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22 April 2016

Jason Martin
Senior Environmental Scientist
Hansen Bailey
Via email: JMartin@hansenbailey.com.au

RE: Air Quality Assessment – Bengalla Mine Development Consent Modification 2

Dear Jason,

Todoroski Air Sciences has assessed the potential for air quality impacts to arise due to the proposed modifications to increase the height of the Main Overburden Emplacement Area (Main OEA) at the Bengalla mine (Bengalla) and access to the Clean Water Dam (CW1) site office north of Wybong Road.

Modification description

Bengalla is an open cut coal mine located approximately 4 kilometres (km) west of Muswellbrook in the Upper Hunter Valley of New South Wales. Bengalla Mining Company Pty Limited (BMC) was granted approval on 3 March 2015 for the continuation of mining under State Significant Development Consent SSD-5170.

BMC is seeking approval from the NSW Minister for Planning or their delegate for a modification to SSD-5170. The modification is sought under section 96(2) of the *Environmental Planning and Assessment Act* (EP&A Act) for the following:

- Alterations to maximum approved height of the Main OEA to improve visual amenity from primary viewing locations in and around surrounding the township of Muswellbrook and Denman Road, in two select locations (Visual Relief Areas):
    - The Northern Relief Area constructed to a maximum height of Reduced Level (RL) 300; and
    - The Southern Relief Area constructed to a maximum height of RL 290.
- Establishment of a new gravel access road from Wybong Road to the Dry Creek Diversion Project Construction Site Office being a former homestead (Homestead Access).

An overview of the Modification interactions with the approved conceptual Year 4 and Year 8 mine plans are presented in **Figure 1** and **Figure 2** respectively.

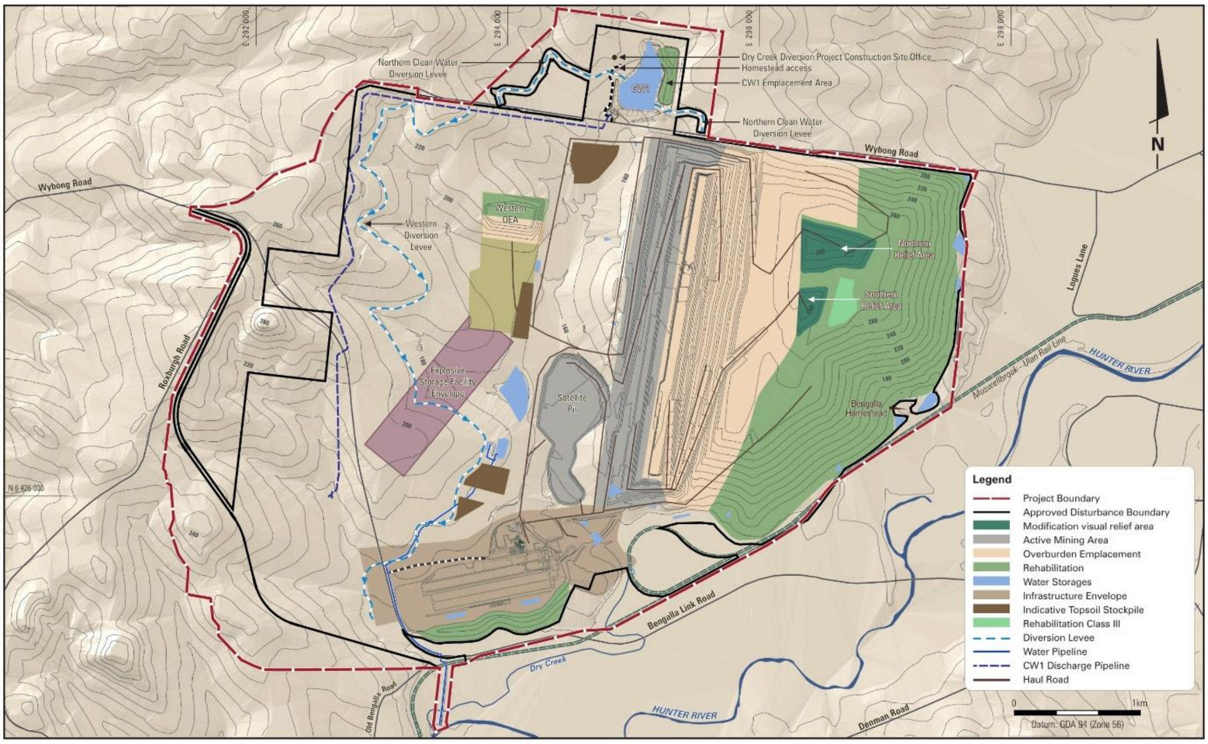

Figure 1: Modification overview – Year 4 Mine Plan

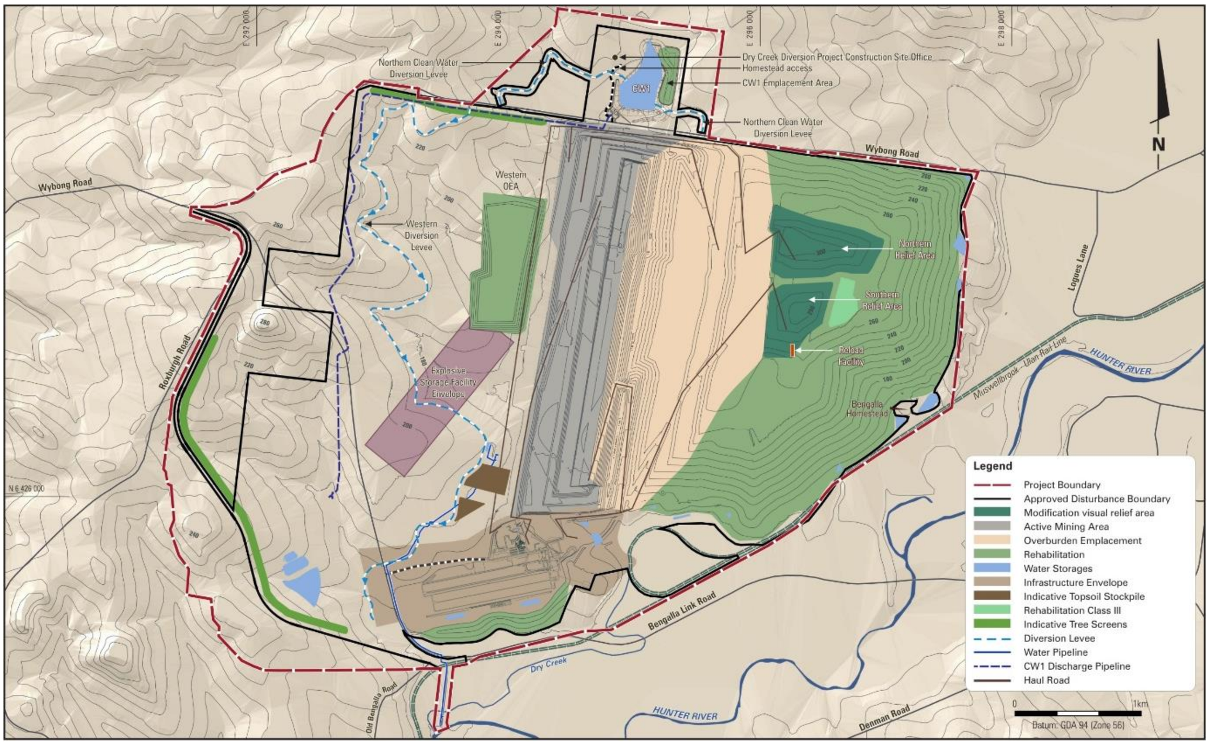

Figure 2: Modification overview – Year 8 Mine Plan

The letter report provides an assessment of the potential change in air quality associated with the proposed modifications at Bengalla. The assessment focuses on the activity required for the alteration to the approved height of the Main OEA. These changes are necessary to allow the construction of the final overburden emplacement areas to create a more visually natural looking landform, seen as two distinct visual relief areas shown in dark green in **Figure 1** and **Figure 2** respectively.

Compared to the development of the currently approved flat topped emplacement area, to form the overburden material into these two mounds would require some minor additional handling, transport and shaping of the material, which is likely result in a small increase to the existing approved level of dust emissions for the mine. No additional material is required for the Modification however the location for the emplacement of this material is the subject of the assessment.

To investigate what effect the alteration to the approved height of the Main OEA may have on dust levels in the wider environment, air dispersion modelling was performed to predict the potential change associated with this aspect of the Modification.

The establishment of the Homestead Access is expected to only generate a small quantity of dust for a short period. Relative to the total quantity of dust generated from the operations, any potential dust impacts from this activity would be negligible, and hence has not been considered further. Appropriate dust mitigation and management measures for these activities would apply regardless.

Assessment of potential air quality impacts

To enable a visually more natural landform of the Main OEA, the construction of two visual relief areas over the approved relatively flat topped emplacement area are proposed (refer to **Figure 1** and **Figure 2**). The visual relief areas would result in an increase in height of the Main OEA (in the two visual relief areas only), with some overburden material originally proposed to be emplaced in the Main OEA for SSD-5170 to be redirected.

The development of the visual relief areas would involve the emplacement of approximately 10 million bank cubic metres (Mbcm) of overburden material. It is important to note that no additional overburden material would be moved in any one year as a result of this modification, material would only be redirected.

The potential change in total dust emissions for Bengalla and intensity of activity is therefore expected to be small, however, as this would be largely concentrated at the crown of the Main OEA this may have an effect on dust levels off-site. To investigate the extent of this effect, air dispersion modelling was performed using the comprehensive and detailed model previously developed for the Continuation of Bengalla Mine Environmental Impact Statement (EIS) (**Hansen Bailey, 2013**), which was subsequently updated to reflect the proposed features of the Modification.

The air dispersion model is setup identically to allow for a direct comparison with the previous assessment. Further details regarding the air dispersion model setup can be found in the Air Quality Impact Assessment (AQIA) (**TAS, 2013**). The Modification is anticipated to occur over an approximate six year period and would only involve changes during Years 4 and 8 of the AQIA. Years 1, 15 and 24 would remain consistent with the predicted impacts in the AQIA and as included in SSD-5170 (as modified).

A comparison of the estimated total annual dust emissions in Year 4 and Year 8 for the approved mining operation and the proposed Modification is presented in **Table 1**. The cells highlighted in orange indicate the activities associated with the proposed Modification.

It is calculated that the total annual dust emissions associated with the Modification would increase by approximately 2 – 2.5% relative to the approved Project. The small increase in total annual dust emissions due to the Modification arises from the additional haulage distances, the dozer activity required for shaping and the increase in exposed areas of the visual relief areas.

Table 1: Comparison of estimated TSP emission rate for the proposed modification (kg/year)

Activity	Year 4 – Approved operations	Year 4 – Modification	Year 8 – Approved operations	Year 8 – Modification
OB - Topsoil Removal	4,184	4,184	4,184	4,184
OB - Drilling	12,469	12,469	12,469	12,469
OB - Blasting	53,589	53,589	53,589	53,589
OB - Loading OB to haul truck	128,650	128,650	128,650	128,650
OB - Loading OB to haul truck Sat-Pit	10,675	10,675	-	-
OB - Loading OB to haul truck at Wybong Dump	-	1,770	-	-
OB - Hauling to Emplacement	2,698,560	2,542,873	3,053,058	2,941,018
OB - Hauling to Emplacement WOEA	60,058	60,058	-	-
OB - Hauling to Emplacement Sat-Pit	150,162	150,162	-	-
OB - Hauling to Emplacement Relief from Main Pit	-	108,789	-	77,503
OB - Hauling to Emplacement Relief from Wybong Dump	-	6,392	-	-
OB - Emplacing at Dump	133,424	126,342	128,650	128,650
OB - Emplacing at Dump WOEA	5,901	5,901	-	-
OB - Emplacing at Dump Relief	-	8,852	-	4,721
OB - Loading OB to haul truck at WOEA	-	-	17,704	17,704
OB - Hauling to Emplacement from WOEA	-	-	283,400	283,400
OB - Emplacing at Dump from WOEA	-	-	17,704	17,704
OB - Rehandle Overburden	6,175	6,175	6,175	6,175
OB - Dozers on various OB Activities	677,876	677,876	677,876	677,876
OB - Dozers on various OB Relief	-	67,788	-	4,051
OB - Dragline	362,222	362,222	250,169	250,169
CL - Drilling	1,233	1,233	1,233	1,233
CL - Blasting	5,954	5,954	5,954	5,954
CL - Dozers ripping/pushing/clean-up	246,855	246,855	246,855	246,855
CL - Loading ROM coal to haul truck	570,899	570,899	622,914	622,914
CL - Loading ROM coal to haul truck Sat-Pit	52,015	52,015	-	-
CL - Hauling to ROM hopper	282,226	282,226	295,294	295,294
CL - Hauling to ROM hopper Sat-Pit	16,347	16,347	-	-
CHPP - Unloading ROM to hopper	93,437	93,437	93,437	93,437
CHPP - Rehandle ROM at hopper	93,437	93,437	93,437	93,437
CHPP - Dozers at ROM hopper	706	706	706	706
CHPP - Unloading to product coal stockpile	548	548	548	548
CHPP - Loading Rejects	514	514	514	514
CHPP - Hauling Rejects	70,864	70,864	62,573	62,573
CHPP - Dumping Rejects	514	514	514	514
PC - Loading coal to train at Bengalla Rail loop	438	438	438	438
WE - Overburden emplacement areas	745,689	745,689	537,260	537,260
WE - Overburden emplacement areas Relief	-	107,303	-	161,612
WE – Wybong Dump area	-	13,853	-	-
WE - Open pit	557,901	557,901	1,146,130	1,146,130
WE - ROM stockpiles	1,247	1,247	1,247	1,247
WE - Product stockpiles	7,156	7,156	7,156	7,156
Grading roads	62,778	62,778	62,778	62,778
Total TSP emissions (kg/yr)	**7,114,705**	**7,266,683**	**7,812,619**	**8,007,483**
% Change of Total TSP emissions		**+2.14**		**+2.49**

Dispersion modelling predictions

The predicted air quality levels due to the proposed Modification are overlaid with the predictions for the indicative Year 4 and Year 8 of the AQIA (**TAS, 2013**) and as amended in a letter report (**TAS, 2014**). The amended letter report demonstrates the dust mitigation strategy for short-term dust impacts outlined in the existing air quality management plan (as modified) for Bengalla (**Hansen Bailey, 2016**). Overlaying these contours allows for a direct comparison of the potential change associated with the proposed Modification and any adjustment to be clearly seen.

Year 4

The dispersion modelling results showing the predicted incremental maximum 24-hour average and annual average PM_{10} and $PM_{2.5}$, annual average TSP and annual average dust deposition levels for Year 4 are presented as isopleth diagrams in **Figure 3** to **Figure 9**.

The results indicate that the Modification has a noticeable effect immediately adjacent the area where the modification is taking place and only a slight increase in dust levels are predicted for the far-field areas to the east and northwest of Bengalla.

The figures show that the predicted dust levels are unlikely to change significantly at any privately-owned receptor as a result of the proposed Modification in comparison with the results presented in **TAS (2013)** and **TAS (2014)**. No additional privately-owned receptor locations are predicted to exceed any of the relevant air quality criterion as a result of the Modification during Year 4.

Year 8

The dispersion modelling results showing the predicted incremental maximum 24-hour average and annual average PM_{10} and $PM_{2.5}$, annual average TSP and annual average dust deposition levels for Year 8 are presented as isopleth diagrams in **Figure 10** to **Figure 16**.

The results indicate that the Modification has a noticeable effect immediately adjacent the area where the modification is taking place and only a slight increase in dust levels are predicted for the far-field areas to the east and northwest of Bengalla. The Modification would also see a slight reduction in areas immediately to the west of Bengalla.

Overall, the results also show that there is negligible change in the predicted impacts for areas in the far-field and in particular at any privately-owned receptor location. The figures show that the predicted dust levels are unlikely to change significantly at any privately-owned receptor as a result of the proposed Modification in comparison with the results presented in **TAS (2013)** and **TAS (2014)**. No additional privately-owned receptor locations are predicted to exceed any of the relevant air quality criterion as a result of the Modification during Year 8.

Comparison of short-term predictions

The predicted maximum 24-hour average impacts for the proposed Modification (Year 4 and 8 combined) are compared with the predicted maximum envelope for Bengalla (**TAS, 2013**) (i.e. maximum zone of influence for all years) in **Figure 17**.

The figure shows the extent of short-term dust impacts for the proposed Modification would largely remain within the existing approved maximum envelope, with the exception of a small area directly to the east of the

Bengalla, close to the proposed activity. However the small additional envelope as a result of the Modification does not result in any exceedances of the maximum 24-hour average impact criteria.

Figure 18 presents a comparison of the predicted maximum 24-hour average impacts for the proposed Modification (Year 4 and 8 combined) with the predicted maximum envelope for Bengalla including consideration of the dust mitigation strategy for short-term dust impacts (**TAS, 2014**).

This figure shows a similar result, in that the predicted impacts due to the proposed Modification would largely remain within the existing approved envelope and demonstrates that the application of the dust mitigation strategy for short-term dust impacts can further minimise and prevent the potential for adverse dust levels occurring due to the proposed Modification.

<u>Cumulative total effects</u>

A comparison of the cumulative annual average PM_{10} impacts for the proposed Modification with the approved impacts in Year 4 and Year 8 is presented in **Figure 19** and **Figure 20** respectively. The figures indicate that the proposed modifications would have no detectable influence on the existing approved situation in regard to the total cumulative level of impact.

Overall, the proposed Modification would result in a negligible change to the approved operations and would not result in any materially significant additional impacts at the surrounding receptor locations and no additional acquisition or management requirements would be triggered.

It should be noted that the small changes that may arise would be within the modelling accuracy, and the natural variation in the background dust levels that occur day to day or year to year.

Summary and Conclusions

The activities associated with the proposed Modification to the Main OEA may generate approximately two to two and a half per cent more dust relative to the approved SSD-5170 (as Modified) Project. This change is within the degree of daily or annual variation that naturally occurs in background dust levels and the modelling accuracy.

Direct modelling of all mining activities including the proposed Modification to the Main OEA during mine plan Year 4 and Year 8 was conducted and compared with the approved levels (i.e. without the Modification from **TAS (2013)**).

The comparison shows that the proposed Modification would only influence dust levels in close vicinity to the site of the activity and that no significant change in dust level at any off-site receptor would occur from the mine as a result of the proposed Modification. The cumulative levels, including background levels and the emissions from all other mines show no discernible change. No additional privately-owned receptor locations are predicted to exceed any of the relevant air quality criterion as a result of the Modification.

It is concluded that the activities required to increase the height of the Main OEA to a more natural landform will not result in any discernible additional impact above that presented in the **TAS (2013)** assessment at any receptor locations.

Please feel free to contact us if you need to discuss (or require clarification on) any aspect of this report.

Yours faithfully,
Todoroski Air Sciences

Aleks Todoroski

Philip Henschke

References

Hansen Bailey (2013)

“Continuation of Bengalla Mine Environmental Impact Statement”, prepared by Hansen Bailey, September 2013.

Hansen Bailey (2016)

“Bengalla Mine Air Quality Management Plan”, prepared by Hansen Bailey, January 2016.

Todoroski Air Sciences (2013)

“Air Quality and Greenhouse Gas Impact Assessment Continuation of Bengalla Mine”, prepared for Hansen Bailey by Todoroski Air Sciences, July 2013.

Todoroski Air Sciences (2014)

“Bengalla Continuation – Dust mitigation strategy for short-term dust impacts”, prepared for Hansen Bailey by Todoroski Air Sciences, December 2014.

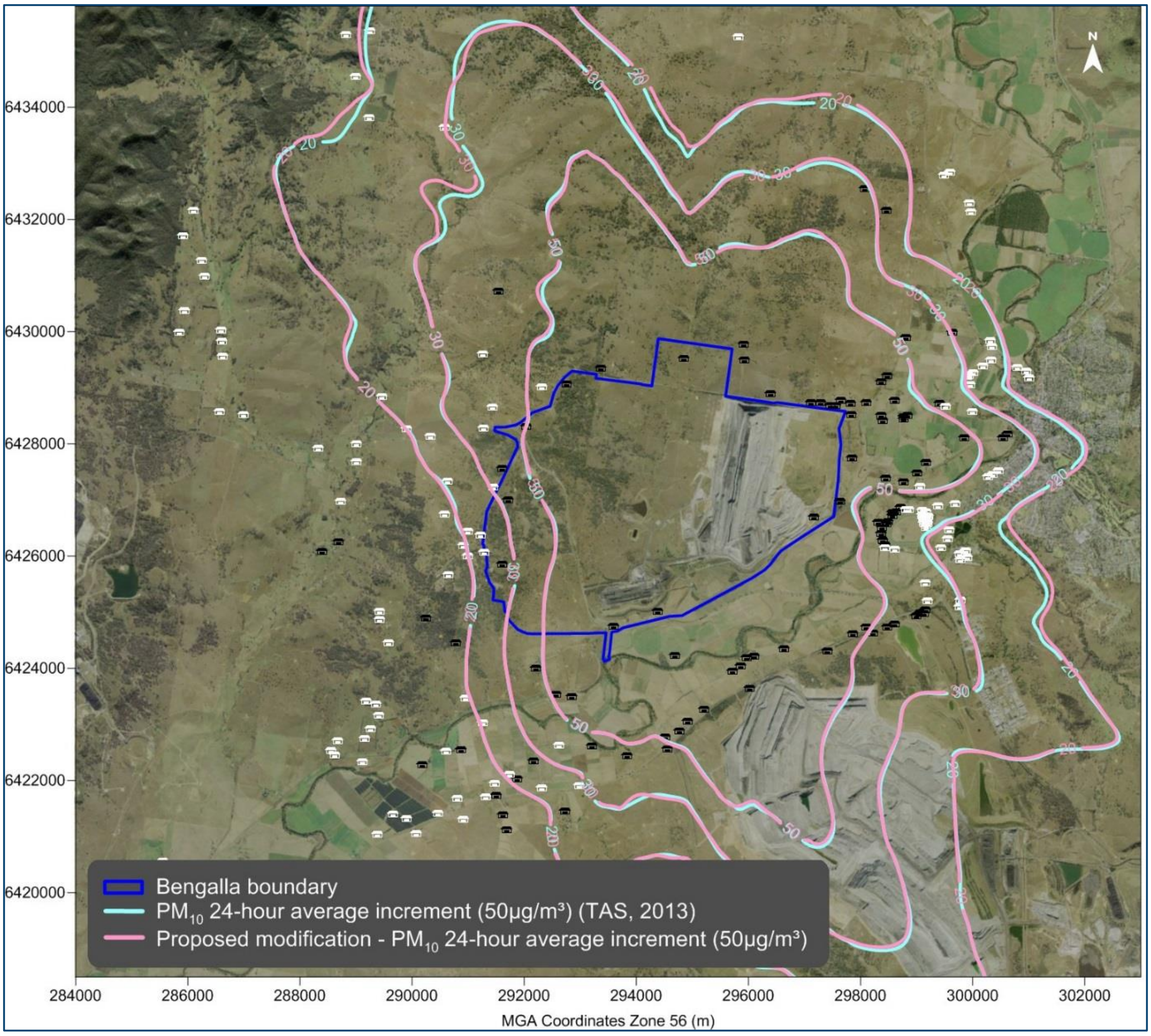

Figure 3: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed modification as per AQIA (TAS, 2013) –Year 4 (µg/m^3)

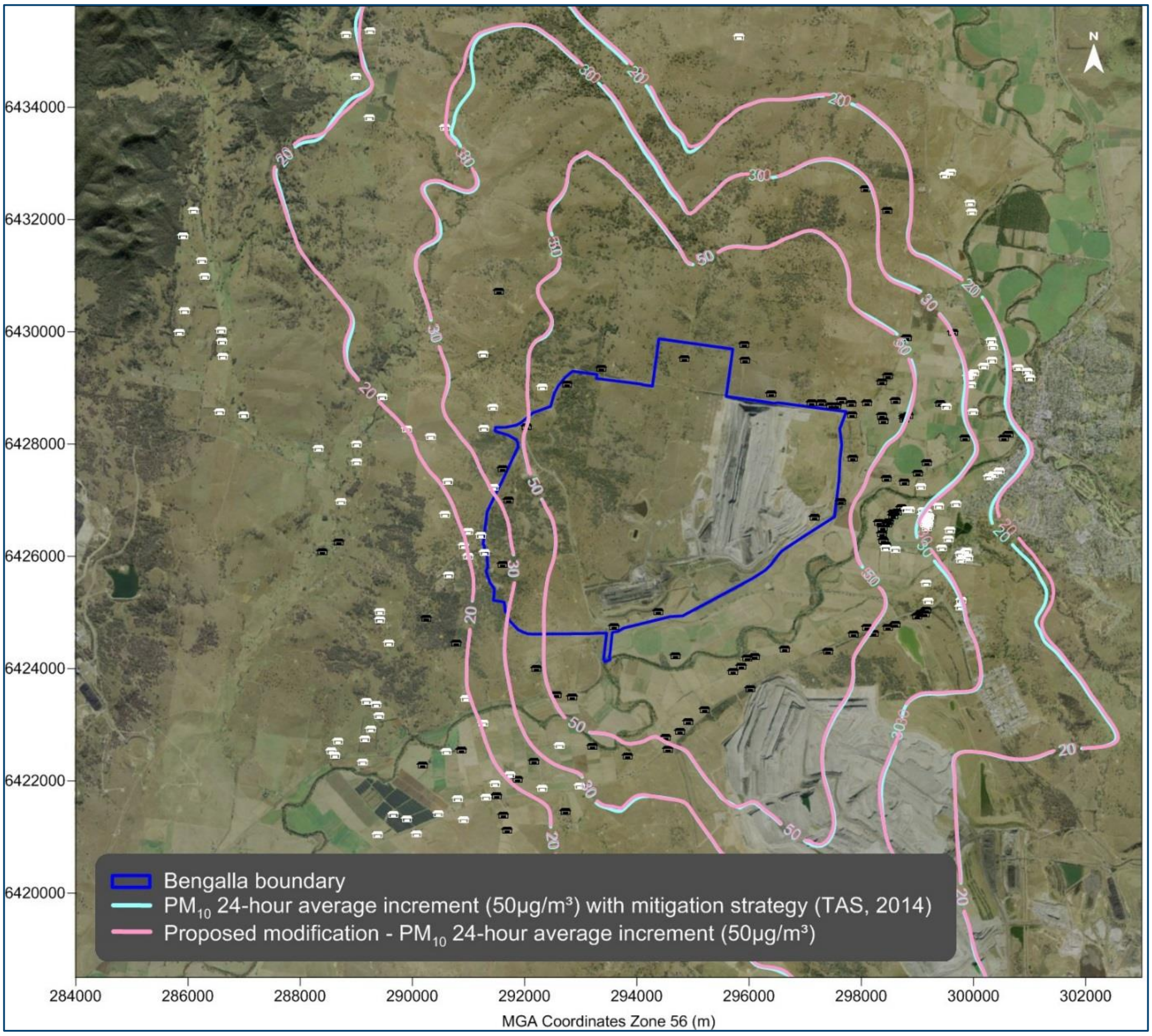

Figure 4: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed modification including consideration of mitigation strategy (TAS, 2014) –Year 4 (µg/m³)

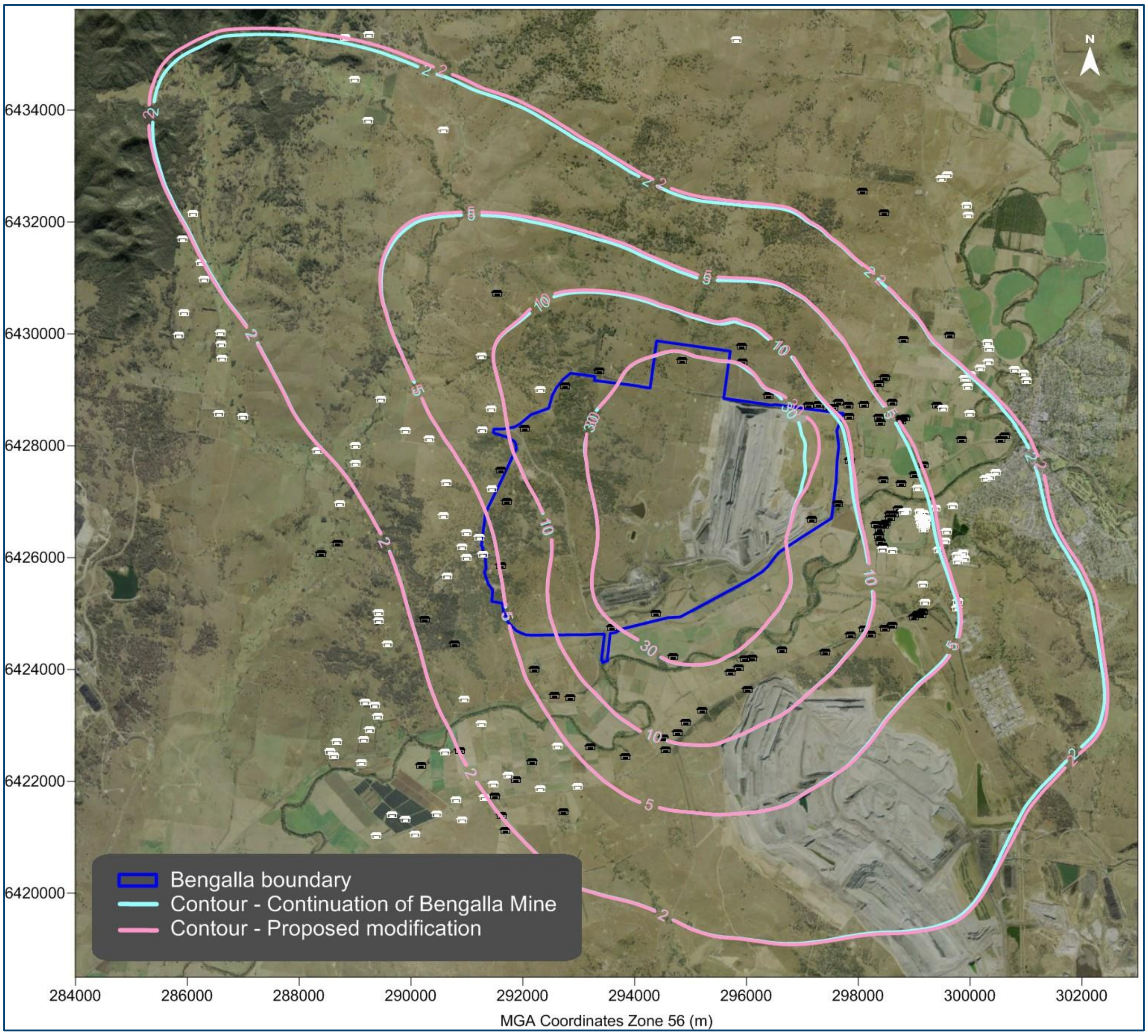

Figure 5: Comparison of predicted incremental annual average PM_{10} concentrations –Year 4 ($\mu g/m^3$)

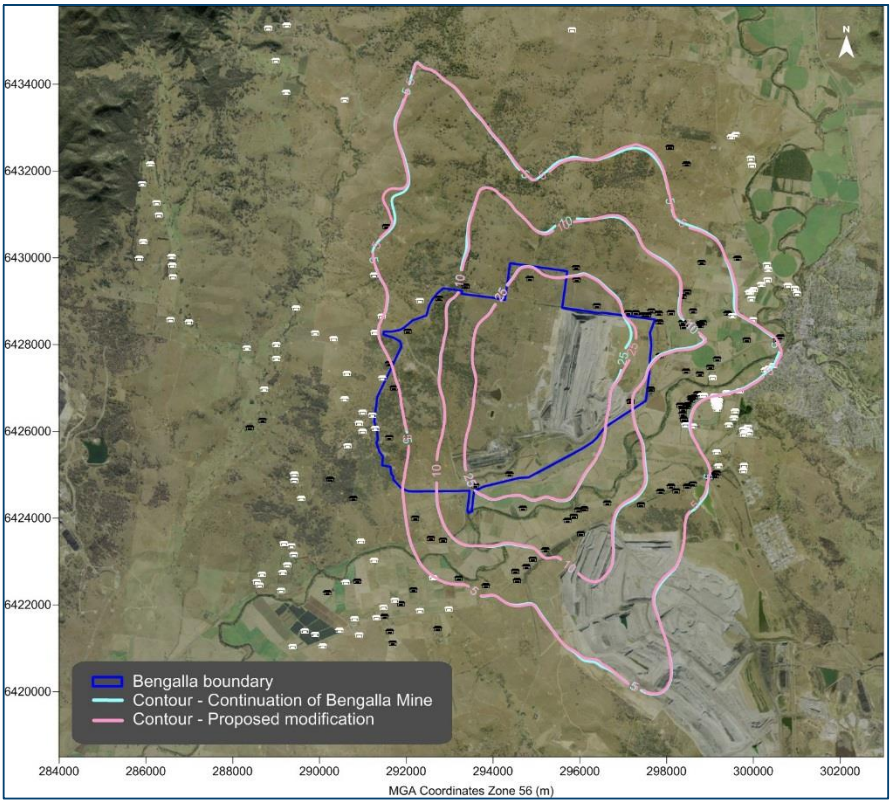

Figure 6: Comparison of predicted maximum incremental 24-hour average $PM_{2.5}$ concentrations – Year 4 (µg/m^3)

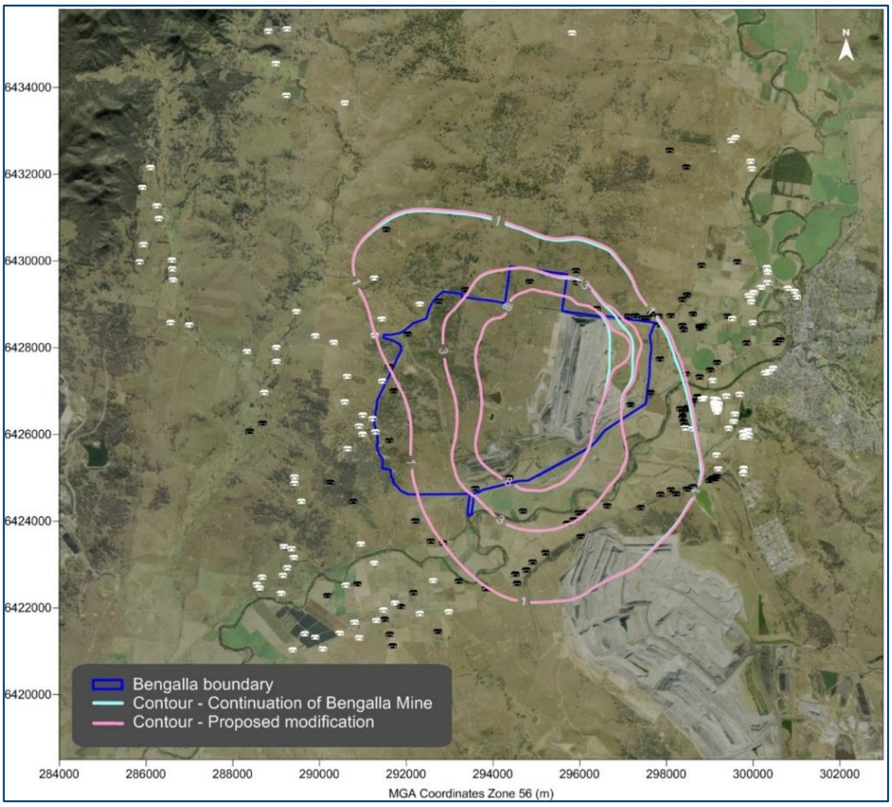

Figure 7: Comparison of predicted incremental annual average $PM_{2.5}$ concentrations –Year 4 (µg/m^3)

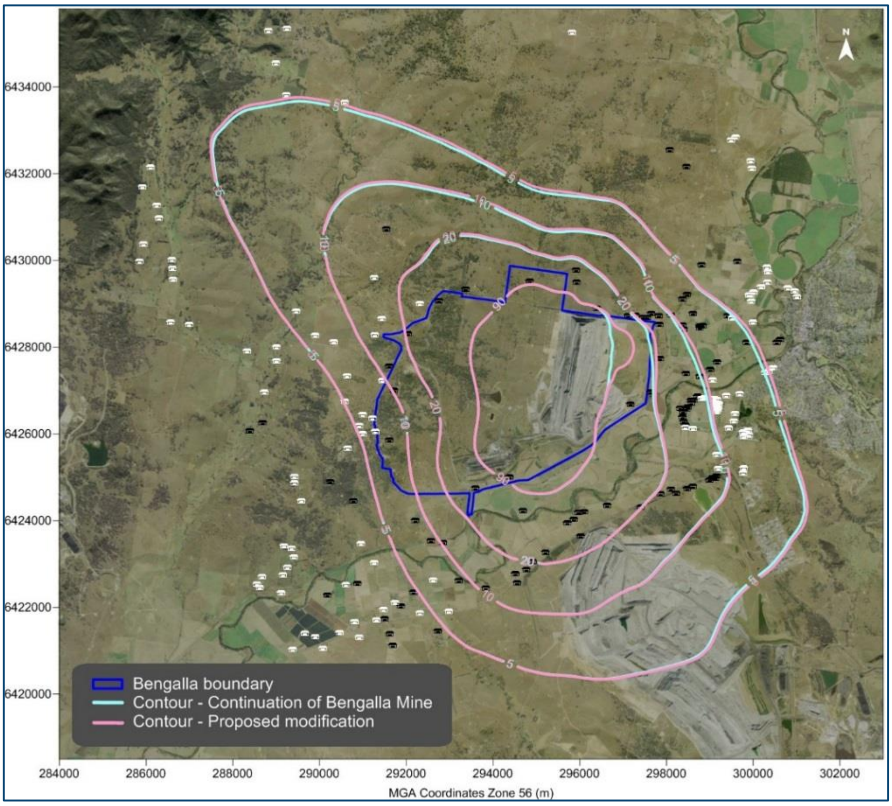

Figure 8: Comparison of predicted incremental annual average TSP concentrations –Year 4 (µg/m³)

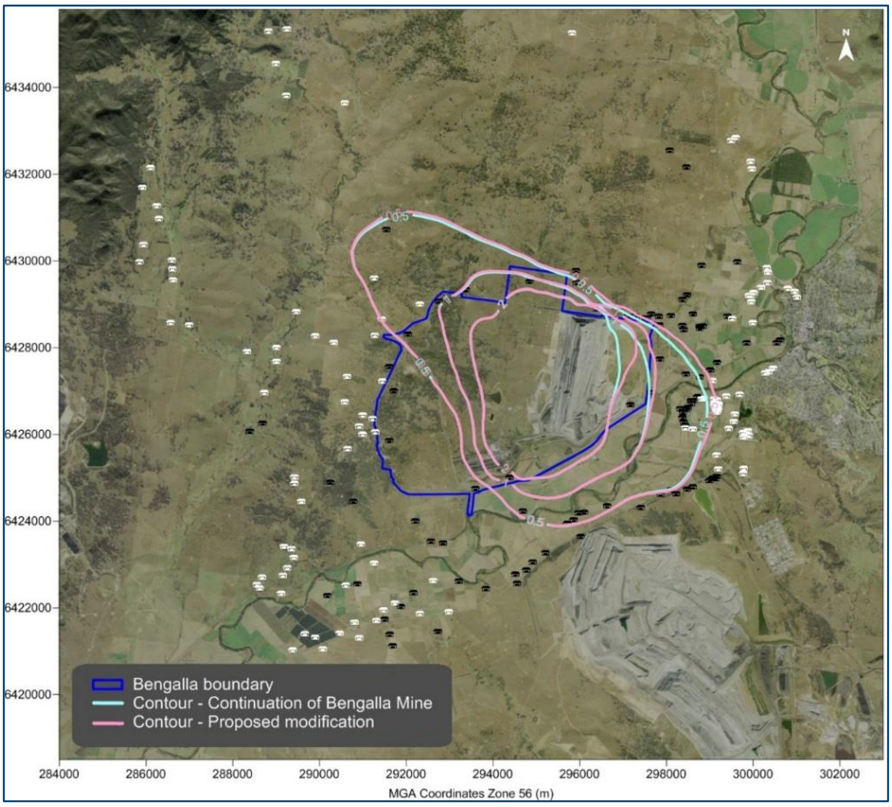

Figure 9: Comparison of predicted incremental annual average dust deposition levels –Year 4 (g/m²/month)

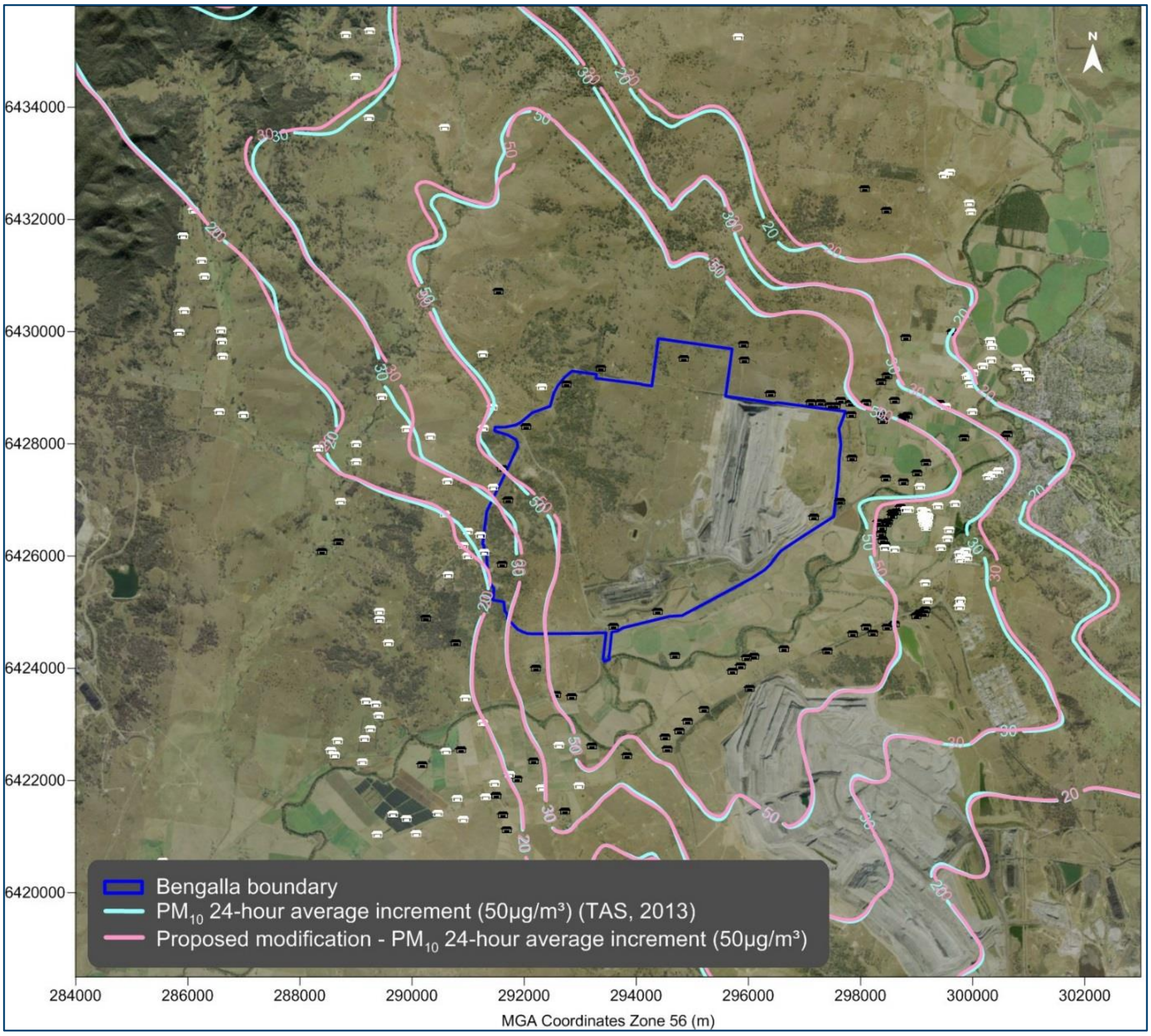

Figure 10: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed modification as per AQIA (TAS, 2013) –Year 8 (µg/m^3)

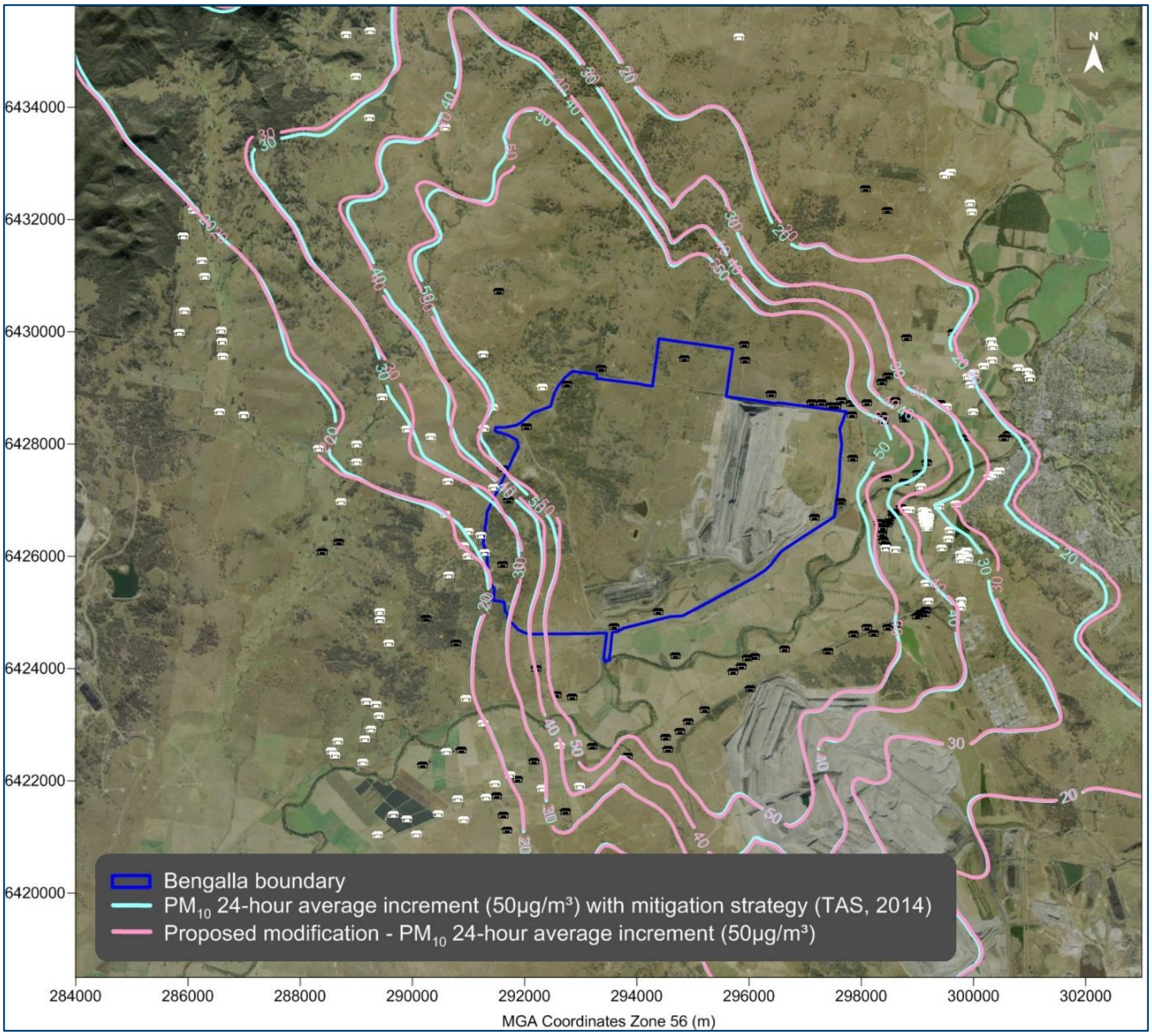

Figure 11: Comparison of predicted maximum incremental 24-hour average PM_{10} concentrations for proposed modification including consideration of mitigation strategy (TAS, 2014) –Year 8 (µg/m^3)

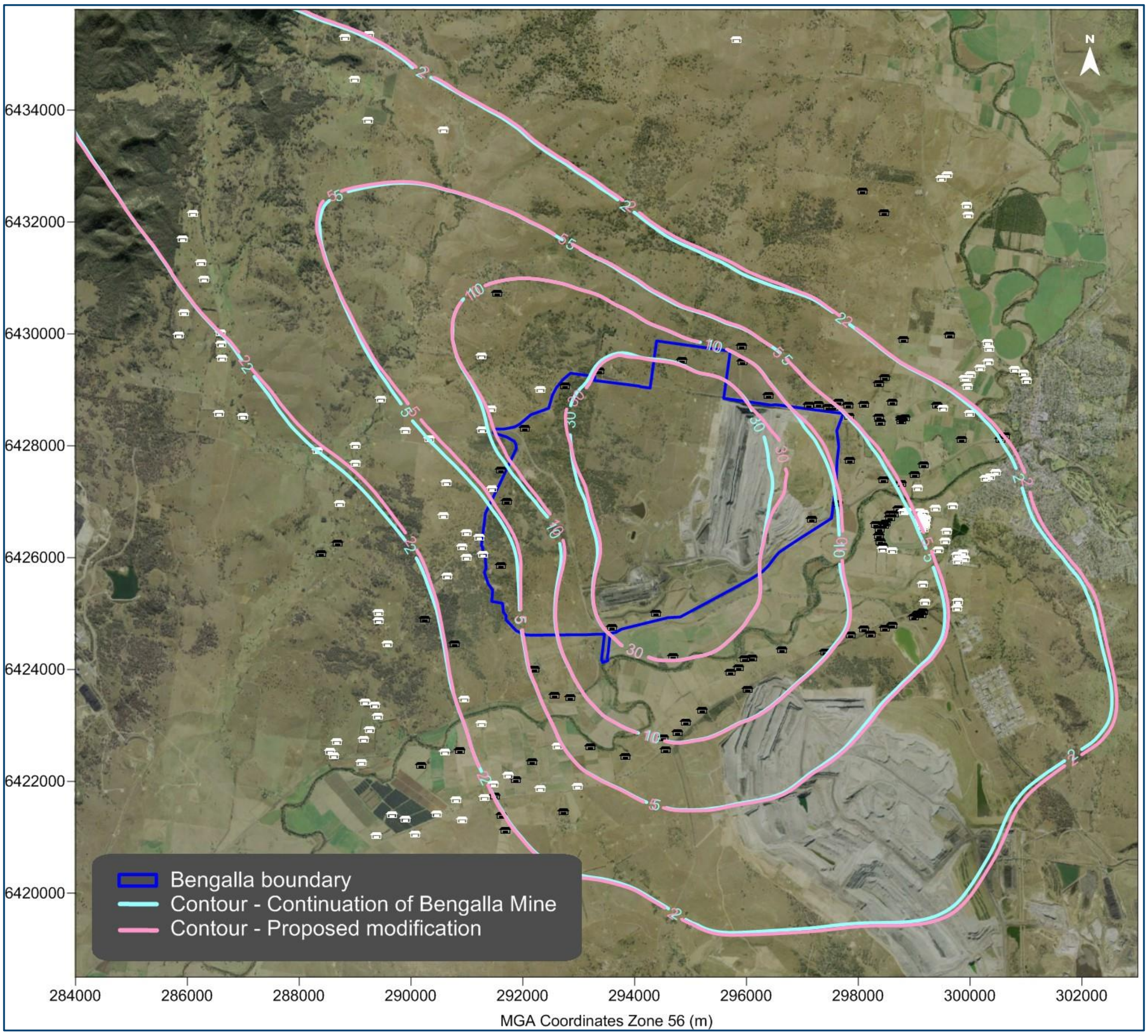

Figure 12: Comparison of predicted incremental annual average PM_{10} concentrations –Year 8 ($\mu g/m^3$)

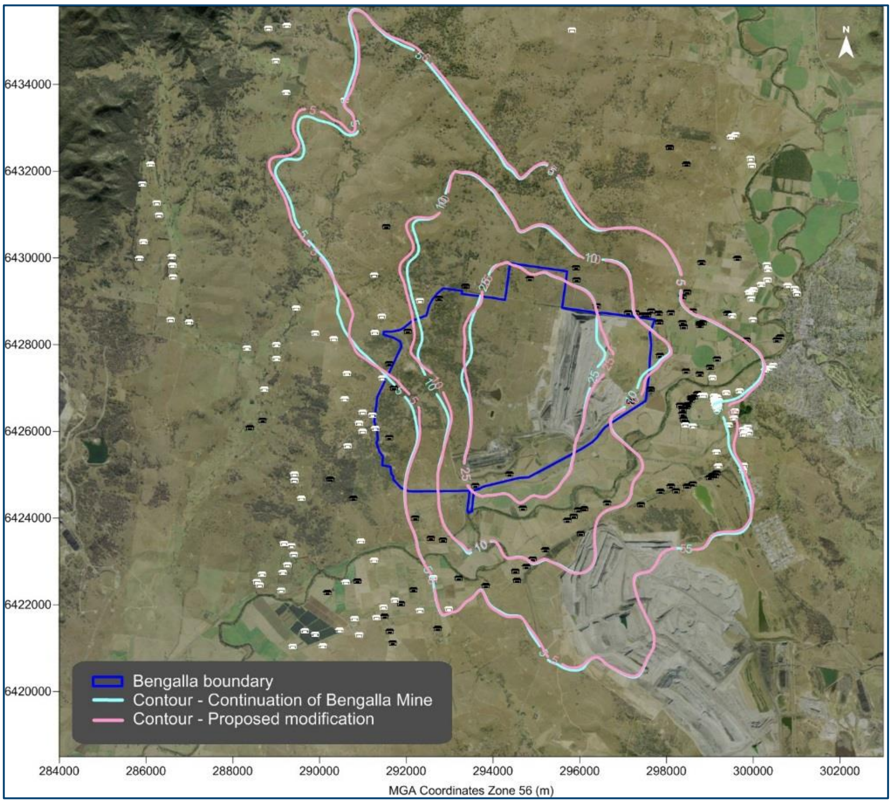

Figure 13: Comparison of predicted maximum 24-hour average $PM_{2.5}$ concentrations –Year 8 (µg/m³)

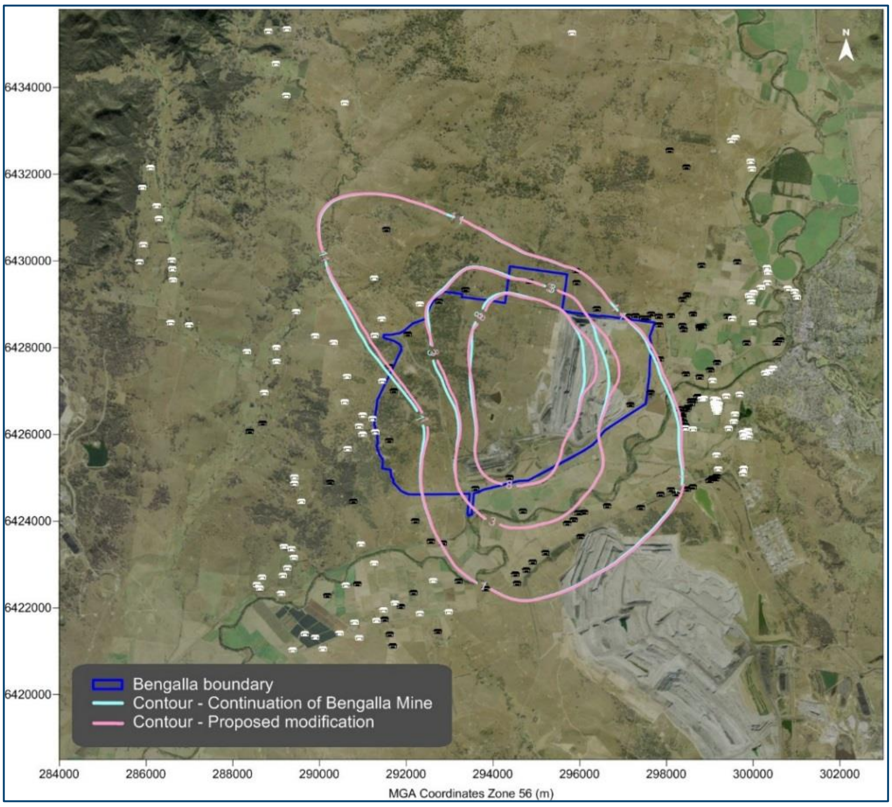

Figure 14: Comparison of predicted annual average $PM_{2.5}$ concentrations –Year 8 (µg/m³)

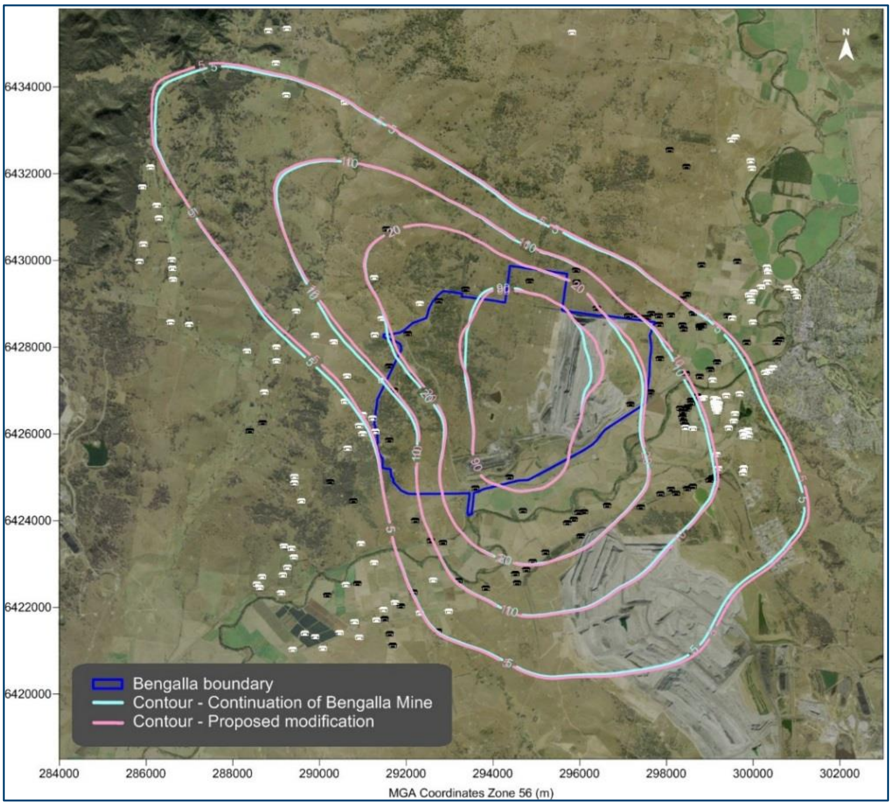

Figure 15: Comparison of predicted annual average TSP concentrations –Year 8 (µg/m^3)

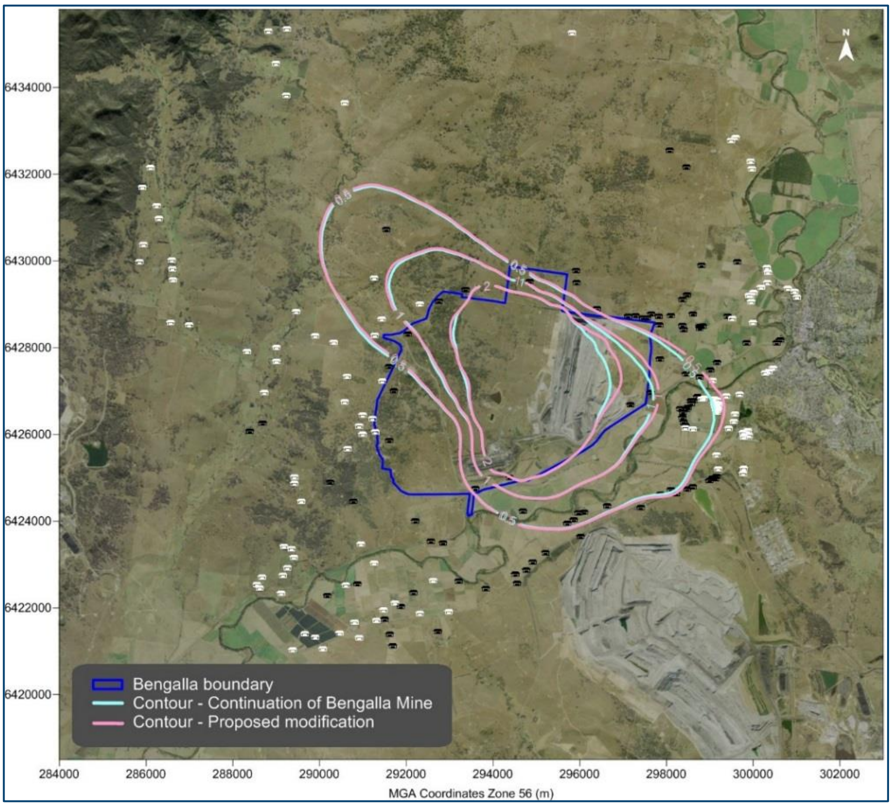

Figure 16: Comparison of predicted annual average dust deposition levels –Year 8 (g/m^2/month)

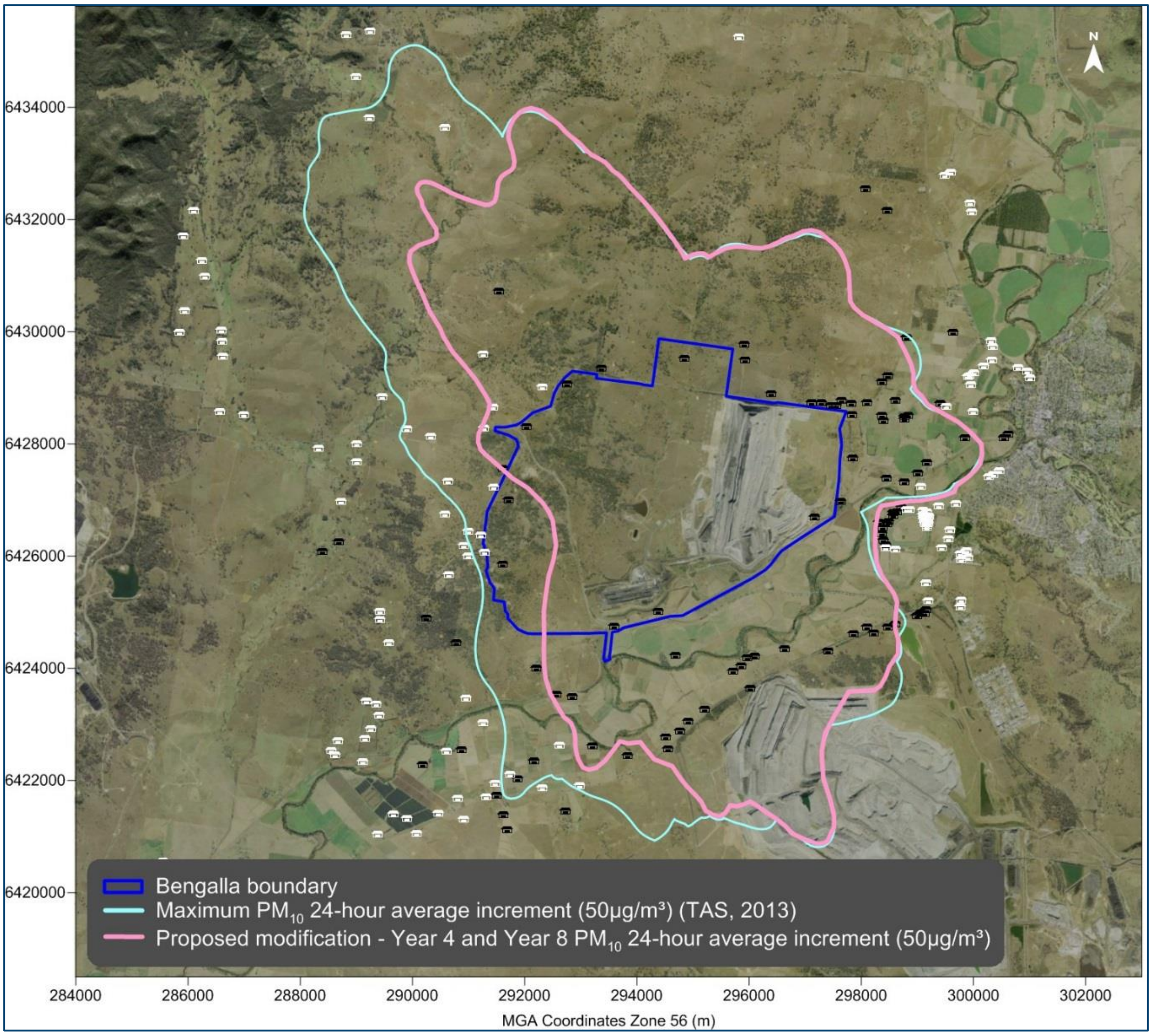

Figure 17: Comparison of maximum incremental 24-hour PM_{10} concentrations for all years, as per AQIA (TAS, 2013) with proposed modification (Year 4 and Year 8).

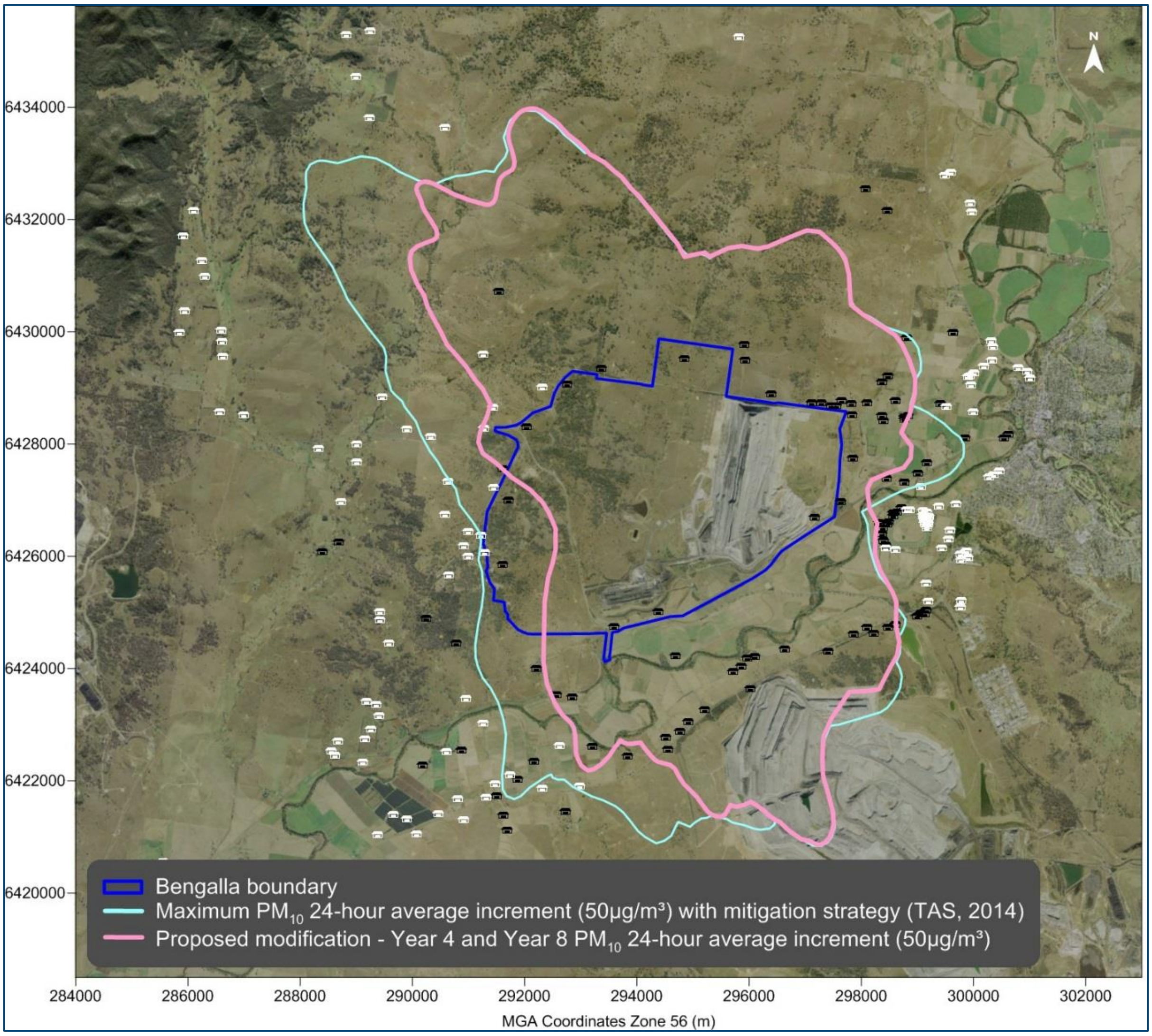

Figure 18: Comparison of maximum incremental 24-hour PM_{10} concentrations for all years with proposed modification (Year 4 and Year 8) including consideration of mitigation strategy (TAS, 2014)

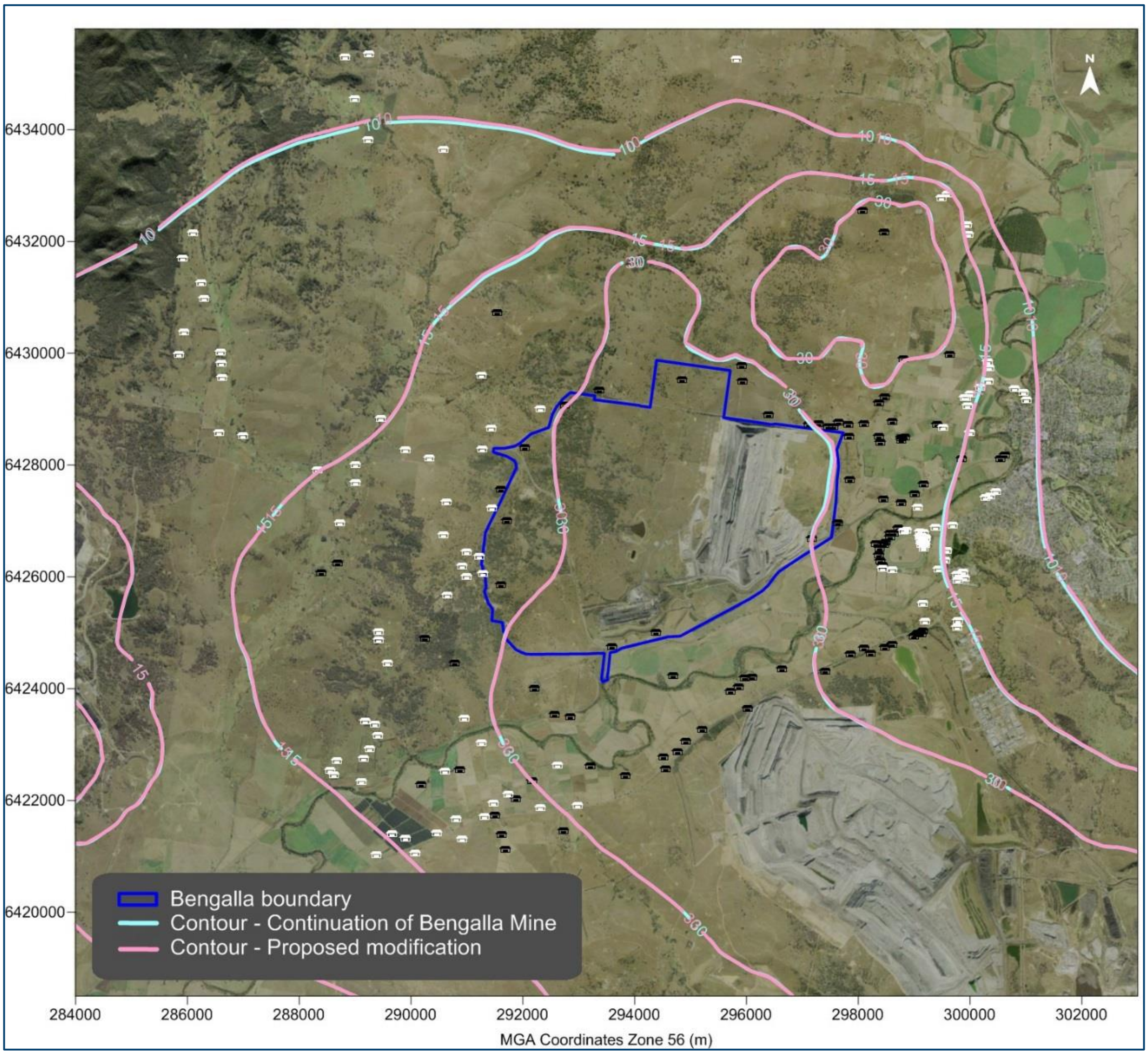

Figure 19: Comparison of cumulative predicted annual average PM_{10} concentrations (Bengalla and other sources) – Year 4 ($\mu g/m^3$)

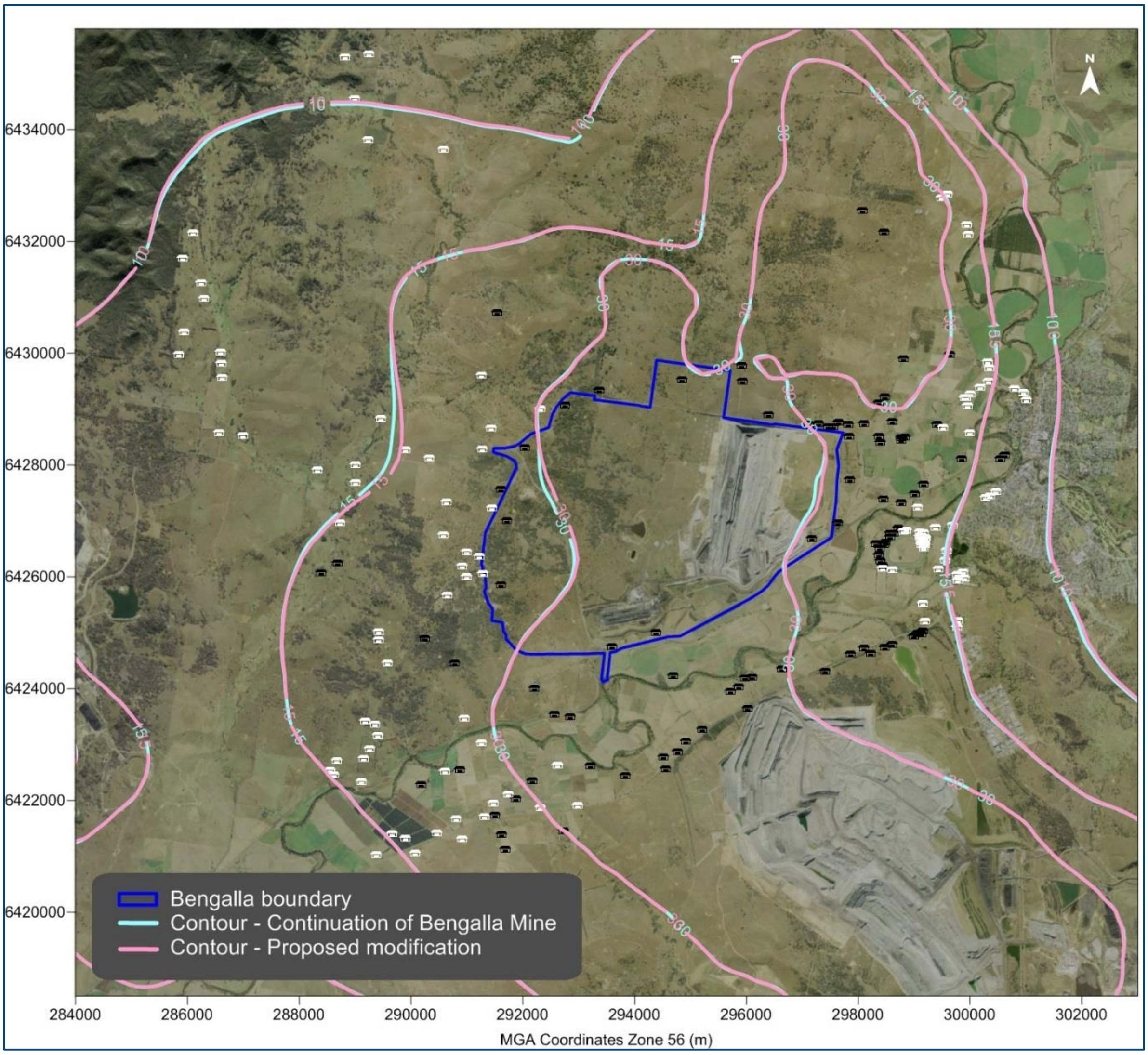

Figure 20: Comparison of cumulative predicted annual average PM_{10} concentrations (Bengalla and other sources) – Year 8 (µg/m^3)