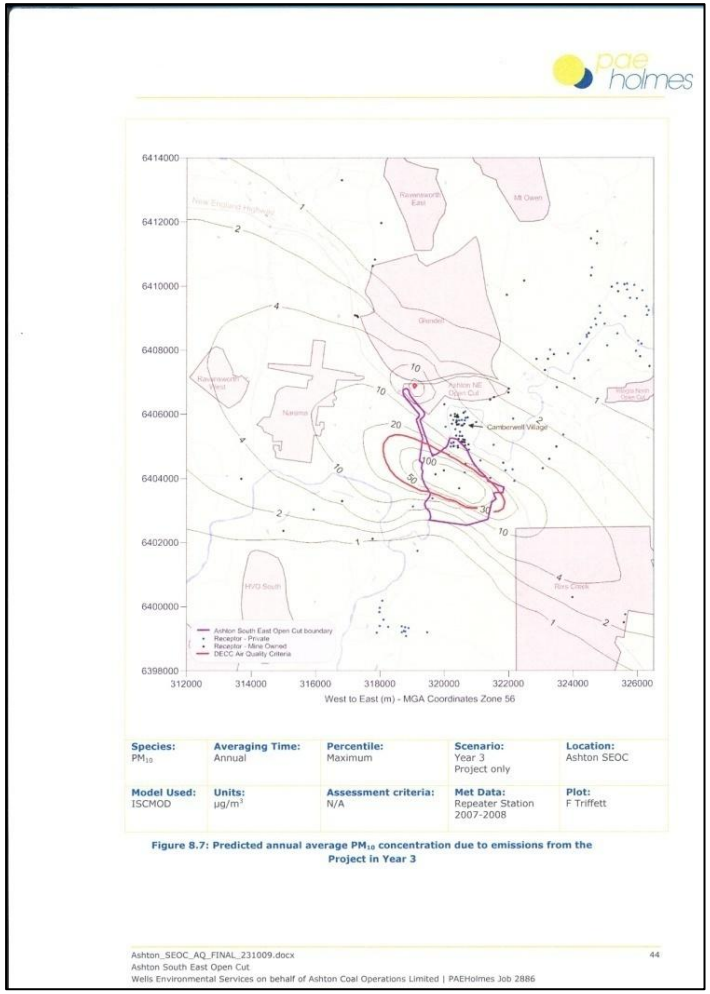
EA CONTOUR UPDATED

REFER TO FIGURE ON RIGHT FOR UPDATED CONTOUR

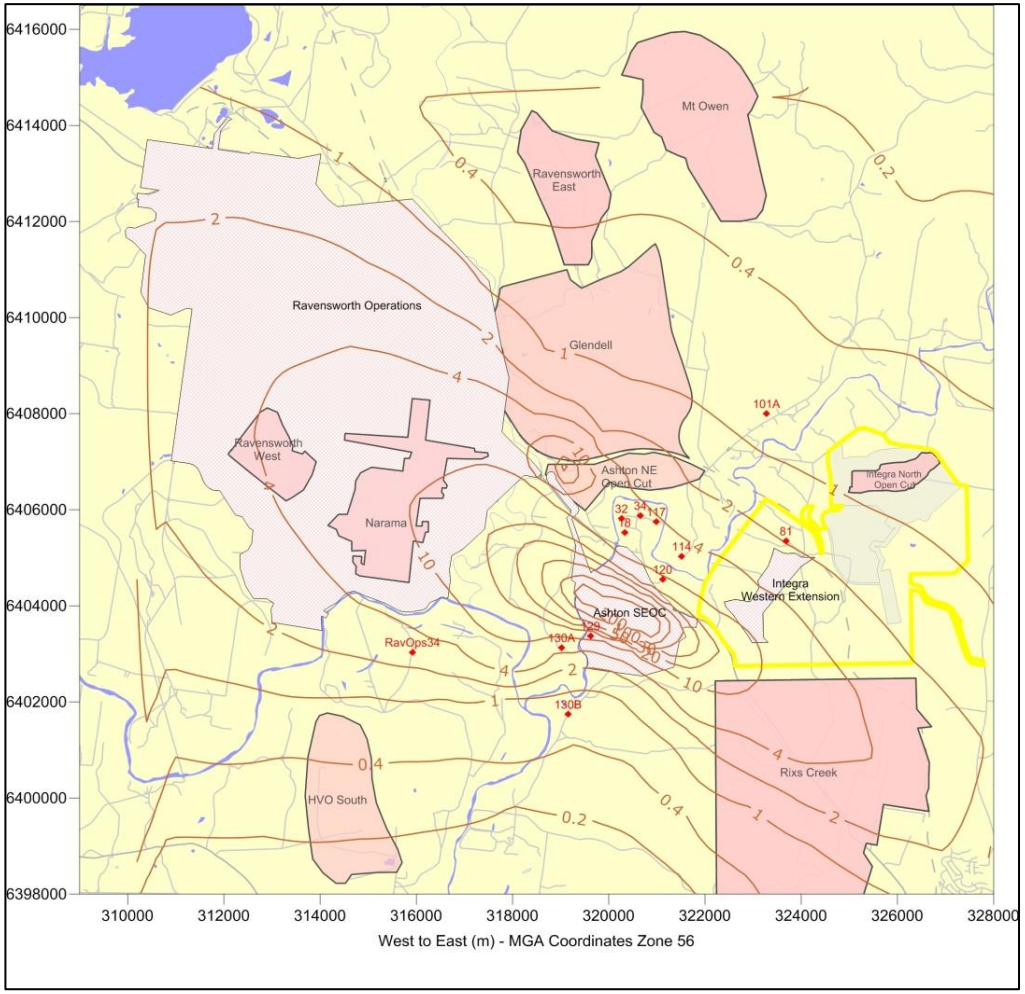


Contour from environmental assessment **Same contour on common map**

Figure A.28: Ashton South East Open Cut (SEOC) annual average PM_{10} concentration – Year 1 modified (2011) ($\mu g/m^3$)

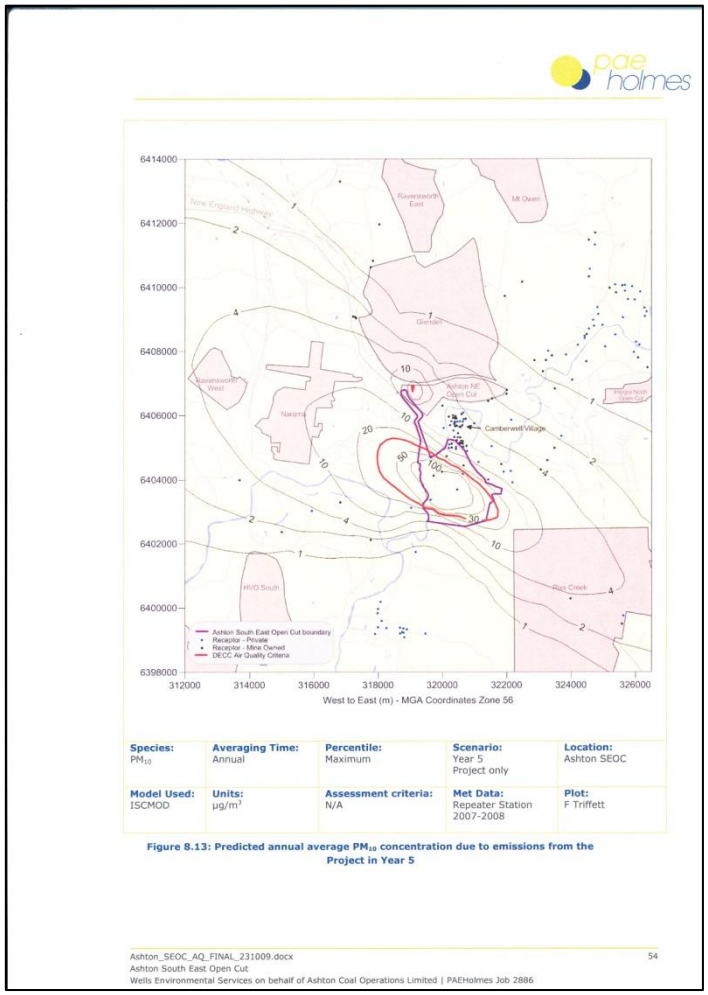


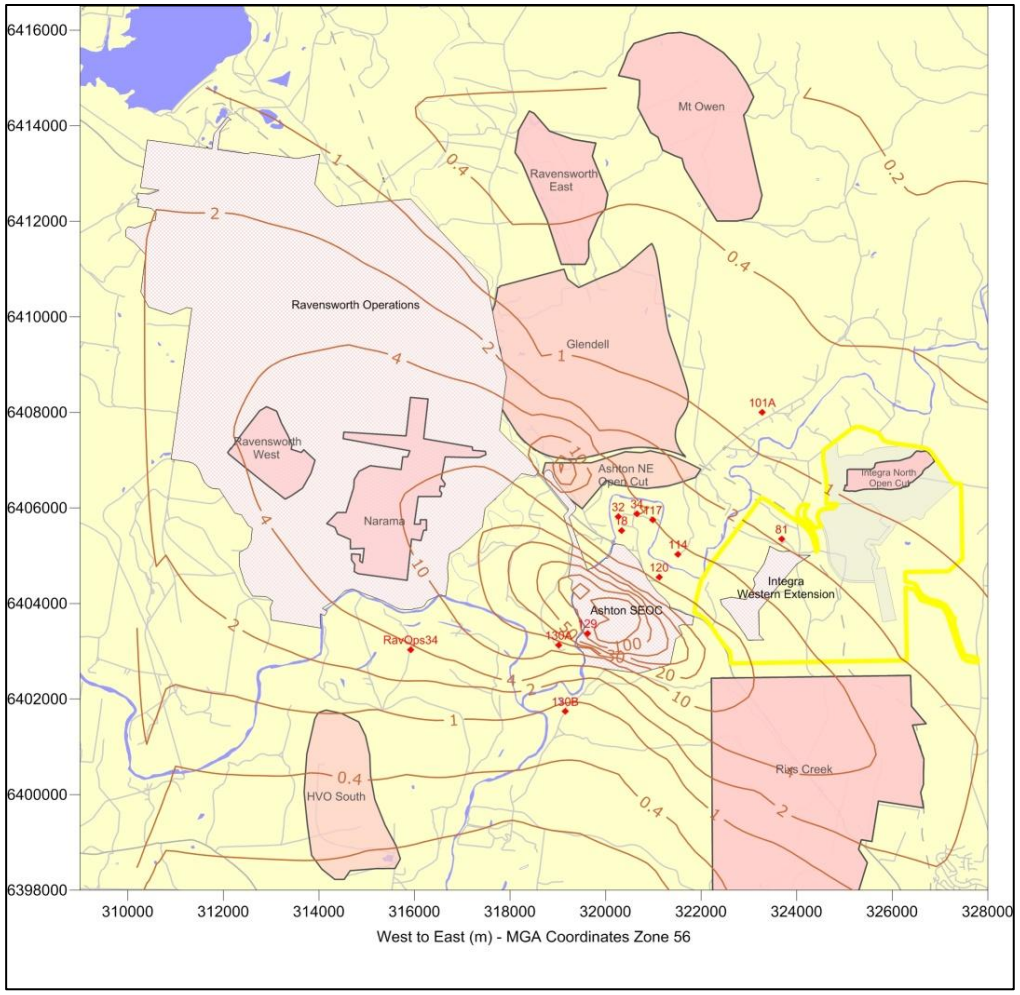
Contour from environmental assessment



Same contour on common map

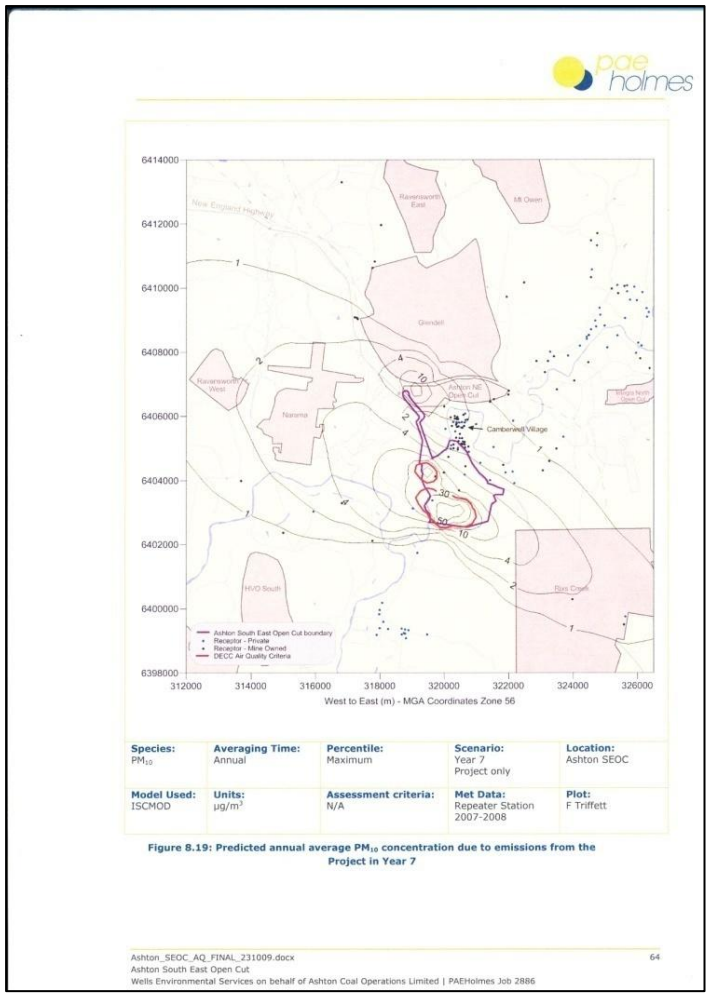
Figure A.29: Ashton South East Open Cut (SEOC) annual average PM_{10} concentration – Year 3 (2013) (µg/m^3)

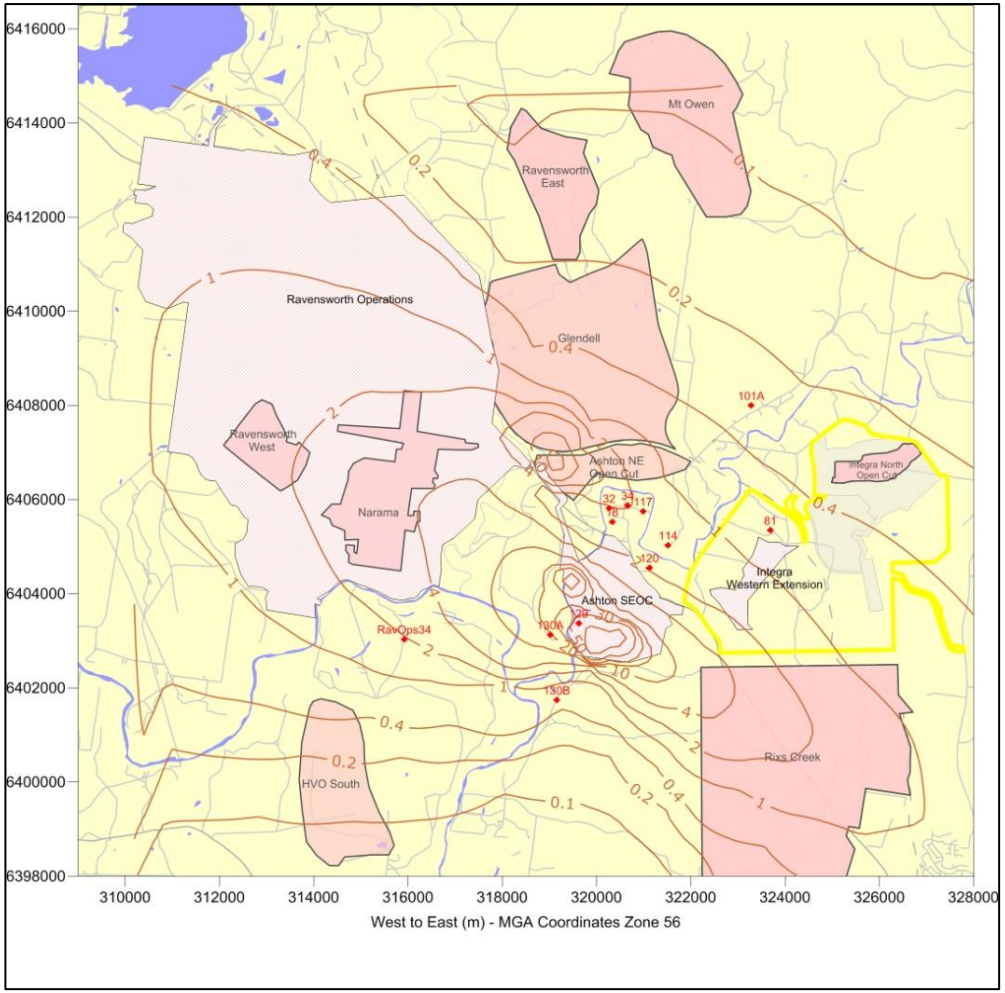




Contour from environmental assessment **Same contour on common map**

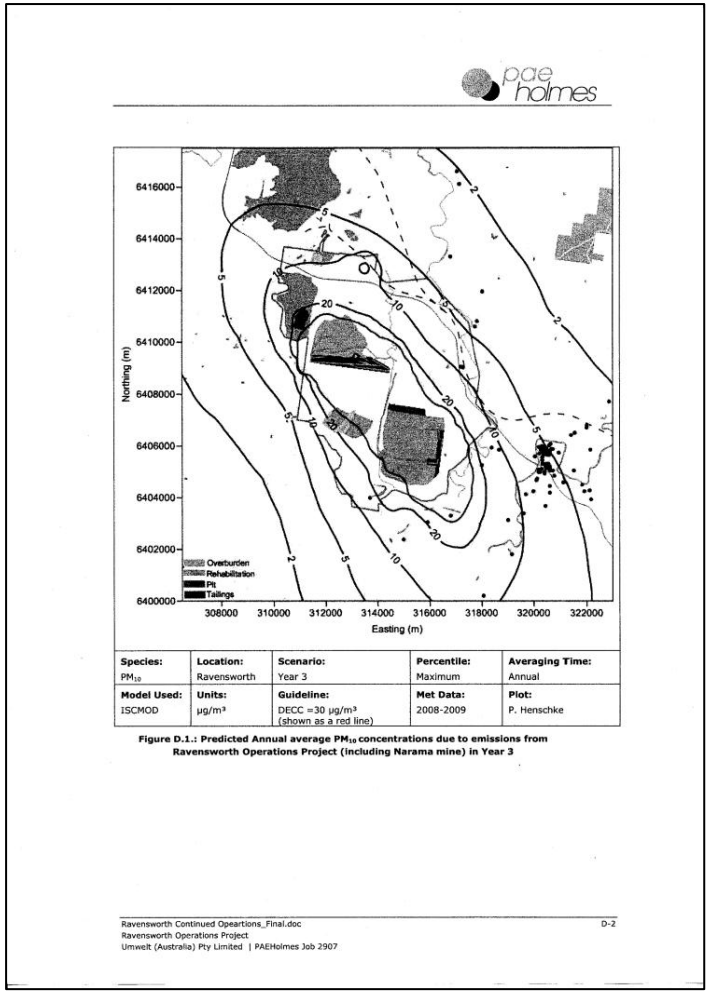
Figure A.30: Ashton South East Open Cut (SEOC) annual average PM_{10} concentration – Year 5 (2015) (µg/m³)

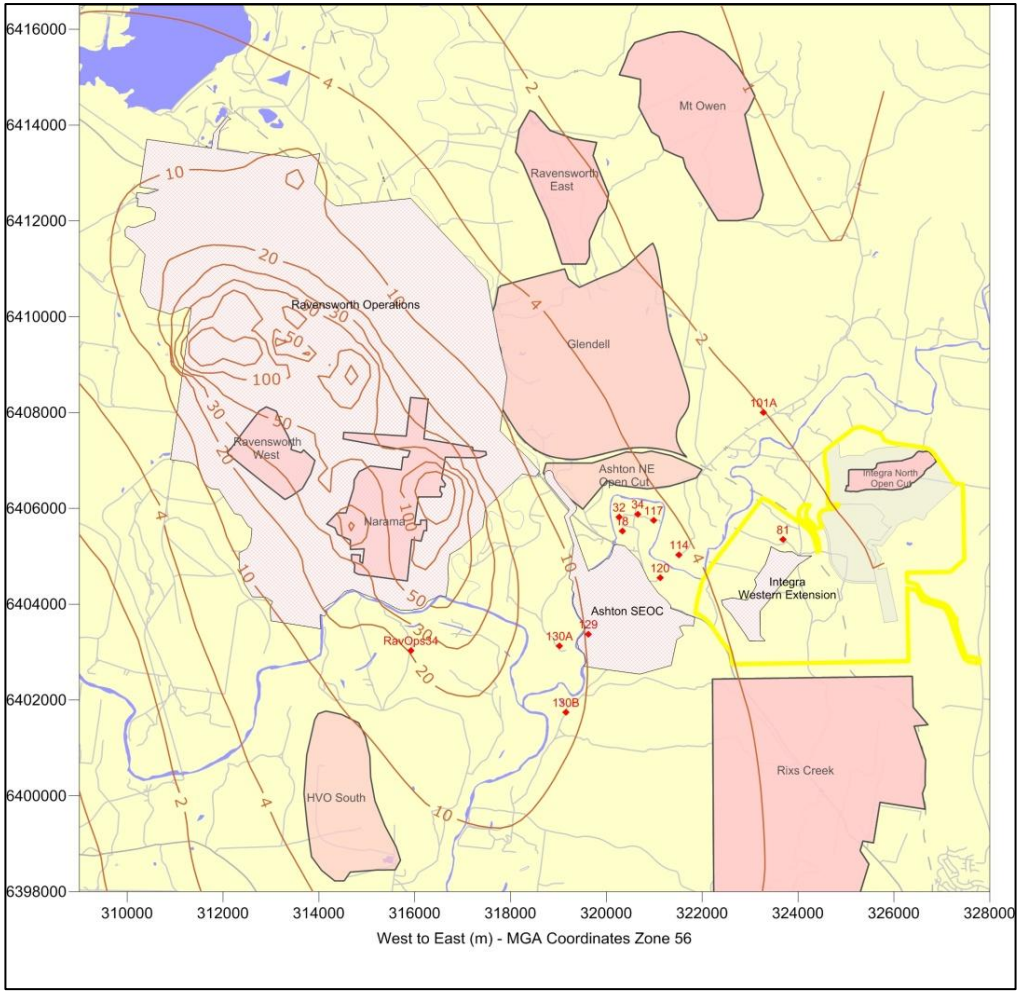




Contour from environmental assessment **Same contour on common map**

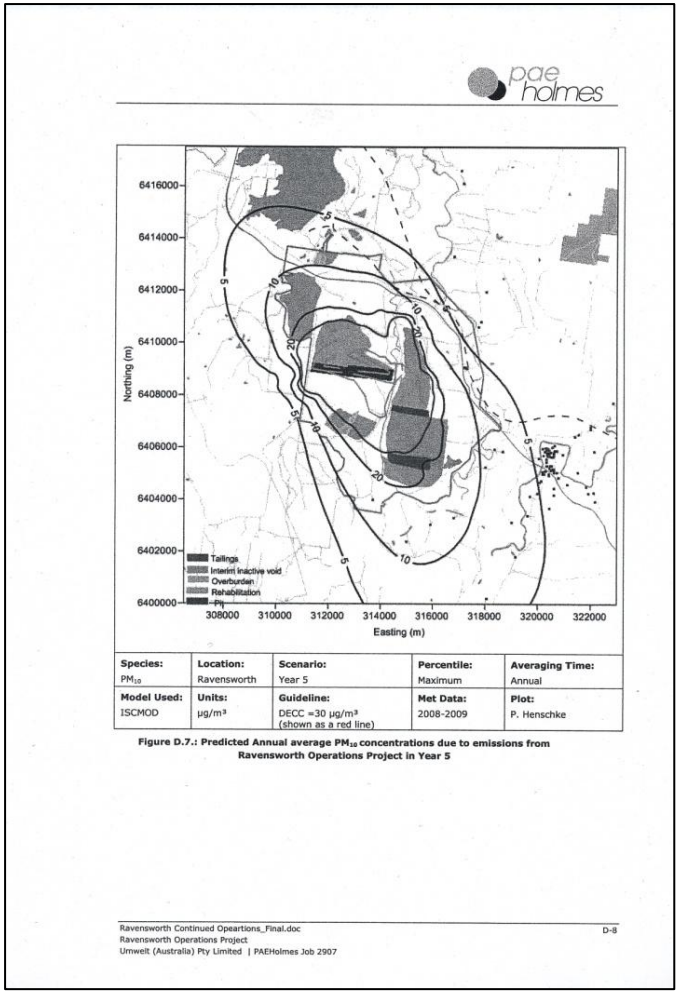
Figure A.31: Ashton South East Open Cut (SEOC) annual average PM_{10} concentration – Year 7 (2017) (µg/m³)



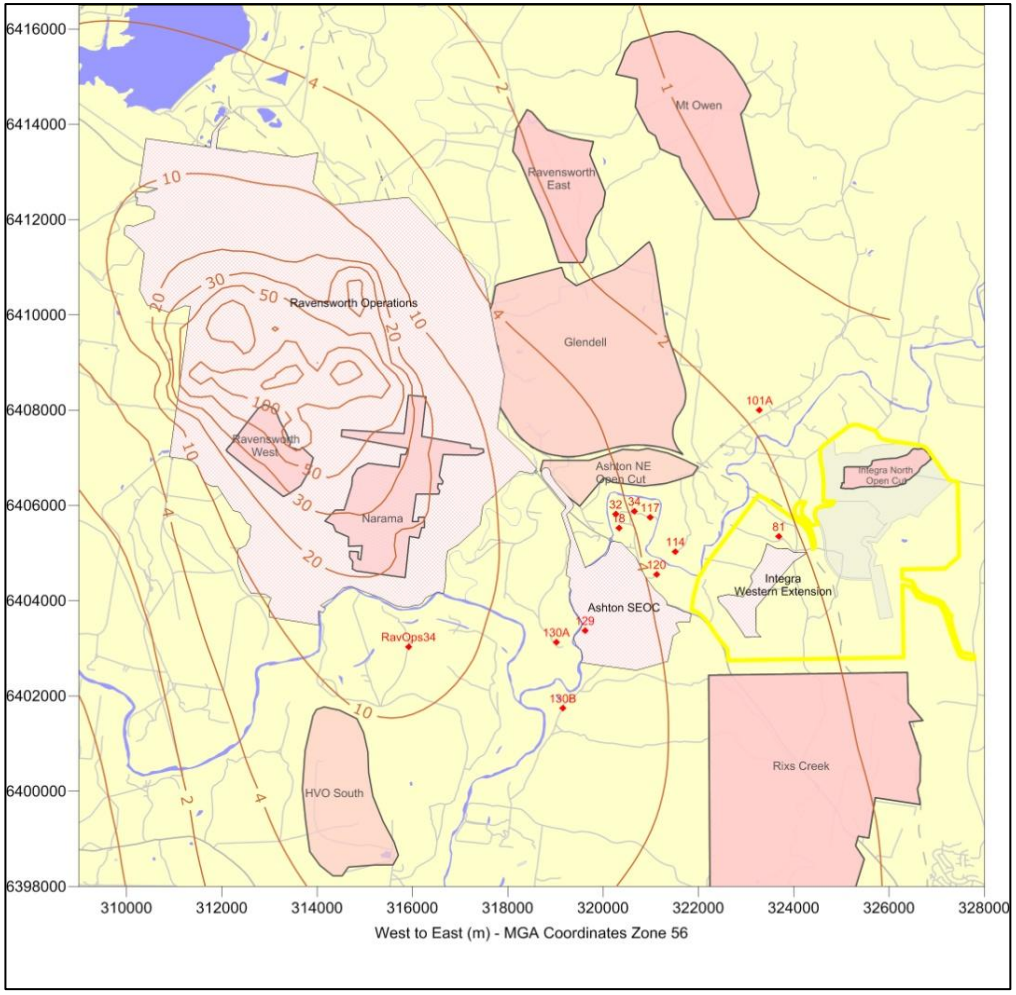


Contour from environmental assessment **Same contour on common map**

Figure A.32: Ravensworth Operations annual average PM_{10} concentration – Year 3 (2013) ($\mu g/m^3$)

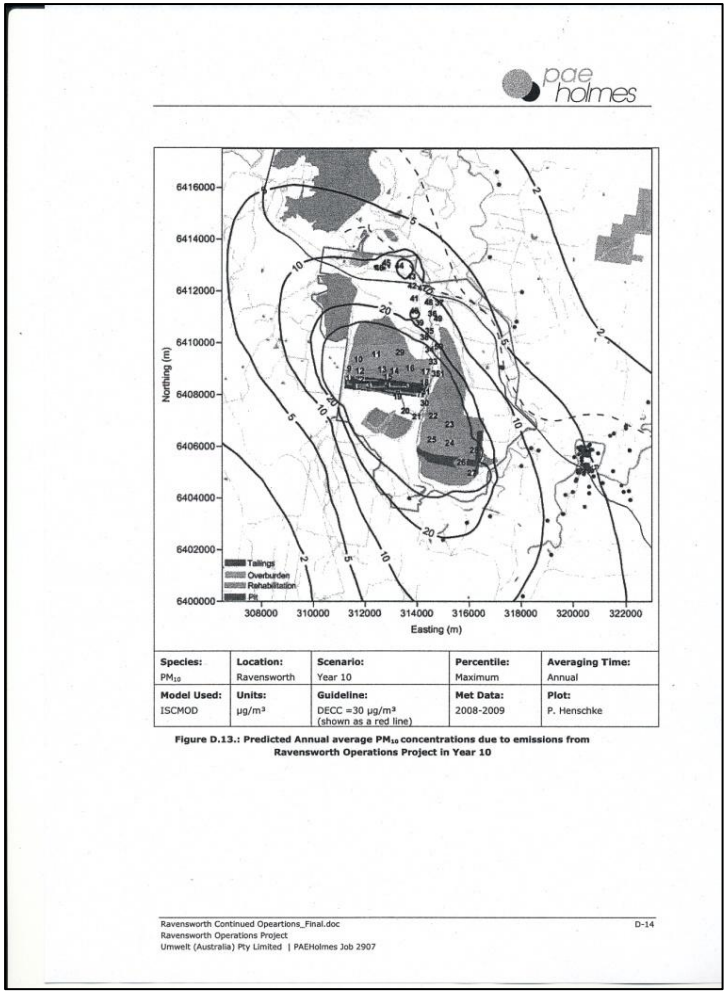


Contour from environmental assessment

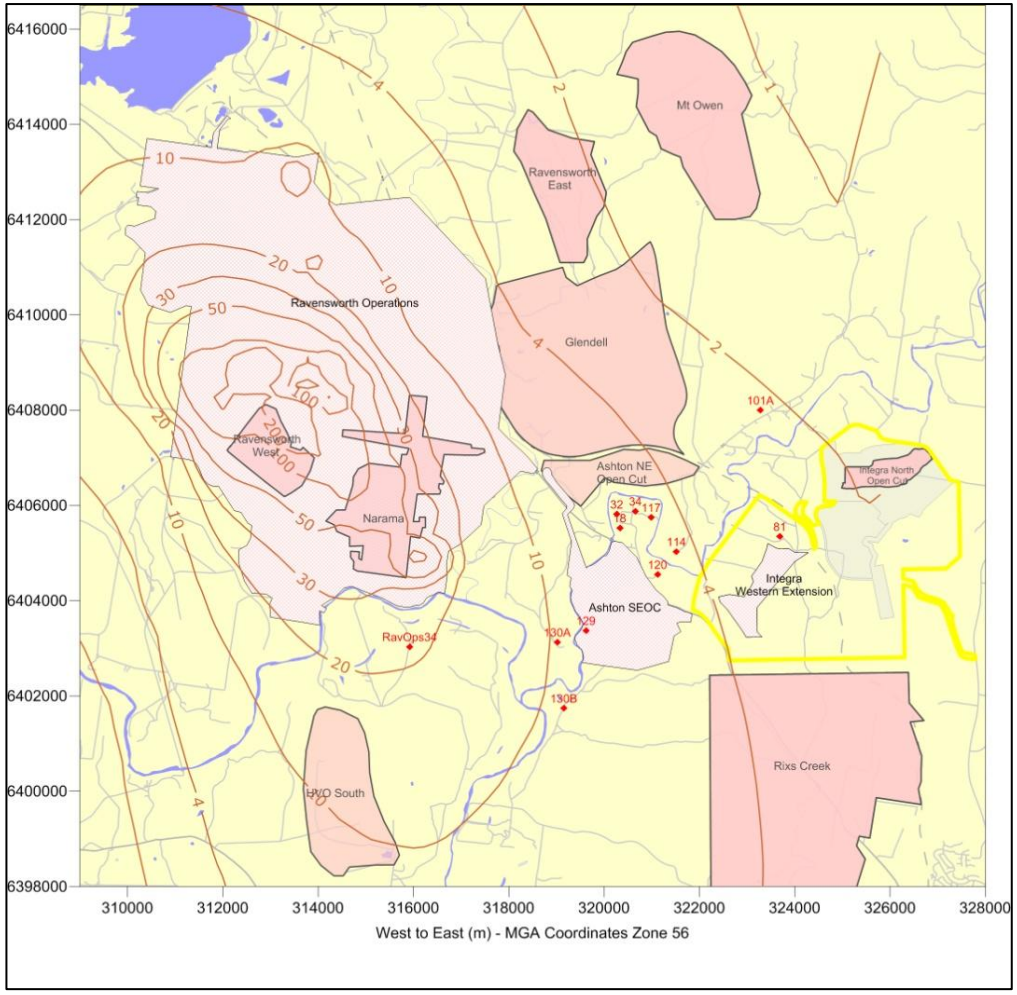


Same contour on common map

Figure A.33: Ravensworth Operations annual average PM_{10} concentration – Year 5 (2015) ($\mu g/m^3$)



Contour from environmental assessment



Same contour on common map

Figure A.34: Ravensworth Operations annual average PM_{10} concentration – Year 10 (2020) (µg/m³)