GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

SLR

Our Ref: Lt_633.10057_RTS_Mar2013(Final)

8th April 2013

Mr David Mooney
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GPO Box 39
SYDNEY NSW 2001

Sent via: Post and Email Transmission (david.mooney@planning.nsw.gov.au)

Dear David,

RESPONSE TO SUBMISSIONS:
PROPOSED MODIFICATION TO BLAKEFIELD NORTH UNDERGROUND MINE
DA 376-8-2003 (MOD 5)

A detailed Environmental Assessment (EA) in support of a proposed modification to the approved Bulga Underground Operations (DA 376-8-2003) under Section 75W of the *Environmental Planning and Assessment Act* 1979 (EP&A Act) was lodged by Bulga Coal Management Pty Ltd (BCM) with the NSW Department of Planning and Infrastructure (DP&I) in November 2012.

The proposed modification (referred to as Modification 5) relates to the approved Blakefield North Underground Mine and includes the realignment of the approved longwall layout, increased gas drainage infrastructure, relocation of mine ventilation fans, changed coal clearance for development coal, the addition of a small scale power plant (up to 32MW) and associated surface infrastructure.

The EA was placed on public exhibition from 23 November to 10 December 2012 and seven submissions were received. Five submissions were from NSW government agencies, one was from a private landowner and one was from a special interest group (the Construction, Forestry, Mining and Energy Union).

In accordance with DP&I's requirements, a response to the matters raised in each of the submissions is provided in **Table 1**. In addition, the following supporting information has been appended to this letter to support the responses provided overleaf in **Table 1**:

- *Aboriginal Heritage Community Consultation Log and Correspondence* prepared by Ozark EHM (**Appendix 1**);
- Revised *Noise Impact Assessment* prepared by Global Acoustics (**Appendix 2**);
- Revised *Air Quality & Greenhouse Gas Assessment* prepared by Todoroski Air Sciences (**Appendix 3**); and
- *Soil Survey and Land Capability Assessment* prepared by GSSE (**Appendix 4**).

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1. CFMEU (10 December 2012)		
1.a.	The CFMEU considers that the overall potential impacts of the modification are consistent with the approved DA and objectives of the EP&A Act and therefore supports the modification.	Noted.
2. NSW OFFICE OF ENVIRONMENT AND HERITAGE (10 December 2012)		
Aboriginal Cultural Heritage		
2.1	**Aboriginal cultural heritage values** OEH acknowledges the significance of the local environment to the local Aboriginal community. OEH notes the existence of numerous registered Aboriginal sites in the immediate locality and acknowledges that the proposed modified project area contains landforms which have yielded a significant volume of evidence of Aboriginal occupation. There is also a strong possibility that currently undetected cultural material may be present within the project area in those areas where Aboriginal objects have not been previously identified. OEH also acknowledges the results of the field assessment of the project area undertaken in January 2011, which located the surface expressions of a number of previously recorded artefact scatter sites and enabled the site boundaries of some of these sites to be extended. The results of the additional subsurface investigation program undertaken during May 2012 are also acknowledged and it is noted that an additional artefact scatter site and associated PAD were identified in the SIS1 and VW1 Study Area. A search of the Aboriginal Heritage Information Management System (AHIMS) revealed that this new Aboriginal site has not been registered in AHIMS. The proponent is therefore advised to promptly complete Aboriginal Site Recording Forms for this site and submit to the AHIMS Registrar, as per the requirements of Section 89A of the *National Parks and Wildlife Act 1974* (NPW Act). Any management outcomes for these sites must be included in the information provided to AHIMS.	It seems there may have been some minor misinterpretation of the report by OEH. No new artefact scatter site with PAD was recorded. SIS1 and VW1 are the gas well construction areas that were tested, both located along the ETL that was also tested (all three areas are collectively referred to as Area 1. Site # 37-6-1406 is located about 100m from one of the two gas well sites and about 200m from test pit E5, which was the only pit to contain artefacts (n=2). These artefacts were interpreted as not being *in situ* (p. 53). Pit E5 is not in close proximity to either SIS1 or VW1, and is located at the east end of the ETL. We can register a site on AHIMS for the 2 artefacts recovered from test pit E5 in Area 1, as no previously recorded site is within 100m, if OEH feels this is the best management. A site card will be forwarded to AHIMS for this. The only other artefacts recorded on the ETL survey (not derived from the excavation) that appear in Figure 12, were attributed to previously recorded site # 37-6-1406 in Section 5.1.
2.2	**Impacts on Aboriginal Cultural heritage** It is noted that the development proposal is likely to impact a number of	A series of management recommendations were contained within the Aboriginal heritage assessment report, see Section 7.

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	Aboriginal cultural heritage values associated with the project are, including the significant Beltana Grinding Groove Site *(BMU 1)* and artefact scatter sites. Impacts will primarily occur as a result of mine subsidence and the construction of surface infrastructure (gas wells, access tracks, transmission lines, gas drainage plant, pipeline maintenance facility and power generation plant) associated with the proposal. It is therefore expected that the proponent develop culturally appropriate management strategies in compliance with the requirements of the NPW Act and in consultation with the registered Aboriginal parties (RAPs) for the project.	An Aboriginal Cultural Heritage Management Plan for the Blakefield Underground mine already exists. The management strategy is to consider each site on a case by case basis - whereby sites that will be impacted by subsidence remedial works or other mine related surface infrastructure (access roads, additional bore holes etc.) will be appropriately managed at the time in the face of, the then known, impacts. It was noted in Section 7 of the report that the two more significant sites, BMU1 and scarred tree (37-6-0428), within the impact footprint of the BFN development modification, will be managed as part of the forthcoming BOP heritage and project assessment and will not be dealt with by this assessment. The Aboriginal Cultural Heritage Management Plan for the Blakefield Underground mine will be updated with the results of the current Blakefield North modification assessment.
2.3	**Management of Aboriginal Cultural heritage** OEH refers to Section 6.2 of the AHA (Management and Mitigation of Recorded Aboriginal Sites) and Section 6.7.4 of the EA (Mitigation Measures). OEH acknowledges and supports the Proponent's commitment to update the currently approved Aboriginal Cultural Heritage Management Plan for the broader project area to incorporate the additional management of the Aboriginal cultural heritage values associated with this project. It is also recommended that this process is undertaken in consultation with the RAPs for the project. OEH refers to Section 1.4.3 of the EA. It is noted that Aboriginal site 'BM 1' is located within the project area and this site is subject to a separate development approval issued in accordance with the requirements of Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act). OEH notes that in 2007 the Proponent had previously applied to OEH for an Aboriginal Heritage Impact Permit (AHIP) in accordance with the provisions of Section 90 of the NPW Act. It is noted that AHIP #2776 was issued by OEH on 6 September 2007, for a period of five years, and this	As Above. The issues regarding Aboriginal heritage Sites BMU1 (axe grinding grooves: AHIMS #37-6-0967) and B6 (scarred tree: AHIMS #37-6-0428) are understood. If impacts were to occur to these sites as part of this project, AHIPs would be required. As is understood by OEH, impacts to these sites are to be addressed in the forthcoming BOP EA.

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	site was partially impacted by underground mining activities. However, this AHIP has now expired. Accordingly, further impacts to site BMU 1' cannot occur without a new approval from OEH. It is also noted that Aboriginal site 'B6' has not been subject to an AHIP issued by OEH. Therefore, if the proposed development is likely to impact or harm these two sites, it is expected that the proponent develops appropriate management strategies which comply with the NPW Act. This would require the submission to OEH of an AHIP application for consideration following any approval of the development application. It is also recommended that any revision of the Aboriginal Cultural Heritage Management Plan address this matter. OEH also understands that these matters are likely to be addressed by the proponent as a component of a separate development application for the proposed Bulga Optimisation Project.	
2.4	**Local Aboriginal community consultation** OEH acknowledges a summary of the consultation with the local Aboriginal community has been provided by the proponent regarding the proposed modification in Appendix 1 of the Aboriginal Heritage Assessment. However, OEH notes that there is no evidence of consultation from a majority of the RAPs (11 out of 12) in support or otherwise of the final management recommendations presented in Section 7 of the Aboriginal Heritage Assessment and Section 6.7.4 of the EA. Further, it is noted that the only response provided from one of the RAPs did not support the final management recommendations. The lack of evidence of consultation and support concerning the management recommendations indicates that the consultation process for the Aboriginal cultural heritage assessment is incomplete. In order to progress this inadequacy, OEH recommends that the proponent undertake additional consultation with all RAPs in order to form a complete submission. OEH would also expect the proponent to detail any contrary or differing positions to those of the RAPs if there is some disagreement with the outcomes of the assessment process. OEH has drafted a recommended condition of approval below to address this matter.	OEH point out a lack of Aboriginal community consultation. It is reiterated here that consultation was carried out in strict accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010.* (ACHCRs). This is detailed in Sections 2.3 and Appendices 1 and 2 to the report. Additional email reminders were sent to all stakeholders to provide comment (beyond the ACHCR requirements), but as noted by OEH, only one response was received. It is acknowledged that this response does not support the recommendations of the report, but this comment provides no material reason why it does not support the recommendations, other than saying that they are working with Xstrata on the BOP project and will discuss the recommendations for sites in light of that. It is appropriate to point out to OEH that the much larger and more intensive BOP project covers the complete same areas as the Blakefield North project and the consultation for BOP has been extensive and covers all the same sites as noted for the Blakefield assessment Consultation for BOP was so much more of a focus through 2012 and most groups became consultation fatigued, and remained, quite fairly,

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	OEH also encourages the proponent to maintain continuous consultation processes with the community for the entire life of the project and for all Aboriginal cultural heritage matters associated with the project area. As a general rule, gaps in the consultation process of six months or more will not constitute a continuous consultation process. Where a proponent or developer envisages a gap of more than six months it is recommended that RAPS are regularly informed of any progress.	more focussed on the larger BOP project. In response to this recommendation, OzArk distributed another round of letters to the RAPs again asking for comment on the report. This correspondence was accompanied by a duplicate copy of the management recommendations as found in the Aboriginal Heritage Assessment report, and sent only to the RAPs that had not taken the opportunity to respond in the first instance. It is noteworthy that two responses had been received from RAPs subsequent to the original comment closure date, thus were not included in the documents submitted to OEH. Again email reminders were sent to stakeholders to provide comment, in addition to follow up phone calls. During this second round of consultation five RAPs submitted feedback. A copy of the consultation log and correspondence can be found in **Appendix 1**. As noted above, the salient point remains that the BOP is the overarching project and the most significant sites under consideration in the current BFN footprint, are being managed under that project banner.
2.5	**Conclusion** OEH has no additional concerns with the Aboriginal cultural heritage assessment for the modified project application and recommends that the following conditions of approval for Aboriginal cultural heritage are reflected in any approval conditions for the project. **RECOMMENDED CONDITIONS OF APPROVAL FOR ABORIGINAL CULTURAL HERITAGE** 1. The applicant must comply with Part 6 of the National Parks and Wildlife Act 1974 (NPW Act), prior to commencing any development activities and during the development. 2. The proponent must consult with and involve all the registered local Aboriginal parties for the project, in the ongoing management of the Aboriginal cultural heritage values. Evidence of this consultation must be collated and provided to the consent authority upon request. 3. The proponent must update the existing Aboriginal Cultural	The proposed conditions for approval are acknowledged, with specific reference as follows: 1. Appropriate. The existing ACHMP provides appropriate provision for this on a case by case basis. 2. Additional consultation as noted above has been carried out and documented. This proposed condition is no longer required. 3. Consultation will also occur with regards to updating the ACHMP. 4. Standard unexpected find protocol, covered in the ACHMP. 5. Standard human remains protocol, covered in the ACHMP. 6. ASIRFs will be completed when necessary. 7. The need for inductions acknowledged.

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	Heritage Management Plan for the project area in consultation with the registered Aboriginal parties to detail procedures for managing all Aboriginal cultural heritage values associated with the project area. This process must be undertaken prior to commencing any ground disturbance or development works subject to the development. 4. In the event that ground disturbance identifies a new Aboriginal object/s within the project area, all works must halt in the in the immediate area to prevent any further impacts to the object(s). A suitably qualified cultural heritage specialist and representatives of the local Aboriginal community must be contacted to determine the nature, extent and significance of the finds. The site is to be registered in the Aboriginal Heritage Information Management System (AHIMS) (managed by the OEH) and the management outcome for the site included in the information provided to the AHIMS. The proponent will consult with representatives of the local Aboriginal community, and the cultural specialist to develop an appropriate management strategy for all objects/sites which complies with the requirements of the NPW Act. 5. If human remains are located in the event that surface disturbance occurs, all works must halt in the immediate area to prevent any further impacts to the remains. The NSW Police are contacted immediately. No action is to be undertaken until the NSW Police provide written notification to the proponent. If the skeletal remains are identified as Aboriginal, the proponent must contact the OEH's Environment Line on 131 555 and representatives of the local Aboriginal community. No works are to continue until the OEH provides written notification to the proponent. 6. All Aboriginal sites impacted by the project must have an Aboriginal Site Impact Recording form completed and be submitted to OEH's AHIMS Registrar within three months of being impacted. 7. An Aboriginal Cultural Education Program must be developed for the induction of all personnel and contractors involved in the	

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	construction activities on site. Records are to be kept of which staff/contractors were inducted and when for the duration of the project. The program should be developed and implemented in collaboration with the registered Aboriginal parties.	
Threatened Biodiversity		
2.6	**Biodiversity Offsets** The OEH acknowledges that some of the forecast mine subsidence impacts have been covered in the previously issued consents, and that much of the area to be affected by mine subsidence for this project also falls within the footprint of the proposed Bulga Optimisation Project for which the proponent has already commenced discussions with OEH with regards to possible biodiversity offsets. Therefore consideration of possible mine subsidence impacts for this project will focus on areas outside the footprint of the Bulga Optimisation Project that are greater than impacts already considered. The proposed changes to the plan of longwall panels for Blakefield North would result in a reduced number of panels of larger width that would now be stacked, as opposed to offset, with the longwall panels in the overlying Whybrow seam. Where these changes lead to harm to threatened species (such as *Acacia pendula*), populations, communities or their habitats, particularly outside the footprint of the Bulga Optimisation Project, then the OEH requests that the proponent makes a commitment to offset them appropriately. It is not clear how the proposed development fits with the proposed flora and fauna corridors for the Bulga Coal Continued Underground Operations Project as required under consent condition 43 in Schedule 4 of DA376-8-2003 for it appears that the proposed modification would develop some of the proposed corridor habitat areas. On 26 November 2012, the proponent met with OEH to discuss the Bulga Optimisation Project, during this discussion, offsets for the Bulga Optimisation Project, the likely offsetting requirements for the modification were raised. OEH advised the proponent that they would be required to justify the rationale behind any offsets offered, especially if 'substitution	These comments are noted. As detailed in Section 6.6.4 of the Environmental Assessment, an offset strategy will be developed for the proposed modification. As previously discussed with OEH, disturbed vegetation communities will be offset in conjunction with offsets required for the BFN Mod 5, the Bulga Open Cut Western Mining Limit Modification (recently approved by DP&I) and the Bulga Optimisation Project (recently lodged with DP&I). The proposed flora and fauna corridors are illustrated in Figure 12.2 of the *Bulga Coal Continued Underground Operations EIS* (Umwelt, 2003) and noted in Condition 43(c) of the consent to DA376-8-2003. The approved *Bulga Coal Complex Landscape Management Pla*n (KMH, 2011) reflects the intent for the establishment of conservation corridors at the cessation of mining (refer to Section 11 of Figure 11.1.1 of the *Rehabilitation and Offset Management Plan*, which forms part of the Landscape Management Plan). The proposed modification will not impact on this commitment as it relates to post mining and will not impact on the commitments of the existing approved Landscape Management Plan.

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	ratios' are used to match non like-for-like vegetation communities between the offset and the development area. In addition, the offsets for the current modification would need to be specified so that they can be clearly linked to this project without the risk of being double counted for any future project.	
2.7	**Pre-Clearing Surveys** OEH acknowledges that the proponent discusses a proposed tree clearing protocol in the EA (Appendix 6) and endorses this approach.	Noted.
2.8	**Conclusions** The OEH recommends that the proponent prepares a biodiversity and offset package for the known harm to threatened biodiversity to come from this project, and make a commitment for offsetting in the event that mine subsidence also causes harm to threatened biodiversity. OEH also recommends some standard conditions for the tree felling protocol and what to do in the event that a threatened fauna species is found during this process: 1. That any clearance of threatened species, populations or communities, or their habitats, or harm caused by mine subsidence due to this development must be offset in accordance with OEH offsetting policy. That is, either the 'Principles for the use of biodiversity offsets in NSW' (DECC 2011) or the 'NSW OEH Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, State Significant Development (SSD) and State Significant Infrastructure (SSI) Projects' (OEH, 2011). 2. That pre-clearing surveys are conducted by a suitably qualified and experienced ecologist (as per DECC, 2004). 3. That the translocation of any threatened fauna found in the development site is conducted in line with OEH Policy – 'Policy for the Translocation of Threatened Fauna in NSW' (NPWS 2001).	Noted and as per comments above in 2.6 and 2.7.
3. BEATTY LEGAL (ON BEHALF OF RATH FAMILY) (11 December 2012)		
3.1	Our clients are frequently disturbed by the noise from existing mining	The Noise Impact Assessment (including the revised NIA in **Appendix 2**)

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	separations (sic) at Bulga. Of late that noise has disturbed our clients sleep. Our client's complaints to Xstrata Coal have not reduced the levels of disturbing noise.	undertaken as part of the Environmental Assessment concluded that the proposed modification would not result in any significant impacts on the Rath residence and would not trigger the relevant acquisition criteria outlined in DA 376-8-2003.
3.2	Our client's property is adversely affected by dust (including coal dust). This is having an ongoing adverse impact on the amenity of our clients who are now obliged to wash down their outdoor living areas at least once a week.	The Air Quality Impact Assessment undertaken as part of the Environmental Assessment concluded that the proposed modification would not result in any significant impacts on the Rath residence and would not trigger the relevant acquisition criteria outlined in DA 376-8-2003.
3.3	Vibrations caused by blasting, drilling and other activities, have increased substantially over the last few months. Incidences of noticeable vibration recorded by our clients since August 2011 now exceed 40 of which at least a quarter are severe. Recently our clients lost the ridge capping on their roof during strong winds. Upon examination, it was apparent that the screws and rivets had worked loose because of chronic (and occasionally, acute) vibration. An inspection of other rivets that they too had worked loose and our clients home has been "twisted" on its foundations.	There are no blasting activities associated with the proposed modification. In terms of drilling, the Noise Impact Assessment concluded that the proposed modification would not result in any significant impacts on the Rath residence.
3.4	It is clear that our clients are likely to suffer additional, cumulative adverse effects if the Proposal is approved and additional mining activity ensues. The approval of the proposal will have a deleterious effect of the health of our clients, their amenity and of course the value of the Property into which they have invested so much.	The Noise and Air Quality Impact Assessments undertaken as part of the Environmental Assessment concluded that the proposed modification would not result in any significant impacts on the Rath residence or trigger the relevant acquisition criteria outlined in DA 376-8-2003. Notwithstanding, BCM understands the concerns raised in this submission and are in currently consultation with the Rath family.
3.5	If the proposal is to be approved, despite this and any other objections, our clients have concluded that they will eventually have to leave the Property as their enjoyment of their land will be compromised. In the circumstances, our clients submit that the only appropriate course of action is the imposition of an acquisition clause in the planning consent if the proposal is to be approved.	BCM is consulting with the Rath family about their concerns.
4.	**DEPARTMENT OF TRADE AND INVESTMENT, REGIONAL INFRASTRUCTURE AND SERVICES (DEPARTMENT OF RESOURCES AND ENERGY) (17 December 2012)**	
4.1	**Mining Titles**	Noted.

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	DRE requires that all mining activities are contained within mining leases held by the proponent for the project. DRE understands the proposed realignment of the approved longwall layout is within Mining Leas (ML) 1547 held by the proponent. Further petroleum rights are also included within ML 1547.	
4.2	**Subsidence** DRE has not undertaken a detailed subsidence assessment of this proposed modification. It is a condition of ML1547 that a Subsidence Management Plan (SMP) be prepared prior to commencing any underground mining operations which will potentially lead to subsidence of the land surface. The SMP must be submitted and approved by the Director General of NSW Trade and Investment, Regional Infrastructure and Services prior to the commencement of mining.	Noted.
4.3	**Rehabilitation** DRE recommends that the following conditions be incorporated into the planning approval if granted: <u>Rehabilitation Plan</u> The proponent should prepare and implement a rehabilitation plan to the satisfaction of the Director General of NSW Trade and Investment, Regional Infrastructure and Services. The Rehabilitation plan should: - Be prepared in accordance with DRE NSW Guidelines and in consultation with relevant agencies and stakeholders; - Be submitted and approved by the Director General of NSW Trade and Investment, Regional Infrastructure and Services prior to the commencement of mining; - Address all aspects of rehabilitation and mine closure, including final land use assessment, rehabilitation objectives, domain objectives, completion criteria and rehabilitation monitoring.	Noted.

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5. NSW ENVIRONMENTAL PROTECTION AUTHORITY (17 December 2012)		
Letter		
5.1	**NO_2 Emissions** Emissions from the approved 25MW of gas-fired power generation have not been included in the air impact assessment and the method of transformation from NO to NO_2 has not been specified. The EPA recommends the Air Quality Impact Assessment provided as part of the EA be revised to include all existing, approved and proposed nitrogen emission sources. The EPA recommends the Air Quality Impact Assessment be revised to include further detail to clarify the method used to estimate NO_2 impacts. Specifically more detail is required on the method used in the assessment to model the oxidation of NO to NO_2.	BCM has accepted the EPA's recommendations and a revised Air Quality and Greenhouse Gas Assessment (AQGGA) has been provided in **Appendix 3**. The revised assessment includes: • Cumulative modelling predictions with the inclusion of the 25 MW power station proposed for Blakefield South Underground Mine, and all other significant NO_x sources; and • A description of the Level 1 Janssen Method, applied per the EPA Approved Methods Guidelines for modelling NO_x transformation. BCM has also provided it's comments to the draft EPL conditions for EPA's consideration (see letter dated 28 March 2013 in **Appendix 3**). The suggestions provided aim to meet the EPA's objectives in formulating the conditions in an efficient and enforceable manner consistent with other similar operations.
5.2	**Cumulative Dust Impacts** The worst case project dust emissions result in only a small increase in cumulative impacts, however cumulative 1-hour average NO_2 impacts are 57% of the assessment criteria.	It is noted that the EPA recognises that the Project contribution to cumulative dust impacts is negligible and that the cumulative NO_x impacts of the Project are below criteria. The revised modelling includes all significant existing and proposed sources of NO_2, and also shows that levels would remain below criteria.
5.3	**Power Generation** The projects extra power generation capacity will exceed the *Protection of the Environment Operations Act 1997* (POEO Act) threshold for general electricity works and will consequently trigger the requirement for load based licencing.	Noted.
5.4	**Noise Assessment (Item 1)** The EA does not appear to comply with the New South Wales Industrial Noise Policy (INP) in its assessment of low-frequency noise or construction noise impacts. The EA assesses low frequency noise against criteria specified by Broner (2010) rather than the procedure used in the INP. The INP procedure is current government policy and should be used to assess	1. <u>Low Frequency Noise</u> Section 2.4 of the Noise Impact Assessment (NIA) outlines both of the methodologies adopted for assessment of low frequency noise (LFN). Both the INP method and the Broner (2010) method are described. Section 6.4.1 and 6.4.2 of the NIA present results of the operational and construction LFN assessments respectively. Results are presented for

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	the impact of low-frequency noise on sensitive receivers unless it results in perverse environmental outcomes -this approach was agreed with the Department of Planning and Infrastructure in December 2010. The EPA notes that both construction and operational phases of the project will have a significant low-frequency noise component at sensitive receivers as defined in the INP. The Interim Construction Noise Guideline (DECC 2009) does not generally apply to mining, therefore the INP criteria apply.	both methodologies. With regards to operational LFN, it is acknowledged that a number of receptors have predicted C minus A results equal to 15 dB. In accordance with the INP procedure, a 5 dB penalty should be applied to predicted A-weighted totals for purposes of assessment. However, the highest predicted C-weighted total level is LCeq 47 dB for any receptor. In terms of LFN, this is a low level, and in Global Acoustics professional opinion, application of the 5 dB modifying factor penalty is not warranted. Should the EPA insist the penalty is applied, 5 dB should be added to the A-weighted predictions presented in Table 6.6 of the NIA. It is likely then that if DP&I would set these higher levels as operational noise criteria in the Project Approval. In effect, this would allow BCM to generate higher noise levels at these receptors than if criteria were based on the original NIA predictions, effectively resulting in a perverse environmental outcome. It is Global Acoustics recommendation that the modifying factor penalty is not applied. BCM have a requirement to monitor LFN in their approved Noise Management Plan (NMP). The LFN criterion in the approved NMP is based on the Broner method. Should LFN be a real issue as a result of the modification, monitoring would identify the issue and appropriate action could be taken. With regards to construction LFN, the assessment in the NIA was mistakenly conservative. Assessment of the Vertical Well construction sites was undertaken considering prevailing meteorological conditions for the day, evening and night periods; however, construction at these locations is only to occur during the day period. A revised NIA is included in **Appendix 2**. Additionally, the NIA considers all proposed drilling locations, not just the selected "worst case" locations adopted in the NIA. 2. <u>Construction Noise</u> Assessment of construction noise criteria is discussed below in Sections 5.5 and 5.6.
5.5	**Noise Assessment (Item 2)** Data provided in the EA indicates that twelve sensitive receivers will	A revised construction noise assessment that considers all proposed drilling locations is included in the revised NIA in **Appendix 2**.

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	experience noise in excess of 5 dBA above the Project Specific Noise Level of $L_{eq\ (15minute)}$ 35 dBA, and the EPA does not propose to licence these impacts. The Negotiated Agreement provisions of the INP are available to the proponent and the EPA recommends that the most appropriate way to deal with these impacts is by negotiation between the proponent and the affected receivers - a 'Private Negotiated Agreement'.	Night results were revised to include a meteorological condition of 4 degrees per 100 metres inversion rate for F-class stability. For the evening period, the construction noise results presented in the NIA are unchanged. There are no predictions in excess of 5 dBA above the Project Specific Noise Criterion of LAeq,15 minute 35 dB during these periods. It is important to note the primary noise generating works are all scheduled to occur during the day period (civil works, vertical and goaf well drilling, extraction infrastructure construction). SIS drilling is the only construction activity scheduled to occur during the evening and night periods. It is recommended a construction noise criterion of LAeq,15 minute 45 dB is prescribed for the day period. Global Acoustics feel this criterion is justified for the following reasons: • Extended noise logging undertaken by Global Acoustics around the BCC during 2009 and 2010 indicated LAeq noise levels exceeding 45 dB are very common during the day period. • Rural activities are relatively loud. Road traffic noise and elevated noise levels due to rural activities are common during the day period. • Appendix A of AS1055.2 estimates background levels of LA90, 11 hour 45 dB, for the day period in areas with low density transportation. Although this background level is considered higher than the rural area surrounding the BCC, it is an indication that elevated background levels are not uncommon in this type of area. DP&I have agreed LAeq,15 minute 45 dB is a suitable criterion to adopt as the construction noise criterion for the day period. BCM will negotiate private agreements with receptors where noise is predicted to exceed this criterion.
5.6	**Noise Assessment (Item 3)** The EPA is concerned that the choice of two "worst case" vertical well drilling locations appears to have underestimated the noise impact of this activity on sensitive receivers, and that therefore more receivers may be	A revised NIA that considers all proposed drilling locations is included as **Appendix 2**. The drill locations for which results are provided in the EA are worst case for the evening and night periods (they are the only substantial construction activity planned for those times).

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Ref.	Matters Raised in Submission	Response
	significantly affected than those indicated in the EA. With reference to Figure 8 of the EA, it appears that a number of sensitive receivers will be in close proximity to vertical well and goaf well drilling operations and experience noise impacts of greater than 5 dBA above the PSNL at various stages throughout the life of the project (20 years), as the actual drilling locations are proposed to be distributed across each longwall. The EPA therefore does not expect to be able to licence noise impacts at these receptors and recommends the proponent pursue a private negotiated agreement at the following sensitive receivers: 160 Dwyer, 217A, 217B and 217C Russell, 156A and 156B Todhunter & Brook, 179 Brooks & Thompson, 162 Lamaro, 164 Sharrock, 195 Kennedy, 154 Rath, 169B McCraw, 171 Owens, 151 (Unknown) and 197 (Unknown).	The results of the revised assessment indicate the following receptors would experience levels exceeding the DP&I agreed day period construction noise criterion of LAeq,15 minute 45 dB: • 160 Dwyer, 195 Kennedy, 217n, 217m and 217s Russell, and 165B Todhunter and Brook. BCM will negotiate a private agreement with these receptors. For more detail on revised construction noise results, refer to **Appendix 2**.
5.7	**Meteorological Conditions** For the proponent and the EPA to assess compliance against noise limits, the proponent will need to implement a method for directly measuring temperature lapse rate. The EPA's preference is for this to be calculated as twice the temperature differential over 50 metres and 60 metres above the ground level on a fixed tower. Alternatively the proponent could provide noise level predictions for the F Class Stability Category, which could be established for compliance purposes for appropriate wind measurements at 10m above ground level and a method such as the sigma theta method.	As part of this response to submissions, the revised NIA predictions were modelled including a meteorological condition of 4 degrees per 100 metres inversion rate for F-class stability, whereas the original NIA used an inversion rate of 3 degrees per 100 metres for assessment of temperature inversion effects. Results of the revised NIA are included as **Appendix 3**. Results indicate no significant change to the previously modelled outcomes presented in the NIA. The alternate method of determining inversion rates using the sigma-theta method should apply using meteorological data measured at 10m above ground level.
Recommended Conditions		
ADMINISTRATIVE CONDITIONS		
5.8	**Work to be undertaken in accordance with information supplied** 1. Except as provided by these recommended conditions of approval, the works and activities shall be undertaken in accordance with the proposal contained in: a) The Development Application DA-376-8-2003 MOD 5 submitted to the NSW Department of Planning and Infrastructure; b) The Document "Environmental Assessment Proposed Modification to DA 376-8-2003 under Section 75W of Part 3A of the EP&A Act 1979	Noted.

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Ref.	Matters Raised in Submission	Response
	Blakefield North Underground Mine Project" prepared by GSS Environmental and dated November 2012. Unless otherwise specified in these conditions of approval.	
NOISE CONDITONS		
5.9	**2. Limit Conditions** 2.1 Noise Generated at the Premises must not exceed the noise limits in the table below. The locations referred to in the Table below are indicated by Figure 2 and Figure 3 in Appendix A, Bulga Coal Complex Pollution Reduction Program Environmental Noise, prepared by Global Acoustics, dated 28 September 2012. *[refer EPA Table in Section 2.1 of submission]* 2.2 For the purpose of condition 2.1: • Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and Public Holidays. • Evening is defined as the period from 6pm to 10pm. • Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and Public Holidays. 2.3 The noise limits set out in condition 2.1 apply under all meteorological conditions except for the following: a) Wind speeds greater than 3 metres/second at 10 metres above ground level; or b) Temperature inversion conditions greater than 3°C/100m. 2.4 For the purposes of condition 2.3: a) Data recorded by the meteorological station identified as Identification point (to be confirmed by licensee) must be used to determine meteorological conditions; and b) Temperature inversion conditions (vertical temperature gradient in degrees C) are to be determined by direct measurement over a minimum 50m height interval as referenced to in PartE2 of Appendix E to the NSW Industrial Noise Policy.	2.1 Noise Limits BCM agree in principle with the noise limits outlined in the table. However, it is recommended a review of the noise limits is undertaken in light of the revised results for the night period submitted with this response to submissions (see revised NIA in **Appendix 2**). 2.2 Time Periods Noted. The definition of time periods is as per the INP. 2.3 Meteorological conditions Noted. 2.4 a) Meteorological monitoring station Specifying an absolute value for vertical temperature gradient is where EPA are then requiring a tower. This section should read like all contemporary consents/approvals where exemptions are as per the INP (which is then 3m/s and stability class G). 2.4 b) Measurement of temperature inversions Predictions have now been provided for a meteorological condition of 4 degrees per 100 metres inversion rate for F-class stability. As per Section 5.g., the alternate method of determining inversion rates using the sigma-theta method should apply using meteorological data measured at 10m above ground level. 2.5 Monitoring locations The described monitoring locations are consistent with many contemporary development approvals. However, in rural settings, it is often impractical to effectively monitor mining operations at these locations, particularly within 1 metre of a dwelling facade. In most cases, monitoring near the residence is impractical due to barking dogs or issues with obtaining access. Global Acoustics recommend alternate

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Ref.	Matters Raised in Submission	Response
	2.5 To determine compliance: a) With the $L_{eq(15\ minute)}$ noise limits in condition 2.1, the noise measurement equipment must be located: • Approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or • Within 30 metres of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or, where applicable • Within approximately 50 metres of the Boundary of a National Park or a Nature Reserve. b) With the $L_{A1(1\ minute)}$ noise limits in condition 2.1, the noise measurement equipment must be located within 1 metre of a dwelling façade. c) With the noise limits in condition 2.1, the noise measurement equipment must be located: • At the most affected point at a location where there is no dwelling at the location; or • At the most affected point within an area at a location prescribed by conditions 2.5(a) or 2.5(b). 2.6 A non-compliance of condition 2.1 will still occur where noise generated from the premises in excess of the appropriate limit is measured: • At a location, other than an area prescribed by conditions 2.5(a) and 2.5(b); and/or • At a point other than the most affected point at a location. 2.7 For the purposes of determining the noise generated at the premises the modification factors in Section 4 of the NSW Industrial Noise Policy must be applied, as appropriate, to the noise levels measured by the noise monitoring equipment.	monitoring locations are approved that allow monitoring in suitable yet representative locations. It is therefore suggested that proposed condition 2.5 a) be reworded as follows: *2.5 To determine compliance:* *a) With the $L_{eq(15\ minute)}$ noise limits in condition 2.1, the noise measurement equipment must be located:* *• Approximately on the property boundary, where any dwelling is situated 30 metres or less from the property boundary closest to the premises; or* *• Within 30 metres of a dwelling façade, but not closer than 3m, where any dwelling on the property is situated more than 30 metres from the property boundary closest to the premises; or* *• Within approximately 50 metres of the Boundary of a National Park or a Nature Reserve (where applicable); or* *• Within a suitable yet representative location of the above.* 2.6 Non compliance As previously noted, monitoring at the locations described is often not practical. 2.7Modifying factors Modifying factors outlined in Section 4 of the INP will be determined and applied when applicable, although the low frequency method is currently under review.
5.10	**3. Monitoring Conditions** **Meteorological Monitoring** 3.1 The meteorological weather station must be maintained so as to be	3.1 Weather station Noted.

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Ref.	Matters Raised in Submission	Response
	capable of continuously monitoring the parameters specified in condition 3.2. 3.2 For each monitoring point specified in the table below the licensee must monitor (by sampling and obtaining results by analysis) the parameters specified in Column 1. The licensee must use the sampling method, units of measure, averaging period and sample at the frequency, specified opposite in the other columns. *[refer EPA Table in Section 3.2 of submission]* **Requirement to Monitor Noise** 3.3 To assess compliance with Condition 2.1, attended noise monitoring must be undertaken in accordance with Conditions 2.5 and: a) at each one of the locations or at a location representative of the most-affected locations listed in Condition 2.1 ; b) occur quarterly in a reporting period; c) occur during each day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum of: • 1.5 hours during the day; • 30 minutes during the evening; and • 1 hour during the night. d) occur for three consecutive operating days.	3.2 Meteorological parameters It is recommended a sampling period of 15 minutes be implemented for all meteorological parameters. Averages for longer periods can be determined from 15-minute samples if required. Global Acoustics recommend wind direction standard deviation (sigma theta) is measured rather than lapse rate. 3.3 Monitoring frequency Global Acoustics has provided a letter dated 20 March 2013 regarding monitoring frequency which provides suggested alternate attended noise monitoring schemes (Refer to **Appendix 2**).
5.11	**4. Reporting Conditions** **4.1 Noise Monitoring Report** A noise compliance assessment report must be submitted to the EPA with the Annual Return. The assessment must be prepared by a suitably qualified and experienced acoustical consultant and include: a) the results of all quarterly monitoring carried out under the conditions of this licence; b) an assessment of compliance with noise limits presented in Condition 2.1; c) measurement and reporting of C-weighted noise levels; and	An annual report, prepared by a suitably qualified and experienced acoustical consultant, will be submitted to the EPA. The report will include the elements listed in points a) to d).

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	d) an outline of any management actions taken within the monitoring period to address any exceedences of the noise limits specified in the licence. **Definition of Terms** • NSW Industrial Noise Policy -the document entitled "New South Wales Industrial Noise Policy published by the Environment Protection Authority in January 2000." • Noise - sound pressure levels.	
AIR CONDITIONS		
5.12	**5. Flare related conditions** **Location of monitoring/discharge points and areas** 5.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point. *[refer EPA Table in Section 5.1 of submission]*	A letter dated 28 March 2013 and a revised AQGGA have been provided in **Appendix 3** in response to the draft EPA conditions detailing all key air quality issues.
5.13	**Limit Conditions** **6. Combustion Parameters** 6.1 For each monitoring/discharge point or utilisation area specified below (by point number), the parameter must be equal to or greater than the limit specified for that parameter in the table: *[refer EPA Table in Section 6.1 of submission]* 6.2 Any flare must have no visible emission other than for a total period of no more than 5 minutes in any 2 hour period.	Refer to letter dated 28 March 2013 in **Appendix 3** which recommends alternative wording for this draft condition. It is suggested that the nominated residence time may not be applicable to this type of flare. Monitoring of temperature and oxygen level is recommended as these are the two parameters that govern the efficient operation and control of the flaring system.
5.14	**7. Operating Conditions** **Flare** 7.1 Any flare must be operated in such a way that a flame is present at all times while air impurities are required to be treated.	Noted. This is a necessary for safety.
5.15	**8. Monitoring and Recording Conditions** **Requirement to monitor combustion parameters**	BCM accepts the intended objectives of the EPA's draft EPL conditions for air quality, which are understood to aim to ensure that emissions from

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Ref.	Matters Raised in Submission	Response
	8.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns: *[refer EPA Table in Section 8.1 of submission]*	the flares and the engines comprising the power station are maintained within acceptable levels and pose no threat to the environment. As detailed in the letter dated 28 March 2013 in **Appendix 3**, suggestions are provided to improve the conditions in relation to flare parameters that can be practically measured and that reflect the actual control system used to maintain flare efficiency.
5.16	**9. Power generation related conditions:** **Location of monitoring/discharge points and areas** 9.1 The following points referred to in the table below are identified in this licence for the purposes of monitoring and/or the setting of limits for the emission of pollutants to the air from the point. *[refer EPA Table in Section 9.1 of submission]*	See above.
5.17	**10. Limit Conditions** **Load Limits** 10.1 The actual load of an assessable pollutant discharged from the premises during the reporting period must not exceed the load limit specified for the assessable pollutant in the table below. 10.2 The actual load of an assessable pollutant must be calculated in accordance with the relevant load calculation protocol. *[refer EPA Table in Section 10.2 of submission]* Note: An assessable pollutant is a pollutant which affects the licence fee payable for the licence. **Air Concentration Limits** 10.3 For each monitoring/discharge point or utilisation area specified below (by point number), the parameter must be equal to or greater than the limit specified for that parameter in the table: *[refer EPA Table in Section 10.3 of submission]*	Load limits would be calculated per the load calculation protocol and agreed with EPA post installation and sampling of actual operational emission rates, and also commensurate with the maximum likely levels of emissions considered in the air assessment (see **Appendix 3**).
5.18	**11. Monitoring and Recording Conditions** **Air Monitoring Requirements** 11.1 For each monitoring/discharge point or utilisation area specified below	BCM seeks the option to conduct either continuous or campaign monitoring. Refer to letter dated 28 March 2013 in **Appendix 3** which recommends alternative wording for this draft condition.

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	(by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns: *[refer EPA Table in Section 11.1 of submission]*	BCM provides some suggested amendments to the draft EPL conditions to include more frequent campaign monitoring than presently occurs for example at other similar power station operations at Tahmoor and Glennies Creek. This is considered appropriate for the first year of operation to ensure that the engines are operating as intended. The suggested amendments incorporate the principle that if more intense monitoring for one year or longer shows no compliance issues, then the frequency of monitoring can be progressively reduced to the same monitoring frequency applied at other similar power station operations. Given that the engines are identical, it would also seem reasonable that BCM seeks that only one of the engine emission points require monitoring at any one time and that compliance may be inferred for the other engines on this basis.
6. NSW DEPARTMENT OF PRIMARY INDUSTRIES (OFFICE OF AGRICULTURAL SUSTAINABILITY & FOOD SECURITY) (21 December 2012)		
Letter *(**Note**: A meeting and site visit was held at the Bulga Coal Complex with representatives of DPI on 1 February 2013. The DPI representatives were Mr David Davis (Resource Management Officer, Agriculture NSW), Mr John Friend – (Leader, Soil & Salinity; Agriculture NSW) and Ms Rebekah Gomez-Fort (Policy Manager, Office of Agricultural Sustainability & Food Security). The responses provided below were discussed with the DPI representatives).*		
6.1	The EA challenges claims that the impacted area includes Strategic Agricultural Land (SAL) as defined in the Upper Hunter Regional Strategic Land Use Plan (Sept 2012). The EA bases this claim on the results of soil tests. The soil-testing program completed is not considered adequate. The survey design did not comply with recognised Australian soil survey standards such as McKenzie and others (2008).	The key points in response are as follows: • No DGRs were originally issued for the Project. A supplementary letter was received from the DP&I requesting the preparation of an AIS, however, this did not require a detailed soil survey to be undertaken as part of either the EA or the AIS. • Notwithstanding, a field survey for Biophysical Strategic Agricultural Land (BSAL) was undertaken in June 2012 across part of the Project Area (the Study Area) and formed an Appendix to the AIS. At the time of the field survey, the process/methodology to verify BSAL was not available. The relevant guideline, released in November 2012, is "*Interim protocol for site verification and mapping of biophysical agricultural* land. The field survey was conducted in June 2012 prior to the release of this guideline. • The site verification criteria, as defined in the draft Mining SEPP,

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Ref.	Matters Raised in Submission	Response
		are yet to be gazetted. Further, the process/methodology to assess Land and Soil Capability (LSC), which is part of the BSAL verification process, was not available at the time of the field survey. This guideline is "*The land and soil capability assessment scheme: second approximation*" and was released in October 2012. • In lieu of the above, the previously industry accepted standard, *Systems used to classify rural lands in NSW* (Cunningham et al., 1988) was used to assess the Rural Land Capability for the Study Area. • The field survey was undertaken using a high intensity survey scale of 1:25,000 (intensity defined in accordance with the industry standard *Guidelines for Surveying Soil and Land resources: second edition (McKenzie et al., 2008*). This scale is suitable for strategic planning for intensive land use developments. • Soil laboratory sampling was undertaken to target a selected soil attribute of topsoil fertility. Target sampling of this nature is in accordance with aforementioned industry standard. Fertility was assessed using Cation Exchange Capacity, as the methodology to assess fertility for BSAL was not available. • The Addendum to AIS states: *As a result, the findings of the soil sampling program in Appendix 1 of the AIS are no longer current and it cannot be concluded that no land should be mapped as SAL – Biophysical within the Project Area.* In summary, AIS no longer challenges the presence of BSAL in the area soil surveyed (therefore the soil testing results & soil survey methodology are no longer relevant). In any event (as requested by the DPI at their meeting at the BCC with BCM on 1 February 2013) the results of the field survey undertaken in June 2012 by GSSE over part of the Project Area, have been compiled into a letter report entitled *Soil Survey and Land Capability Assessment* (GSSE, February 2013). This has been attached for information purposes as **Appendix 4**).

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Ref.	Matters Raised in Submission	Response
6.2	Although the AIS confirmed that the project would impact on dwellings and agricultural activities, these impacts have not satisfactorily been considered or discussed.	See Point 6.6 below
6.3	The socio-economic impacts of the proposal are inadequately covered in the AIS.	See Points 6.12 –6.17 below.
Attachment 1		
6.4	The AIS disputes the accuracy of the Strategic Regional Land Use Plan (SRLUP) mapping and after 'ground truthing' declared 'that the project area does not contain soil of land capability or soil fertility that warrants SAL -Biophysical classification'. They also dispute the SAL-Viticulture Classification. These conclusions are rejected. Significant areas of SAL (Biophysical and Viticulture) will be impacted by the project design. Namely '421 ha of mapped SAL in the draft SRLUP, comprising 421 ha of Viticulture SAL which overlies 253 Ha of biophysical SAL.	In addition to Point 6.1 above, the following additional key points are relevant. • The AIS did not dispute the Critical Industry Cluster (CIC) - Viticulture classification. Table 8 of the AIS states - *It is considered that the SAL Viticulture Cluster land does meet the criteria for SAL mapping, though it is unlikely that additional viticultural operations shall establish to the east side of the SAL Viticulture (towards Charlton Rd) due to poorer quality soil and the fact that land is entirely in mine ownership*. • The Addendum to the AIS states (p3) - *As it was considered that the SAL Viticulture Cluster land does meet the criteria for SAL mapping, the soil sampling program did not address this industry cluster.*
6.5	The proponent has not recognised that BSAL criteria changed as a following the exhibition of the draft SRLUPs. The analysis should have determined whether soils with moderate fertility and a LSC Class of 1 and 2 existed in the project area.	The key points in response are as follows: • The Addendum to the AIS (p3) acknowledged that the BSAL maps had changed between the draft and final SRLU Plans. However, the mapping for the SAL within the Project Area did not change - *The above assessment in Section 2.5 regarding Mapped SAL remains current as there have been no changes to the mapped SAL between the draft (March 2012) and the final SRLUP (September 2012), as they apply to the Project Area.* • Figure 5 of the AIS shows 'Inherent Soil Fertility', with 'moderately high' coinciding with the mapped BSAL. Elsewhere on the Project Area the soil is 'moderately low', therefore no additional BSAL is possible under the revised criteria. • No revised Inherent Soil Fertility or LSC mapping within the Project

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Ref.	Matters Raised in Submission	Response
		Area is known to exist. • The DPI may be alluding to the proposed requirement to undertake 'verification' of BSAL under SRLUP (p12) and hence the proposed Gateway process. However - The proposed site verification process is not yet in place and the Mining SEPP amendments to enact this are only draft. - The proposed Gateway process is not yet in place and will not apply to projects (such as the current Mod 5) where DGRs have already been issued (SRLUP Transitional arrangements p14). Notwithstanding the above (and as requested by the DPI at their meeting with BCM on 1 February 2013) the results of the field survey undertaken in June 2012 by GSSE over part of the Project Area, have been compiled into a letter report entitled *Soil Survey and Land Capability Assessment* (GSSE, February 2013). This has been attached for information purposes as **Appendix 4**).
6.6	While 11.8 ha will be surface disturbed, the remainder may be affected by subsidence. The AIS claims 'no adverse' impacts occur following subsidence under viticulture but also notes that compensation was previously paid for production losses. The claim that no production losses will occur under this project is not substantiated. There remains a risk that houses (5 private, 8 owned by Bulga) would be affected by subsidence (page 1 main report).	The key points in response are as follows: • The EA concludes that there will be no significant impacts resulting from subsidence. • Figures 4-9 of the AIS show areas of difference between the approved Blakefield North Underground Mine and the proposed modification. • There are a total of 29.4ha vineyards in the Project Area, with 25.5ha in private ownership. • The majority of the existing vineyards were previously undermined by the Beltana No.1 Underground Mine (overlying Whybrow coal seam) and suffered no significant subsidence impacts. • Three claims for compensation due to reduced tonnages, allegedly due to subsidence, were forwarded to BCM. As part of ongoing community relations, these claims were settled by BCM. However, it is relevant to note that the vineyard which was subject to the most

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		substantial claim achieved record yields in the year following the claim, indicating that there were no long term impacts on yields as a result of mining. Furthermore, there has never been any claim regarding subsidence impacts on fruit quality. (p33 of AIS). • Monitoring and management of the potential impacts of subsidence upon the vineyards was previously, and will continue to be, subject to Private Property Management Plans required under the SMP approval process, which includes monitoring in consultation with vignerons. As requested by the DPI at their meeting with BCM on 1 February 2013, further information will be provided directly to DPI under separate cover detailing some of the vineyard research and monitoring that has been occurring at the BCC. • The DPI appears to have incorrectly referenced and calculated the number of houses to be impacted. There is no reference to houses on p1 of the AIS or p1 of the EA. Five privately owned properties and one private residence is located in the Subsidence Area (p 86 EA), as opposed to the 13 houses referenced by DPI. In any event, the dwellings are only relevant as supporting infrastructure (habitation/management) to agriculture, not relevant to agricultural production per se. Management of any private building/infrastructure impacted by subsidence would continue to be undertaken by Private Property Management Plans required under the SMP approval process, which includes monitoring in consultation with landowners.
6.7	A significant area of vineyards along with some olive growers are also on impacted land (Fig 5).	The key points in response are as follows: • The olive groves to be affected are owned by Xstrata and are not privately owned. There are 22.4ha of olives within the Project Area of which only 0.42ha (1.9%) will be removed due to the proposed surface works. • There are 4,161ha of vineyards in the Upper Hunter (UH) and 855ha in the Singleton LGA. There are a total of 29.4ha vineyards in the Project Area, with 25.5ha in private ownership. 29.4ha represents 0.7% of vineyards within the UH and 3.4% within the

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		Singleton LGA, which is not considered significant. In any event, there are no vineyards that will be directly impacted by any surface works. They will only potentially be indirectly impacted by mine subsidence, however, the assessed impacts will not be significant.
6.8	The AIS (page 11) states 'the area of difference between the previously approved Blakefield North underground mine and proposed modification is 208ha on the land to the SW of the existing open cut operations. Within the project area an additional 15 ha of olive groves, 15 ha of vineyards and 178 ha of grazing land are subject to underground mining compared to that originally approved'. This increased disturbance refutes the proponent's claims that existing conditions should prevail.	The statement of additional areas in the AIS is factual and the impact assessment upon this additional land is the subject of the AIS.
6.9	A biodiversity offset strategy is to be developed with the Office of Environment and Heritage (OEH) to offset 5 ha of Central Hunter Box-Ironbark woodland. It is recommended that the offset not include land classes 1, 11 and 111.	It is acknowledged in the EA and AIS that any area to be offset should avoid quality agricultural land. This will form part of the offset strategy outlined in Point 2.6.
6.10	The soil survey undertaken is not sufficient (number of cores and analysis) for this project. Only 18 soil cores to a depth of 1m were hand cored in the soil survey. Analysis of only the top 10cm is considered inadequate. The soil survey needs to be current to ensure that BSAL determination is accurate. The industry standard reference for soil survey should be followed (See McKenzie, and others 2008).	See Point 6.1 above and **Appendix 4**.
6.11	Figure 20 'Existing Land Capabilities' is the AIS's conclusion that mapped SAL is actually Land Capability Class IV, V and VI. Such a conclusion would not have been possible with the earlier identified inadequate soil testing program. More detailed testing is required to accurately dispute the SAL mapping as the existing Singleton soil landscape map is at (expansive) scale of 1:250000.	See Point 6.1 above and **Appendix 4**. Figure 20 cited in the DPI submission is actually in the EA and not in the AIS. Figure 7 of the AIS (same as Fig 20 EA) is a map of "Land Capability" sourced from the former Department Land and Water Conservation.
6.12	The Section 4.0 ASSESSMENT OF IMPACTS -SOCIO-ECONOMIC does not present a cost benefit analysis on the impacts of the proposed changes on agricultural production.	The key points in response are as follows: • The draft Gateway criteria (SRLU Plan UH March 2012) did include the consideration of a 'cost benefit analysis' (CBA). However, the DGRs did not require the preparation of a CBA. • The DGRs stated: *as the Government is yet to publish a cost benefit*

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		methodology, the applicant may submit any additional information relating to the social, environmental and economic aspects of the proposal that may be relevant to the consideration of whether the proposal would be in the public interest. • The final SRLU Plan UH (Sep 2012) does not require a CBA and a CBA is not required as part of the future Gateway process (which in any event will not apply to the subject modification as DGRs were issued in October 2011). The final SRLU Plan UH states in relation to a CBA (p81) *As the Gateway assessment will be limited to a scientific assessment of the agricultural and water impacts of proposals, triple bottom line cost benefit analysis will not be considered at the Gateway stage.* *Instead, cost benefit analysis will be available to applicants at the DA stage for consideration through the comprehensive merit assessment process. This will assist in the consideration of the potential economic, social and other benefits of a proposal against its possible impacts. It will be particularly relevant to projects for which the Gateway has issued a conditional certificate.* *If a cost benefit analysis is prepared by the proponent it will be independently peer reviewed and considered by the Planning Assessment Commission in its determination of the DA.* • The Guideline/s for preparing an AIS (March 2012 and Sep 2012) do not require a CBA. • The SRLU Policy provides for a CBA to be 'optional' after the issue of a Gateway certificate as part of the Development Application (DA) (p13 & 14). The *Guideline for the Use of Cost Benefit Analysis in Mining and Coal Seam Gas Proposals* (Nov 2012) (exhibited with draft the Mining SEPP) reinforces the fact that a CBA will be optional with DAs post the proposed Gateway process. As stated previously, the proposed Gateway process won't apply as DGRs were issued prior to Sep 2012. • The AIS did examine productivity levels and broader socio-economic impacts etc and concluded that the potential impacts were very

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		minimal in context. Therefore, it is considered that a CBA is not warranted.
6.13	There appears to be no assessment in section 4.0 ASSESSMENT OF IMPACTS- SOCIO-ECONOMIC of the economic impact on the "approximately 421 ha of the mapped SAL in the draft SRLUP " ... "within the Project Area. This comprised 253ha of the Biophysical SAL and 421 ha of the Viticulture Cluster SAL."	The key points in response are as follows: • The Guideline/s for preparing an AIS (March 2012 and Sep 2012) both required identification of the agricultural resources and current agricultural production within the Project Area and within the surrounding locality. The AIS addresses agricultural production levels in the locality and within the Project Area (which includes those located on SAL) at Section 2.3.2. • Only existing agricultural uses can be assessed, as opposed to hypothetical future agricultural uses. Future uses would be subject to numerous other variables – climate, markets, holding size, water, labour, capital, viability etc in addition to SAL that cannot be predicted. • The AIS identified the SAL present in the locality and Project Area (Figure 3 and Section 2.5.3). The AIS did examine productivity levels and broader socio-economic impacts, etc and concluded that the potential impacts were very minimal in context.
6.14	Page 40 s4.3 Processing and Value Adding Industries notes "The loss of 0.42 ha of olive grove is not considered significant at local or regional scale ... " The economic loss of 29.9 ha and 0.42 ha of olive grove may be minimal at the state wide level however it may be critical to affected landholder.	The key points in response are as follows: • The olive grove (22.4ha total) is wholly mine owned and represents 0.06% of the Project Area. Only 0.42ha is to be disturbed by surface works which represents 1.9% of the grove. • Of the 29.9ha of grazing land to be disturbed, only around 8.7ha is in private ownership, on a property which is 153.6ha in total size. This area represents about $1500/yr from a potential grazing value of $27 000. • Arrangements are made with private property owners prior to any surface disturbance and compensation is made available as necessary. However, no land will be permanently removed from agriculture (p 33). The land will be returned to Class VI (grazing land) at the conclusion of mining.

Table 1 - Response to Submissions: Modification to Bulga Underground Mine (DA 376-8-2005 Mod.5)

Ref.	Matters Raised in Submission	Response
6.15	Page 41 s4.6 Tourism infrastructure notes "… three privately owned vineyards would be undermined by the Project ... ". With subsidence likely to affect these developments, the impact and mitigation should be described.	Point 6.6 above responds to these concerns. No tourism operations are known to operate within the Project Area and subsidence impacts on vineyards and infrastructure are discussed elsewhere in the AIS (Section 3.1.3 and Section 4). The AIS did examine subsidence impacts on agricultural resources and concluded that the potential impacts were very minimal in context.
6.16	There would certainly be marginal changes in the overall costs and benefits structure of the approved project resulting from the proposed modifications and resources use changes. It is assumed in the application that the net costs and benefits resulting from the proposed changes will be minor and have net positive benefits to public. However, these are not quantified and the cost benefit analysis should be done to show how the proposed changes impact on the overall costs and benefits streams.	See Point 6.12 above.
6.17	Estimates on the impacts of the modification on agricultural values should show time series data or average values with standard deviation instead of constant values over time.	The key points in response are as follows: • The Guideline/s for the preparation of an AIS (March 2012 and Sep 2012) both required identification of the production levels of each commodity produced by agricultural enterprises and impacts of the Project on agricultural resources. • The respective AIS Guidelines also require a 'risk based assessment' to the AIS, guided by the DGRs. The 'risk' to agriculture was considered to be low (in context). • Neither the AIS Guidelines, nor the DGRs require such a detailed economic or statistical evaluation of the potential economic impacts of the Project. Notwithstanding, the expected impacts are the temporary removal from agriculture of approx. 30.3ha of land (comprising 11.8ha of mapped BSAL) by direct disturbance, which will be returned to Class VI grazing land at the completion of mining. No vineyards will be directly impacted and only 0.42ha of a mine owned olive grove will be directly affected. • Subsidence impacts are predicted to be minimal and can be managed by traditional management plans and mitigation techniques that are currently a statutory requirement and in place at

Table 1 - Response to Submissions: Modification to Bulga Underground Mine (DA 376-8-2005 Mod.5)

Ref.	Matters Raised in Submission	Response
		the BCC (ie. the Subsidence Management Plan Approval process). • This request from DPI for additional economic modelling is considered unwarranted for the relatively minor risk posed by the proposed modification to agricultural resources, noting that the majority of the Project Area is already approved for underground mining (and has previously been undermined by the Beltana No. 1 Mine). The direct impacts on agricultural values will be low (in context).
7. DEPARTMENT OF PRIMARY INDUSTRIES (BUSINESS SERVICES) (21 December 2012)		
7.1	NSW Fisheries advises that there are no Key Fish Habitats in the footprint of the subsidence affected areas of the mine and as such raise no issues in respect to the proposed modification.	Noted.
7.2	**Subsidence Impacts** The NSW Office of Water requests ongoing verification of subsidence and drawdown predictions for the multi seam subsidence expression between the Blakefield and Whybrow seam workings.	Noted.
7.3	**Alluvial Drawdown Accounting** The NSW Office of Water recommends the existing Wollombi Brook Groundwater Contingency Plan, approved by the Department of Planning and Infrastructure be reviewed following extraction of the three southern longwall blocks in closest proximity to the Wollombi Brook alluvium. This review is to demonstrate whether the protective arrangements devised by Bulga Coal Management are effective and the cumulative drawdown in the Wollombi Brook alluvium remains below the nominal 10% saturated thickness limit.	Noted.
7.4	**Subsidence of the Broke-Fordwich Private Irrigation District Pipeline** The NSW Office of Water requests a copy of any signed agreement (dealing with the PID remediation programme) between Xstrata Bulga Coal Operations and the Board of the Broke-Fordwich PID for inclusion in its licence to the PID.	Noted.
7.5	**Recommended Conditions of Approval**	Noted.

Table 1 - Response to Submissions: Modification to Bulga Underground Mine (DA 376-8-2005 Mod.5)

Ref.	Matters Raised in Submission	Response
	Minimise Impacts: • The proponent shall carry out the project in a way that prevents and/or minimises the potential surface and groundwater impacts of the project. Subsidence Performance Criteria: • The proponent shall ensure that the subsidence performance measures for the cumulative Subsidence Control Zone as identified in the EA are achieved. Drawdown Accounting: • The Proponent shall account for the depressurisation drawdown of the Wollombi Brook alluvium caused by the project. The accounting mechanism should be provided by the retention of adequate water entitlements to account for the loss attributable to the project. • The cumulative drawdown loss from the Wollombi Brook alluvial groundwater source should be maintained at below 10% of saturated thickness of the alluvium. Water Management Plan • The proponent shall review its existing Site Water Management Plan and Wollombi Brook Groundwater Contingency Plan to ensure the cumulative drawdown in the Wollombi Brook alluvial groundwater source is maintained within the following nominated limits: - No more than 10% loss of saturated thickness of the alluvial groundwater system, - No change in the beneficial use class within the alluvial groundwater system during or following completion of extraction in the Blakefield Seam, - Review of the static water levels and groundwater quality in bores in the Wollombi Brook alluvium and in the surrounding alluvial groundwater system to devise and implement any remedial actions required to maintain existing water user access to the alluvial groundwater system.	

We trust that the information contained within this response to submissions is sufficient to facilitate the further assessment of the proposed modification. Should you require any further information please do not hesitate to contact either the undersigned or Mr Ralph Northey (Environment and Community Manager at the Bulga Coal Complex) on (02) 6570 2539 or 0418 439 874.

Yours sincerely,

David Humphris
Associate Environmental Planner

APPENDIX 1

Aboriginal Heritage Community Consultation Log and Correspondence prepared by Ozark EHM

COMMUNITY CONSULTATION LOG & CORRESPONDENCE

11.10.12 - Copy of draft report sent to all registered stakeholders - COMMENTS invited by MONDAY 12th November, 2012			
NO COMMENTS RECEIVED - EMAIL ALL STAKEHOLDERS AS A reminder that comments are due today - 12th November. Attached a summary of the management recommendations as a reminder of the project and what stakeholders may wish to comment on.			
12.11.12	Plains Clans of the Wonnarua People / Tocomwall	Scott Franks c/- Yarrawalk Enterprises PO Box 76 Carringbah NSW 2229 E: 'yarrawalk@tpg.com.au ph: 0404 171 544	VIA EMAIL *Dear Cheryl* *On the bases that Tocomwall was engaged to conduct a Cultural heritage assessment we could not agree to the recommendation until such time that we have had the opportunity to discuss with Blakefield and Bop Management our findings.* *We do not support the recommendation.* *Regards,* *Scott Franks* *Native Title & Environmental Services Manager*
RESPONSES RECEIVED AFTER DUE DATE			
15.11.12	Cacatua Culture Consultants	Donna Sampson e: 'cacatua@resetdsl.net.au	VIA EMAIL *Sorry for the delay in our reply.* *Cacatua is in support of the information that was supplied.* *Thank you* *Donna Sampson*
15.11.12	Kawul Cultural Services Vicky Slater Rod Hickey	Kawul Cultural Services E: kawul-culturalservices@hotmail.com	VIA EMAIL *Hi Cheryl* *Re: Draft Report - Blakefield Mine.* *We are happy with the Report. Sorry for the Delay.* *Regards* *Vicky Slater -Manager*

14.01.13	SECOND ROUND OF CONSULTTION - EMAILS AND HARD COPIES DISTRIBUTED TO ALL STAKEHOLDERS ASKING FOR COMMENT….AGAIN.		
22.01.13	Ungooroo Cultural & Community Services Inc	Rhonda Ward e: 'ungooroo5969@hotmail.com	*sorry having problems with my computer , I don't have a problem with the recommedations* *Regards Rhonda*
29.01.13	EMAILED THE FOLLOWING STAKEHOLDERS WHO HAVE NOT TAKEN THE OPPORTUNITY TO RESPOND. Arthur Fletcher / Deslee Talbot Consultant / Hunter Valley Aboriginal Corp. / Ungooroo Aboriginal Corporation /Wattaka Wonnarua Cultural Consultants Services / Yinarr Culture Services / Paulette Ryan		
29.01.13	Deslee Talbot Consultant	Deslee e: 'm-desley@hotmail.com	Deslee phoned the office and advised that she was satisfied with the management recommendations in the report. Deslee queried the recommendation that the 'site' E5 would 'preferably' be avoided, would it or would it NOT be? It was clarified that E5 was a pit and that the site was registered and the artefacts located in the pit had been removed from impact and were now part of the larger collection of artefacts.
29.01.13	Wattaka Wonnarua Cultural Consultants Services	Des Hickey e : deshickey@bigpond.com	Received correspondence from Des Hickey. His organisation does not support the recommendation as he is of the opinion that an 'Aboriginal cultural heritage methodology assessment is required for this Project before any construction occurs within the study area' - see Appendix 2 of report for copy of letter
30.01.13	Hunter Valley Aboriginal Corp	Rhonda Griffiths mob: 0429 989 878	Rhonda Griffiths phoned and said HVAC on principle agree with the management recommendations outlined in the report.

31.01.13	Arthur Fletcher	Arthur Fletcher Wonn1 Sites| 619 Main Road Glendale NSW 2285| Phone/Fax: 02 49547751 | Mobile: 0402 146 193 e: 'wonn1sites@gmail.com arthur.c.fletcher@gmail.com	No active voice mail box on mobile, unable to leave message. Phoned landline, left message requesting feedback should Arthur wish to comment.
31.01.13	Yinarr Culture Services	Kathie Kinchela 0432 720 623 6547 6077	Left 10 second message on mobile to contact the office via phone or email should Kathy wish to comment on the report & management recommendations.
31.01.13	Hunter Traditional Owner	Paulette Ryan Phone: 0432 672 273	Left detailed message for Paulette to phone the office if she wished to comment on the report and management recommendations.
31.01.13	Wonnarua People / Upper Hunter Wonnarua Council	c/ - Mr Victor Perry Mrs Rhoda Perry 6571 4888	Phone rang out, unable to leave message.
01.02.2013	Ungooroo Aboriginal Corporation	Taasha Layer admin@ungooroo.com.au	Taasha phoned the office & apologised for the delay with their response. Advised that UAC agree with the recommendations & that she will send me an email so that it is in writing.

Example correspondence to RAPs requesting comment on report.

14th January, 2013

Deslee Talbot Consultants
2/19 South Street
Gunnedah NSW 2380

Dear Deslee

RE: MANAGEMENT RECOMMEDATIONS - proposed Development Modification to DA 376-8-2003 for the Blakefield North Underground Mine Project.

As you may recall last year your organisation expressed an interest in the Blakefield North Underground Mine Project, and as a Registered Aboriginal Party (RAP) were consulted and invited to participate in the field assessment and test excavation program undertaken in January and May 2012 respectively.

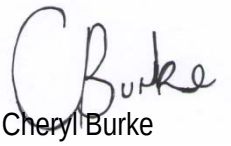
All RAPs were issued with an updated draft report In October 2012 and requested to review and give feedback on the management recommendations outlined in the document. The Office of Environment & Heritage (OEH) has requested that we undertake additional consultation and seek comments from the RAPs who did not take the opportunity to submit comments in the first instance.

As you already have a copy of the draft report, we have included with this correspondence a duplicate of Section 6.2 for review (see attachment). Again, we ask that you take the time to read the management recommendations and submit your comments so that your organisation has an active role in the Aboriginal cultural heritage planning process associated with this project.

If you could forward your reply by close of business Tuesday 29th January, 2013 it would be vastly appreciated. Comments are invited by phone, post, fax or email.

Please do not hesitate to get in touch should you have any questions regarding the enclosed information.

Yours faithfully



Cheryl Burke
Administration Officer

Response from Kawul Cultural Services concerning the draft report and management recommendations.

Archived: Thursday, 31 January 2013 2:34:57 PM
From: Vicky Slater
Sent: Thursday, 15 November 2012 2:05:53 PM
To: Cheryl Burke
Subject: RE: Blakefield North Underground Mine Project - COMMENTS DUE
Response requested: No
Importance: High

Hi Cheryl

Re: Draft Report - Blakefield Mine.

We are happy with the Report. Sorry for the Delay.

Regards

Vicky Slater -Manager

Response from Ungooroo Cultural & Community Services Inc. concerning the draft report and management recommendations.

Archived: Thursday, 31 January 2013 2:33:19 PM
From: rhonda ward
Sent: Tuesday, 22 January 2013 11:06:51 PM
To: Cheryl Burke
Subject: RE: *** RESPONSE REQUESTED *** Blakefield North Underground Mine Project
Response requested: Yes
Importance: High

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sorry having problems with my computer , I don't have a problem with the recommedations

Regards Rhonda

Response from Cacatua Culture Consultants Services concerning the draft report and management recommendations.

Archived: Thursday, 31 January 2013 2:34:35 PM
From: cacatua@resetdsl.net.au
Sent: Thursday, 15 November 2012 4:41:22 PM
To: Cheryl Burke
Subject: Re: Blakefield North Underground Mine Project - COMMENTS DUE
Response requested: No
Importance: High

>Cheryl Burke
> Administration / Consultation Officer

Sorry for the delay in our reply.
Cacatua is in support of the information that was supplied.

Thank you
Donna Sampson

Response from Wattaka Wonnarua Cultural Consultants Services concerning the draft report and management recommendations.

Wattaka WCC Services Des Hickey manager ABN: 57914734912
4 Kennedy St Singleton NSW 2330 Ph: 0432977178
Email:deshickey@bigpond.com

28/1/2013

To; OzArk Environmental & Heritage Management

Attn: Cheryl Burke Administration Officer

Re: management recommendations-Proposed Development modification to DA 376-8-2003 For The Blake field north Underground mine project.

Dear Cheryl

I received the management recommendations for the above said project.
Wattaka wonnarua cultural consultancy servicers do not agree with the recommendations that have been put forward for this project.
You state in your recommdations that no further archaeological investigation is warranted throughout the study area, that's fine however this is coming from a archaeological perspective I am coming from an Aboriginal perspective I believe That more could have been done within the study area to ashore the protection of Aboriginal cultural heritage. There is no guarantee that the sites and landform will be impacted on due to the construction of Gas Drainage Plant, Pipeline Maintenance Facility, Power Generation plant, poles and towers if the electricity Line, Access Roads. As manager of Wattaka WCCS and an Aboriginal Wonnarua man I believe that a Aboriginal cultural heritage methodology assessment is required for this Project before any construction occurs within the study area.

Regards
Des Hickey WWCCS

APPENDIX 2

Revised Noise Impact Assessment prepared by Global Acoustics

Global Acoustics
Noise and Vibration Analysis and Solutions

19 February, 2013

GSS Environmental
PO Box 907
Hamilton NSW 2303
Attention: David Humphris

Dear David,

Regarding: Blakefield North Response to Submissions

1 INTRODUCTION

The NSW Environmental Protection Authority (EPA) has made a submission relating to the noise impact assessment (NIA) undertaken by Global Acoustics for the Blakefield North Development Consent Modification (the EA). This letter addresses a concern relating to construction noise impact, and, provides revised operational noise results including an assessment of 4 degrees per 100 metres inversion rate for the night period.

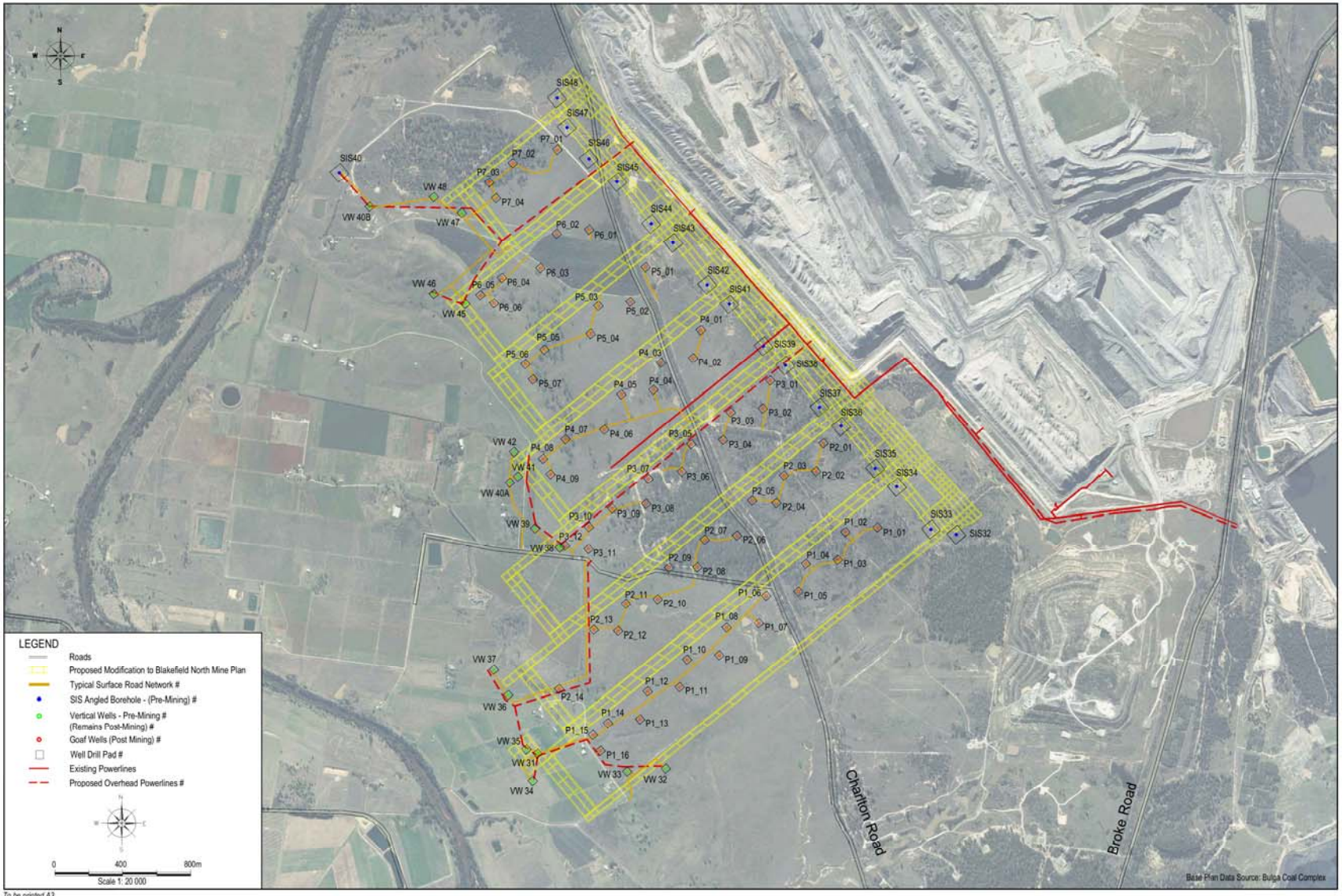
The EPA submission stated that:

"*…The EPA is concerned that the choice of two "worst case" vertical well drilling locations appears to have underestimated the noise impact of this activity on sensitive receivers, and that therefore more receivers may be significantly affected than those presented in the EA…*"

To address this concern, additional assessment has been undertaken that considered all proposed drilling locations (surface to inseam (SIS), vertical wells, and GOAF wells). Figure 1 illustrates the locations of all assessed drill locations. Model inputs (topography, receptors, prevailing meteorological conditions, and sound power) are as presented in the NIA.

It is important to note that all civil works, and, drilling of vertical wells and goaf wells are scheduled to occur during the day period. The only construction activity scheduled to occur during the evening and night periods is SIS drilling (SIS drilling will also occur during the day period).

This letter provides revised construction noise predictions for all time periods. Predictions for the night period now include an assessment of stronger temperature inversion conditions as requested by the EPA. A lapse rate of 4 degrees per 100 meters has been assessed, whereas the NIA assessed a lapse rate of 3 degrees per 100 meters for stability class F meteorological conditions.



To be printed A3

* Buried Pipelines Between Wells Not Shown

\# Indicative Locations will be finalised pending constraints

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Conceptual Gas Drainage Arrangement

FIGURE 1

V:\XCN06-034\Figures\Final\CAD\Fg1_XCN06-034_TypicalGasDrainage_Labelled_130205.dwg

Figure 1 – Assessed Drilling Locations

2 MODELLING ASSESSMENT

To ensure worst-case impact due to construction activities was assessed, all proposed drilling locations (surface to inseam (SIS), vertical wells, and GOAF wells) were modelled. At each location, civil works required to prepare the site for drilling, and, drilling works were assessed separately (these activities do not occur concurrently). The highest result predicted from each of these tasks was taken as the model result for each noise sensitive receptor (NSR).

Model input parameters including topography, NSR, prevailing meteorological conditions and sound power were as presented in the NIA. Acoustic barriers, 4.2 metre high, were included in the drilling models; no barriers were included for the civil works models as it is impractical to have them installed at that stage of works.

A revised assessment of low frequency noise (LFN) was undertaken using both the Broner (2010), and the NSW Industrial Noise Policy (INP) methods. Given the large number of assessed drilling locations, assessment of LFN for the day period was restricted to locations with an A-weighted prediction greater than $L_{Aeq,\ 15\ minute}$ 40 dB (at any receptor). If a 5 dB LFN modifying factor were applied to predictions less than this level, exceedance of the recommended day period construction noise criterion would not result.

The assessment of LFN in the NIA was mistakenly conservative (over estimated). Assessment of the vertical well construction sites was undertaken considering prevailing meteorological conditions for the day, evening and night periods; however, construction at these locations is only to occur during the day period. The revised assessment considers only day period prevailing meteorological conditions (neutral atmosphere) for the day period construction tasks.

3 RECOMMENDED DAY PERIOD CONSTRUCTION NOISE CRITERION

It is recommended a construction noise criterion of $L_{Aeq,\ 15\ minute}$ 45 dB is prescribed for the day period. Global Acoustics feel this criterion is justified for the following reasons:

- Extended noise logging undertaken by Global Acoustics around the BCC during 2009 and 2010 indicated L_{Aeq} noise levels exceeding 45 dB are very common during the day period;
- Rural activities are relatively loud. Road traffic noise and elevated noise levels due to rural activities are common during the day period; and
- Appendix A of AS1055.2 estimates background levels of $L_{A90,\ 11\ hour}$ 45 dB, for the day period in areas with low density transportation. Although this level is considered higher than the rural area surrounding the BCC, it is an indication that elevated levels are not uncommon in this type of area.

DP&I have agreed $L_{Aeq,\ 15\ minute}$ 45 dB is a suitable criterion to adopt as the construction noise criterion for the day period. BCM will negotiate private agreements with receptors where noise is predicted to exceed this criterion.

4 PREDICTIONS

4.1 A-weighted Predictions

Table 4.1 presents construction noise predictions for the day period for receptors with predictions greater than $L_{Aeq,\ 15\ minute}$ 35 dB. Results are the highest predictions for each receptor from all drilling locations assessed. Results include day period predictions for the remainder of the BCC (i.e mining noise is included). Results are presented for civil works, drilling works, and, the highest prediction from both tasks. Results in red type exceed the recommended day period construction noise criterion of $L_{Aeq,\ 15\ minute}$ 45 dB.

Table 4.2 presents construction noise predictions for the evening and night periods due to SIS drilling. Results are presented for construction noise from BFN alone (SIS drilling only), and, for proposed SIS drilling combined with predictions for the remainder of the BCC (i.e mining noise is included). Results in bold type exceed the relevant criterion. An increase to total levels above the base consent criterion of $L_{Aeq,\ 15\ minute}$ 35 dB is only possible when predictions for BFN alone are greater than $L_{Aeq,\ 15\ minute}$ 25 dB. Thus only results for receptors which are predicted to receive BFN construction noise levels of $L_{Aeq,\ 15\ minute}$ 25 dB or more are presented.

Table 4.3 and Table 4.4 present revised operational noise results for Year 11 and Year 15 respectively. These are revised versions of Tables 6.1 and 6.2 of the NIA. Predictions for the night period now include an assessment of stronger temperature inversion conditions as requested by the EPA. A lapse rate of 4 degrees per 100 meters has been assessed, whereas the NIA assessed a lapse rate of 3 degrees per 100 meters for stability class F meteorological conditions. Receptor 6 – Hedley has been omitted from the tables as the property has been acquired by BCM.

Table 4.1 DAY PERIOD A-WEIGHTED CONSTRUCTION NOISE RESULTS – $L_{Aeq,15\ minute}$ dB

Receptor ID	Property Owner	Civil Works	Drilling	Highest Result
160	Dwyer	67	57	67
195	Kennedy	47	49	49
217C	Russell	47	39	47
156B	Todhunter and Brook	47	41	47
217B	Russell	46	38	46
217A	Russell	46	38	46
179	Brooks and Thompson	45	36	45
154	Rath	45	39	45
156A	Todhunter and Brook	44	43	44
151	Lewis	43	35	43
162	Lamaro	43	35	43
169B	McCraw	42	34	42
171	Owens	41	33	41
169A	McCraw	39	32	39
153	Rath	39	36	39
184	Esslemont Family Holdings PTY Limited	38	31	38
147	McLellan	38	31	38
164	Sharrock	38	32	38
183	Foster	38	31	38
170	Owens	38	31	38
144	Bevan	37	31	37
185	Poulos	37	30	37
174	Kastelic	36	30	36
175	Grapemen Holdings Pty Limited	36	30	36
165	Garton	36	31	36
149	McInerney	36	31	36

Table 4.2 EVENING AND NIGHT PERIODS CONSTRUCTION NOISE RESULTS - $L_{Aeq,15\ minute}$ dB

Receptor ID	Property Owner	Criterion		Proposed BFN		BCC + Proposed BFN	
		Eve	Night	Eve	Night	Eve	Night
232	Medhurst	37	36	30	28	**39**	**37**
234	Thompson	36	36	28	27	**38**	**37**
230A	Cant	36	35	29	27	**38**	**36**
233	Vikas	35	35	28	27	**38**	**36**
230B	Cant	36	35	28	26	**38**	**36**
237	Ryan and Harrison	37	37	27	27	**38**	37
240	Godyn	36	36	27	26	**38**	36
239	Waters	37	37	27	27	**38**	37
235	Caban	36	36	26	25	**38**	36
217B	Russell	36	36	29	34	**37**	**37**
217C	Russell	36	36	27	33	**37**	**38**
231	Dawson	35	35	27	25	**37**	34
229	Ritchie	35	35	26	25	**37**	34
226	Vassallo	35	35	27	25	**37**	34
228	Lamb	35	35	27	25	**37**	35
236	Krey	35	35	26	25	**37**	35
241	Kaizer	35	35	27	26	**37**	**36**
238	Topham	35	35	26	25	**37**	35
243	Neville	35	35	26	25	**37**	**36**
217A	Russell	36	36	32	35	36	**38**
222	Vassallo	35	35	27	24	**36**	34
227	Beavis	35	35	27	24	**36**	34
223	Jackson	35	35	26	24	**36**	33

Table 4.3 YEAR 11 OPERATIONAL NOISE RESULTS - $L_{Aeq,15\ minute}$ dB

Receptor ID	Property Owner	Criteria D/E/N[1]	BCC without BFN D/E/N[1]	Proposed BFN D/E/N[1]	BCC + Proposed BFN D/E/N[1]	Change due to Addition of BFN D/E/N[1]
217s	Russell	36/36/36	26/35/34	12/27/25	26/36/36	0/1/0
319A	Estvale Holdings Pty Ltd	35/35/35	22/25/33	11/24/27	22/25/33	0/0/0
97	Lambkin	36/36/36	24/29/32	15/27/27	24/29/33	0/0/1
217m	Russell	36/36/36	23/35/34	10/26/25	23/35/35	0/0/1
149	McInerney	NA	27/35/38	20/26/25	27/35/38	0/0/0

Note: 1. D/E/N refers to Day/Evening/Night.

Table 4.4 YEAR 15 OPERATIONAL NOISE RESULTS - $L_{Aeq,15\ minute}$ dB

Receptor ID	Property Owner	Criteria D/E/N[1]	BCC without BFN D/E/N[1]	Proposed BFN D/E/N[1]	BCC + Proposed BFN D/E/N[1]	Change due to Addition of BFN D/E/N[1]
217s	Russell	36/36/36	26/35/34	12/27/25	26/36/34	0/1/0
217m	Russell	36/36/36	23/35/33	10/27/25	23/35/34	0/0/1

Note: 1. D/E/N refers to Day/Evening/Night.

4.2 Low Frequency Noise Predictions

The Broner method is Global Acoustics' preferred method for assessing the low frequency impact of mining noise; it is expected this method will be adopted by the regulatory authorities in the near future. The current INP method involving the subtraction of total A-weighted levels from total C-weighted levels does indicate the possibility of a low frequency noise problem, however, it has two major failings. One is that it can be influenced by the presence (or absence) of other noise sources in the environment when measured at receivers for compliance. The major problem is though, that at increasing distances from mining noise sources, predicted A-weighted levels will decrease faster than predicted C-weighted levels, skewing the C minus A relationship such that a low frequency noise issue will be identified, when in fact absolute low frequency levels will be lower than nearer locations to the source that have not been identified as having a low frequency issue. This can be seen in the INP low frequency results presented in this assessment. The Broner method predicts that low frequency noise levels will decrease with increased distance from the mining noise source, which follows basic distance loss theory in noise prediction.

Table 4.5 presents LFN results for the day period determined using the INP method. The table includes all receptors that have a predicted C-weighted minus A-weighted (C minus A) level greater than or equal to 15 dB. A 5 dB LFN modifying factor penalty is applied to the A-weighted prediction in accordance with INP guidelines. In all cases, the resulting $L_{Aeq,\ 15\ minute}$ is less than the recommended construction noise criterion of $L_{Aeq,\ 15\ minute}$ 45 dB, except for Receptor 160 (Dwyer), for which a private agreement is required due to higher A-weighted predictions from a different drilling location.

Table 4.6 presents LFN results for all time periods determined using the Broner (2010) method. Receptor 160 (Dwyer) is the only receptor with a C-weighted prediction exceeding the desirable Broner criterion of 60 dB.

Table 4.7 presents LFN results for the evening and night periods due to SIS drilling, determined using the INP method. Drilling location SIS40 is responsible for all predictions. The table includes all receptors that have a predicted C minus A level greater than or equal to 15 dB. A 5 dB LFN modifying factor penalty is applied to the A-weighted prediction in accordance with INP guidelines.

In the assessment of LFN for the evening and night periods, C minus A results were determined for all modelled prevailing meteorological conditions. The results presented in Table 4.7 correspond to the meteorological condition that generated the highest C minus A result for each receptor; this condition is not always the same as the condition that generated the highest A-weighted total, as presented in Table 6.4 of the NIA.

It should be noted that the drilling locations that cause the highest predicted C minus A results are typically not the same locations that cause the highest A-weighted or C-weighted predictions. In the case of Dwyer, vertical well VW37 triggers the C-A result; the associated total A-weighted prediction is $L_{Aeq,\ 15\ minute}$ 41 dB. Goaf well

P6-16 generates both the highest A-weighted ($L_{Aeq,\ 15\ minute}$ 67 dB) and C-weighted ($L_{Ceq,\ 15\ minute}$ 76 dB) predictions; however the C-A result in this instance is 9 dB.

Table 4.5 DAY PERIOD LOW FREQUENCY CONSTRUCTION NOISE RESULTS BY INP METHOD – $L_{eq,15\ minute}$ dB

Receptor ID	Property Owner	Total C-weighted	Total A-weighted	Total C minus Total A-	A-weighted with 5 dB LFN penalty
154	Rath	54	37	17	42
156B	Todhunter and Brook	52	37	15	42
145	Elsmore	45	30	15	35
197	Kennedy	45	30	15	35
160	Dwyer	56	41	15	46

Table 4.6 DAY PERIOD LOW FREQUENCY CONSTRUCTION NOISE RESULTS BY BRONER METHOD – $L_{eq,15\ minute}$ dB

Receptor ID	Property Owner	Total C-weighted	Total A-weighted	Total C minus Total A-	A-weighted with 5 dB LFN penalty
160	Dwyer	76	67	9	72

Table 4.7 EVENING/NIGHT PERIODS LOW FREQUENCY CONSTRUCTION NOISE RESULTS BY INP METHOD – $L_{eq,15\ minute}$ dB

Receptor ID	Property Owner	Total C-weighted	Total A-weighted	Total C minus Total A-	A-weighted with 5 dB LFN penalty
20	Bosco	16	47	31	36
82	Mears	15	46	31	36
84	Stacey	15	47	32	37
85	Towns	15	47	32	37
140	Logan	15	47	32	37
225	Harris	15	47	32	37
261	Smith	15	47	32	37
326	McNaught	15	46	31	36

5 CONSTRUCTION NOISE MONITORING

The *Bulga Coal Complex Noise Management Plan* (BCM, 2010) will be revised to include a noise monitoring protocol for construction noise. It is recommended attended noise monitoring is undertaken for any drilling location with a prediction exceeding $L_{Aeq,\ 15\ minute}$ 40 dB during the day period at any receptor and for which there is no private agreement, or, for any drilling location for which noise complaints are received. This is on the basis that receptors with predictions in the range $L_{Aeq,\ 15\ minute}$ 40 to 45 dB are most at risk of receiving levels exceeding the recommended day period construction noise criterion of $L_{Aeq,\ 15\ minute}$ 45 dB. Receptors with predictions exceeding $L_{Aeq,\ 15\ minute}$ 45 dB would have a private negotiated agreement. Table 5.1 presents a list of drilling locations with a prediction exceeding $L_{Aeq,\ 15\ minute}$ 40 dB during the day period at any receptor. Predictions are provided for both civil works and drillings tasks.

Global Acoustics recommendations regarding the frequency of construction noise monitoring are:

- Attended day period monitoring should be undertaken of both civil works and drilling works upon commencement of works at a new drill site;
- Day period monitoring should be undertaken for any drill site with a prediction exceeding $L_{Aeq,15\ minute}$ 40 dB at any receptor and for which there is no private agreement. Monitoring should be undertaken at NSR located within a 1000 metre radius of the construction site for civil works, and a 1750 metre radius of the construction site for drilling works, and for which there is no private agreement. Where clusters of NSR exist, monitoring should be undertaken at the nearest representative NSR;
- SIS drilling locations SIS40, SIS47 and SIS48 are the only locations with predictions exceeding $L_{Aeq,\ 15\ minute}$ 25 dB (from construction). Monitoring should be undertaken upon commencement of drilling at these locations, at NSR located within a 2500 metre radius of the construction site and for which there is no private agreement. Where clusters of NSR exist, monitoring should be undertaken at the nearest representative NSR; and
- It is recommended the frequency of monitoring is performance based. Monitoring should be undertaken twice in the relevant time period during the first week of construction. If compliance were achieved both times, additional monitoring would only occur upon complaint. Should non-compliance be measured, additional monitoring would occur weekly until such time as compliance is achieved.

Table 5.1 DRILLING LOCATIONS WITH DAY PERIOD PREDICTIONS EXCEEDING $L_{Aeq,15\ minute}$ 40 dB

Civil Works		Drilling	
Drill Site ID	**Prediction $L_{Aeq,15\ minute}$ dB**	**Drill Site ID**	**Prediction $L_{Aeq,15\ minute}$ dB**
P1_07	41	P1_13	42
P1_08	42	P1_14	47
P1_09	43	P1_15	53
P1_10	42	P1_16	57
P1_12	42	P2_14	43
P1_13	49	P3_11	41
P1_14	59	VW_31	50
P1_15	65	VW_32	42
P1_16	67	VW_33	50
P2_12	44	VW_34	49
P2_13	47	VW_35	48
P2_14	53	VW_36	45
VW_31	54	VW_37	49
VW_32	54	-	-
VW_33	62	-	-
VW_34	45	-	-
VW_35	53	-	-
VW_36	46	-	-
VW_37	47	-	-
VW_40B	46	-	-
VW_45	42	-	-
VW_46	47	-	-

Note: Refer to Figure 1 for drilling locations.

I trust this information meets your requirements. If you have any questions or need further details please contact me.

Regards,

Tony Welbourne
Acoustics Engineer

Global Acoustics

Noise and Vibration Analysis and Solutions

20 March 2013

GSS Environmental
PO Box 907
Hamilton NSW 2302
Attention: David Humphris

Dear David,

Regarding: Blakefield North – proposed attended noise monitoring scheme

1 INTRODUCTION

This letter provides a meeting summary, information regarding noise management plans (NMP), and, outlines a proposed attended noise monitoring scheme (in both NMP and Environment Protection Licence format) for the Bulga Coal Complex (BCC). This is all additional follow up to the EPA submissions, particularly their item 3.3 'Requirement to Monitor Noise'.

A meeting was held at Newcastle, 11 March 2013, between Global Acoustics, the EPA and representatives of Bulga Coal specifically to discuss, amongst other items, attended noise monitoring.

2 ORIGINAL REQUIREMENT

The original EPA noise monitoring requirement, in their submission regarding the Blakefield North EA, is reproduced below.

3.3 To assess compliance with Condition 2.1, attended noise monitoring must be undertaken in accordance with Conditions 2.5 and:

a) at each one of the locations or at a location representative of the most-affected locations listed in Condition 2.1;

b) occur quarterly in a reporting period;

c) occur during each day, evening and night period as defined in the NSW Industrial Noise Policy for a minimum of:

- *1.5 hours during the day;*
- *30 minutes during the evening; and*
- *1 hour during the night.*

d) occur for three consecutive operating days.

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3 GENERAL DISCUSSION

During the meeting it was revealed by the EPA that the duration of monitoring nominated for each location was based on covering 10 percent of each time period. Also, they considered three consecutive days of monitoring were required to determine if any impacts were sustained.

Some information about mining noise in rural areas was provided by us, including that noise from distant sources is usually (very commonly) inaudible or very low-level during the day period. It was also pointed out that the evening period is a transition from day to night (6:00 pm in the evening is broad daylight in summer), and, that mining noise levels at 7:00 am are usually the worst case for the day period (atmospheric conditions often still similar to the night period).

It was agreed by all that night period atmospheric conditions are typically a worst-case for propagation of mining noise over long distances.

It was explained to the EPA that because atmospheric conditions at the end of the evening and beginning of the day are as per the night period, and, if mining operations are the same over a 24 hour period (as is common), then measured night period noise levels could be compared against criteria for all periods. That is, the worst-case noise level is quantified (for all monitoring locations) and then conservatively compared to all criteria.

The concept of comparing a measured worst-case against all criteria was understood by all. However, the EPA still have difficulty in agreeing to not having any monitoring in the day and evening periods, when there are limits specified for them.

Additionally explained and understood were the impracticalities of attempting to gather enormous quantities of data as per the original monitoring requirement, much of which would be of little relevance. Other monitoring requirement impracticalities such as having a location one metre from a farm-house bedroom window were also discussed. While it is considered there are modifications that should be made to conditions other than the proposed 3.3 which is the focus of this document, they have not been provided here. Comment on these was provided in other advice about the EPA submission.

4 INFORMATION PRESENTED

Information was provided verbally during the meeting to support a change to the monitoring requirements. The information was that for received mining noise during various periods, given that all receptors are located at a considerable distance from the mine with regard to noise propagation, the following can be said:

- mining noise is typically inaudible during the day period, particularly once the ground heats up (daytime is not usually a problem period). It is acknowledged that meteorological conditions that occur during the night period can extend into the early part of the day period.

- evening is a transitional period from day to night, from the hours 1800 to 2200. Meteorological conditions at 1800 hours are usually as per day (broad daylight in summer), but as per night at 2200 hours.

- highest mining noise levels are received off site, for the vast majority of times, during the night period.

Therefore, it should be sufficient to prove compliance by monitoring during the night period with the assumption that compliance would then result during the periods either side (assuming higher criteria for those), or, the measured levels could be validly compared with criteria for those other time periods.

Additional reasons for monitoring at night only are:

- other activities (farming, road traffic etc.) are more common during the day and evening, making it difficult to measure the source of interest; and

- air movement during the day is often above speeds during which monitoring can take place, and, greater than speeds in which criteria apply.

Other benefits of this approach are:

- less visits are required to each location, reducing potential annoyance to residents; and

- money saved on day and evening monitoring could be used to conduct additional night monitoring when required (which also equals additional day and evening monitoring).

5 NOISE MANAGEMENT PLAN TRENDS

While the EPA do not endorse NMP, they are the document that detail appropriate methodology to determine compliance with approval conditions, and are scrutinised by the DP&I to ensure adequacy. Therefore it is relevant here to consider recent NMP trends and DP&I requirements.

One aim of all NMP is to accurately quantify mining noise for comparison with regulatory limits, with a regard to determining if any measured exceedances are ongoing and common, or an isolated incident. The latter part of that aim is difficult to address, on the basis that attended monitoring is the best methodology for determination of compliance (as opposed to using real-time/unattended data), and much attention has been given to improvement.

Current NMP incorporating the most recent DP&I thinking adopt a variable monitoring frequency based on performance.

DP&I are comfortable with application of the night only monitoring approach where appropriate (operations are the same for all time periods, and there is no significant meteorological condition that occurs during day or evening but not at night).

The default monitoring frequency is one night per month per location; this may not be the starting point for new or contentious operations. If, over time, no exceedances are measured, the monitoring frequency remains unchanged. However, an exceedance at any location triggers additional monitoring there (but not at other locations) until it can be shown that this was an isolated incident or, there is an ongoing problem.

Other aspects of attended monitoring that are addressed in NMP are:

- when and how to remeasure on the night if an exceedance is measured;
- when to contact an operation if an exceedance is measured; and
- assessment of low-frequency noise during monitoring.

6 PROPOSED MONITORING SCHEME

It is proposed that the existing BCC NMP and the EPA noise monitoring requirements both be modified to be in agreement.

The BCC underground operations will necessitate some noise generating infrastructure construction activity (drilling) at locations that are considerably closer to residences than the surface operations (the BCC major noise source). This construction activity is scheduled to occur, with the exception of SIS drilling locations, during the day period only. Noise sources in proximity to residences, and the likelihood of measurable and possibly annoying levels during the day period is a departure from the usual scenario described above.

Accordingly it is considered best to treat operational and construction noise separately with regard to noise monitoring and management.

Addressed individually below are operational and construction noise, and, the EPA requirements.

6.1 Operational Noise

The simplest option would be if EPA generally adopted the current NMP with minor modifications to make it contemporary. The current NMP section 6.1 relates to monitoring frequency and reads as follows:

> *Attended monitoring will be conducted at locations representative of Fordwich, Bulga, Broke and Milbrodale localities, as shown in Figure 2. At each of these sites quarterly monitoring will be undertaken for three (3) nights, which equates to approximately one (1) night per month.*
>
> *Monitoring will only be conducted during the night, as this is representative of the worst case noise scenario. Measurement equipment must be capable of providing 1/3 octave band statistical data. Data gathered must include Laeq (15 mins) and La1 (1min).*
>
> *Attended monitoring data will be assessed against the low frequency criteria as specified in the paper "A Simple Criterion for Low Frequency Noise Emission Assessment" (Broner JLFNV Vol29.1 pp1.14 2010) and the Industrial Noise Policy, to determine if any low frequency noise impact has occurred.*
>
> *The meteorological station operated at the Bulga Coal Complex will be used to monitor wind speed, wind direction and temperature at 2 metres and 10 metres.*

A contemporary version of that section could read:

> *Attended monitoring will be conducted at locations representative of Fordwich, Bulga, Broke and Milbrodale localities, as shown in Figure 2. At each of these sites quarterly monitoring will be undertaken for three nights, which equates to approximately one night per month.*
>
> *DP&I require monitoring to determine if any impacts are systemic/sustained. Accordingly, if a noise criterion exceedance is measured, follow up monitoring will be undertaken at that specific location (not all locations) on one night during each of the following two weeks. The regular monitoring frequency will be resumed if no further exceedances are measured. However, if a further exceedance is measured during the follow up period (fortnight), then a comprehensive*

survey (Ngara logger or similar) will be undertaken, to the satisfaction of the DP&I, to determine if these impacts are regular (systemic/sustained).

Monitoring will only be conducted during the night, as this is representative of the worst case noise scenario. Measurement equipment must be capable of providing 1/3 octave band statistical data. Data gathered must include LAeq (15 mins) and LA1 (1min).

Attended monitoring data will be assessed against the low frequency criteria as specified in the paper "A Simple Criterion for Low Frequency Noise Emission Assessment" (Broner JLFNV Vol29.1 pp1.14 2010) and the Industrial Noise Policy, to determine if any low frequency noise impact has occurred. [low frequency noise criteria still in development]

The meteorological station operated at the Bulga Coal Complex will be used to monitor wind speed, wind direction and temperature at 2 metres and 10 metres.

And, if the EPA cannot accept excluding monitoring in the day and evening periods a suitable alternative may be:

Attended monitoring will be conducted at locations representative of Fordwich, Bulga, Broke and Milbrodale localities, as shown in Figure 2. At each of these sites quarterly monitoring will be undertaken for three (3) nights, which equates to approximately one (1) night per month. Additionally, monitoring would be undertaken on one day per quarter commencing after 9:00 am. There is no requirement for evening monitoring; night period results will be assumed to represent the latter part of this period.

DP&I require monitoring to determine if any impacts are systemic/sustained. Accordingly, if a noise criterion exceedance is measured, follow up monitoring will be undertaken at that specific location (not all locations) on one night during each of the following two weeks. The regular monitoring frequency will be resumed if no further exceedances are measured. However, if a further exceedance is measured during the follow up period (fortnight), then a comprehensive survey (Ngara logger or similar) will be undertaken, to the satisfaction of the DP&I, to determine if these impacts are regular (systemic/sustained).

Measurement equipment must be capable of providing 1/3 octave band statistical data. Data gathered must include LAeq (15 mins) and LA1 (1min).

Attended monitoring data will be assessed against the low frequency criteria as specified in the paper "A Simple Criterion for Low Frequency Noise Emission Assessment" (Broner JLFNV Vol29.1 pp1.14 2010) and the Industrial Noise Policy, to determine if any low frequency noise impact has occurred. [low frequency noise criteria still in development]

The meteorological station operated at the Bulga Coal Complex will be used to monitor wind speed, wind direction and temperature at 2 metres and 10 metres.

6.2 Construction Noise

An additional section could be incorporated into the BCC NMP to read as follows:

> *Attended day period monitoring should be undertaken of both civil works and drilling works upon commencement of works at a new drill site.*
>
> *Day period monitoring should be undertaken for any drill site with a prediction exceeding $L_{Aeq,15\ minute}$ 40 dB at any noise sensitive receptors (NSR) and for which there is no private agreement. Monitoring should be undertaken at NSR located within a 1000 metre radius of the construction site for civil works, and a 1750 metre radius of the construction site for drilling works, and for which there is no private agreement. Where clusters of NSR exist, monitoring should be undertaken at the nearest representative NSR. For details of drill sites with predictions exceeding $L_{Aeq,15\ minute}$ 40 dB, refer to Attachment XXX.*
>
> *SIS drilling locations SIS40, SIS47 and SIS48 are the only locations with predictions exceeding $L_{Aeq,\ 15\ minute}$ 25 dB (from construction). Monitoring should be undertaken upon commencement of drilling at these locations, at NSR located within a 2500 metre radius of the construction site and for which there is no private agreement. Where clusters of NSR exist, monitoring should be undertaken at the nearest representative NSR.*
>
> *It is recommended the frequency of construction monitoring is performance based. Monitoring should be undertaken twice in the relevant time period during the first week of construction. If compliance were achieved both times, additional monitoring would only occur upon complaint. Should non-compliance be measured, remedial actions will be undertaken and additional monitoring would occur weekly until such time as compliance is achieved.*

6.3 EPA Requirements

A suggested modified EPA requirement 3.3 is as follows:

3.3 To assess compliance with Condition 2.1, attended noise monitoring must be undertaken in accordance with the approved noise management plan. [avoids duplication and the possibility of conflicting documentation]

Or alternatively:

3.3 To assess compliance with Condition 2.1, attended noise monitoring of operations must be undertaken in accordance with Condition 2.5 and:

a) at each one of the locations or at a location representative of the most-affected locations listed in Condition 2.1;

b) occur quarterly in a reporting period;

c) occur during one day, and three night periods as defined in the NSW Industrial Noise Policy for a minimum of 15 minutes per measurement.

3.4 To assess compliance with Condition n.n [no proposed construction noise limits], *attended noise monitoring of construction must be undertaken in accordance with Condition 2.5 and:*

a) during the day period at noise sensitive receptors (NSR) located within a 1000 metre radius of the construction site for civil works, and a 1750 metre radius of the construction site for drilling works, and for which there is no private agreement (where clusters of NSR exist, monitoring should be undertaken at the nearest representative NSR) for drill sites listed in Condition n.n;

b) during the night period at NSR located within a 2500 metre radius of a SIS site as listed in listed in Condition n.n and for which there is no private agreement (where clusters of NSR exist, monitoring should be undertaken at the nearest representative NSR);

c) having a performance based frequency where monitoring is undertaken twice in the relevant time period during the first week of construction. If compliance were achieved both times, additional monitoring would only occur upon complaint. Should non-compliance be measured, remedial actions will be undertaken and additional monitoring would occur weekly until such time as compliance is achieved.

7 CLOSURE

The information provided above is my recollection of the EPA meeting discussions and an application of that as a modification to the current BCC NMP as well as a suggested modification to the EPA monitoring requirement (probable future EPL condition).

I trust this information meets your requirements. If you have any questions or need further details please contact me.

Regards,

Tony Welbourne
Director

APPENDIX 3

Revised Air Quality & Greenhouse Gas Assessment prepared by Todoroski Air Sciences

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28 March 2013

Ralph Northey
Environment and Community Manager
Bulga Coal Complex
Via email: rnorthey@xstratacoal.com.au

RE: EPA draft conditions for DA 376-8-2003 MOD5, Bulga underground - Modification 5 - Blakefield North and gas fired Power plant

Dear Ralph,
Thank you for engaging Todoroski Air Sciences to update the Bulga underground Mod 5 Blakefield North air quality impacts assessment and to provide comments in regard to EPA's draft licence conditions outlined in its letter received on 17 December by the Department of Planning and Infrastructure (EPA reference PART3A DDOC 12/4909: Lic08/957-05).

Potential issues with the EPA draft conditions and alternative suggestions to meet the EPA objectives in seeking the conditions are outlined below.

The EPA also raise some issues with the air quality impact assessment for the project, largely related to potential cumulative impacts arising from other existing or proposed plant. These issues would be best addressed through a revised air quality impact assessment report, which is included separately to this letter.

Background
It is understood that the proposed flares would be similar to the existing flares to the south of the site, which I have previously inspected whilst they were in operation. I understand that the proposed flares are of a Swiss engineering design by Hofstetter to meet the most stringent emissions requirements.

Due to the nature of the methane emissions from a coal mine, the required flare specifications need to be different to flares typically used in industrial and land filling operations. The key feature is that the flare control system operates continuously in response to temperature and oxygen levels in order to ensure that the destruction efficiency is optimised at all times.

It is understood that the flares have the following design characteristics:

- Real time continuous monitoring of temperature to maintain a temperature above 760 ^{o}C;
- Real time continuous monitoring of exhaust gas oxygen levels to maintain excess oxygen;
- Combustor design to maintain a theoretical residence time greater than 0.3 seconds; and,

- A large operability range to handle low to high levels of methane and low to high volumes of air.

Another important design characteristic is that a flare comprises multiple flares housed within a large stack for safety and efficiency reasons.

The flares are designed to adjust fuel and air inputs to compensate for the potentially large variation in the level of methane that may arise. This is done to prevent thermal overload beyond the design capacity.

It is understood that the designed destruction efficiency of the proposed flares is 99% or greater.

In considering the requirements for flares in the POEO Clean Air Regulation, the following may assist in interpreting the requirements that may be applicable in this case.

- Flares are different to afterburners, and generally a flare cannot be designed to achieve destruction efficiencies or residence times that are better than afterburners. (A flare is more like a stovetop gas burner with a shroud, whereas an afterburner is more like an enclosed kiln where combusting gasses can circulate for longer). Flares can handle destruction of very large variations in the volume of gas, whereas afterburners have a more limited volumetric flow capacity. Afterburners work on a steady stay emission stream, whereas as flares are needed for variable emissions streams and to handle gasses for emergency/ safety reasons.

- Methane is one of the most easily and cleanly combustible fuels available and achieves more complete combustion and lower emission levels than typical fuels. Mine gas is essentially methane, and is unlike industrial process gas that may be contaminated with impurities, or landfill gas which may contain high levels of sulfurous compounds.

- Residence time for afterburners can be calculated based on direct, accurate measurements of volumetric flow rates. However accurate measurements are generally not possible with a flare as the exhaust/flame is only semi-enclosed/ shrouded and the exhaust gas conditions are not in equilibrium. This specific situation is more limiting in this regard as multiple flares are housed within the large diameter "stack". It should be noted that the "stack" assists in air dispersion (by upwardly directing the heat) and protects the flares from high cross winds. The "stack" is open at the bottom to draw in fresh air.

Draft EPA licence conditions

The EPA conditions essentially seek that the flares and engines are monitored. It is assumed that the conditions aim to ensure that efficient low emissions operation is maintained. The conditions replicate POEO Clean Air Regulation requirements, but in some cases apply conditions that cannot be reasonably met and are not directly applicable to this type of equipment.

The proposed flares however are designed to achieve emissions levels lower than required by the POEO Regulation - in other words, the proposed equipment would meet the intent of the Regulation, but the proposed conditions for showing this intent is met may not be workable.

Issues with the Draft EPA conditions, and suggested alternatives to achieve the same objectives
Draft Condition 6.1

Combustion Parameters

6.1 For each monitoring/discharge point or utilisation area specified below (by point number) the parameter must be equal to or greater than the limit specified for that parameter in the table:

POINT X,Y

Parameter	***Units of measure***	***Lower Limit***	***Averaging Period***
Residence time	*Seconds*	*0.6*	*Hourly rolling*
Temperature	*°C*	*760*	*Hourly rolling*

This condition seeks to limit the residence time of the flares to not less than 0.6 seconds. Residence time and temperature are two key parameters, that together can ensure efficient, low emissions operation. However, there are several technical issues with the proposed 0.6 second residence time in this situation:

- The 0.6 second residence time appears to be applicable, per Clause 38(2) of the Reg to enclosed, ground level landfill gas flares.

  "*An enclosed ground-level flare for the treatment of landfill gas must be operated in such a way that the time between landfill gas entering and exiting the flare is more than 0.6 seconds.*"

  Whilst they are similar, the mine gas flares need to be designed differently to landfill gas flares to operate optimally, and therefore this residence time should not be automatically applied to the proposed flares;

- The proposed (individual) flares are designed to achieve a "residence time" of not less than 0.3 seconds;

- However the "flare" is in fact a group of individual flares located within a semi-open "stack". Per clause Clause 38(3) of the Reg:

  "For the purposes of this clause, the time elapsing between an air impurity (including landfill gas) entering and exiting an afterburner or flare is to be calculated :

  (a) using the volumetric flow rate for the air impurity, as determined in accordance with TM-2 or CEM-6, and

  (b) using a 1 hour rolling averaging period."

  Considering that it would take significant time for the air leaving any individual flare within the "flare" to exit the "stack", the residence time would be significantly higher than 0.3 seconds;

- It is observed that there is no monitoring requirement for residence time in the draft conditions, however there is a commensurate requirement to monitor volumetric flow rate (from which it would be possible to calculate residence time).

- This leads to the key issue, which arises as in this case as it would not be reasonably possible to measure the volumetric flow rate of the "flare" or "stack" per Clause 38(3)(a) of the Reg.

It is noted that there would be no issue in complying with the temperature requirement of the draft Condition 6.1, nor should there be there any issue with the intent of the draft condition, which is understood to aim to ensure that the flare operates optimally, with low emissions.

In summary, there is an issue with the draft Condition 6.1 in that:

- the 0.6 second residence time is not applicable in this case;
- any individual flare is not intended or designed to operate always above this residence time; and
- it would not be reasonably possible to conduct the measurement required to monitor the residence time (and even it if could be done, there would be a problem in trying to relate this to the performance of an array of flares with automatic, continuous adjustment).

It is noted that per Clause 38(1) (b) of the Reg:

> *"An afterburner, other than one that employs a catalytic control system, must be operated in such a way that the time between an air impurity entering and exiting the afterburner is:*
>
> *(b) more than 0.3 seconds in any other case".*

An afterburner not employed destroying principal air toxics, is required to achieve a residence time of 0.3 seconds and the same temperature as a landfill gas flare.

Generally speaking, an afterburner can achieve a greater destruction efficiency than a flare, so it would seem incongruous to apply the same temperature, but a more stringent residence time condition to a flare than would apply to an afterburner.

That aside, in the proposed plant, it would not be practicable to calculate the actual residence time of the flare, as it varies in a complicated manner because the emissions of multiple flare units within the "flare" mix in various ways before exiting the "stack".

It is proposed however to monitor the temperature and residual oxygen level as part of the normal control/operating process. As the flare is designed to achieve 99% or better destruction efficiency (i.e. emit approximately half the methane emissions of a landfill gas flare per the Reg), and also given the clean burning nature of methane, provided that the temperature of such a flare is maintained above 760 ^{o}C and there is sufficient excess oxygen (e.g. >2%) that would ensure efficient combustion is occurring, it would be reasonable to conclude that the emissions of the flare could be regulated based on the temperature and oxygen, and in this way demonstrate efficient performance at all times that is within the intended EPA requirements.

Therefore it is suggested that the limit on residence time in draft Condition 6.1 is omitted or replaced with a limit on residual oxygen level of not less than 2%.

This would remove the risk to EPA and Xstrata in being unable to reasonably demonstrate technical compliance with the draft Condition, and also provides certainty that the flare is being managed in a satisfactory manner at all times.

Draft condition 8.1

Requirement to monitor combustion parameters

8.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

POINT X,Y

Parameter	***Units of measure***	***Frequency***	***Sampling method***
Volumetric flow rate	*Cubic metres per second*	*Continuous*	*CEM-6*
Temperature	*°C*	*Continuous*	*TM-2*

Per the discussion for draft Condition 6.1, the requirement for volumetric flow rate should be omitted or replaced with a requirement to monitor the residual oxygen level.

Draft Condition 11.1

Air Monitoring Requirements

11.1 For each monitoring/discharge point or utilisation area specified below (by a point number), the licensee must monitor (by sampling and obtaining results by analysis) the concentration of each pollutant specified in Column 1. The licensee must use the sampling method, units of measure, and sample at the frequency, specified opposite in the other columns:

POINT X,Y

Pollutant	***Units of measure***	***Frequency***	***Sampling method***
Nitrogen Oxides	*milligrams per cubic metre*	*Continuous*	*CEM-2*
Volatile organic compounds (VOCs), as n-propane	*milligrams per cubic metre*	*Yearly*	*TM-34*

This condition requires continuous monitoring of NO_2 levels from the engines which comprise the power plant.

It is noted that similar operations at Glennies Creek and Tahmoor conduct annual and six monthly monitoring per their EPL conditions.

It is considered reasonable to include the option to alternatively conduct campaign sampling.

The reason for seeking this option is one of equity, practicality and cost. The required continuous monitoring equipment can be costly to install, is likely to have a short service life and due to this can lead to significant maintenance and down time issues over the long term.

Therefore it is suggested that a special frequency of monitoring be applied, based on the principle that as long as the monitoring data has remained below criteria during one year or more in operation, it would be reasonable to conduct less frequent monitoring thereafter.

Potentially the condition could be amended as follows:

- prior to the word "Continuous", add "Special frequency 1* or";

- prior to the word " CEM-2" ads " TM-11 or; and,
- Include the following notes underneath the table;

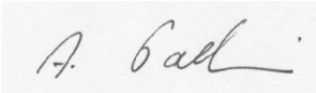
* Special frequency 1 is defined as a round of air emission monitoring conducted:
- every 3 months for a minimum of 12 months, and
- if no pollutant exceeds its relevant limit for 4 consecutive 3-monthly tests over 12 months, thereafter bi-annually for a minimum of 12 months, and
- if no pollutant exceeds its relevant limit for 2 consecutive bi-annual test for over 12 months, thereafter annually.

The condition also requires monitoring at each discharge point. Given that the engines are identical, it would seem reasonable that only one of the various emission points would require continuous emissions monitoring, and that compliance may be inferred for the other engines on this basis.

Please feel free to contact me if you would like to discuss or clarify any aspect of the above.

Yours faithfully,

Todoroski Air Sciences



Aleks Todoroski

AIR QUALITY AND GREENHOUSE GAS ASSESSMENT FOR BLAKEFIELD NORTH UNDERGROUND MINE PROJECT

Prepared for: GSS Environmental

15 February 2013

Job Number 11060004

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Air Quality and Greenhouse Gas Assessment for Blakefield North Underground Mine Project

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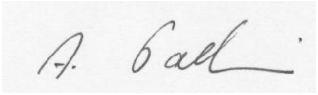
Signature:  

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Executive Summary

Todoroski Air Sciences has prepared this report for GSS Environmental on behalf of Bulga Underground Operations (previously known as Beltana Highwall Mining). It contains an assessment of the potential air quality impacts and greenhouse gas emissions generated from the proposed modifications to the Blakefield North Underground Mine.

The proposed modification includes the realignment of the approved longwall layout, increased gas drainage infrastructure, relocation of mine ventilation fans, changed coal clearance for development coal, the addition of a small scale power plant (up to 30-32MW) and associated surface infrastructure. The Project includes providing a safe and efficient mine working environment by installing effective gas drainage infrastructure which will ultimately reduce the quantity of methane released to the atmosphere via the mine ventilation system. The captured methane will then be flared or beneficially used to produce electricity.

The project will fundamentally reduce greenhouse gas emissions arising from free methane and will further offset electricity use by generating power from methane that would otherwise have entered the atmosphere.

The proposed modifications do not change the rate of coal extraction or any surface infrastructure for receiving and processing the coal. The only changes with potential for additional air quality impacts occur from the temporary use of trucks to transport development coal which would occur until a re-aligned conveyor can be established, the development of a either a 30 or 32 MW power generation plant that would operate to generate electricity from methane, and the flaring operations. All of these aspects have been assessed in the air quality impact assessment contained in this report

The assessment also considers a worst case cumulative scenario in which it was assumed that all proposed NO_2 producing plant and equipment from the Project and the existing and proposed plant from the Blakefield South project operate at maximum levels every hour for a full year. It is unlikely that emissions could actually be as high as this scenario assumes, but nevertheless the predicted levels were below criteria at the most affected point in the modelling domain.

The assessment has found that the predicted additional impacts on air quality arising from the proposed modification would be negligible at the worst impacted receptor. The change in impacts is unlikely to be detectable and the predictions show that levels would be below criteria at the privately owned receptors.

The assessment of greenhouse gas emissions shows a significant reduction in emissions compared with the approved project (i.e. without the proposed modification). Therefore the project is considered to be beneficial.

1 INTRODUCTION

Todoroski Air Sciences has prepared this report for GSS Environmental on behalf of Bulga Underground Operations (previously known as Beltana Highwall Mining) (hereafter referred to as the Proponent). It provides an assessment of the potential air quality impacts and greenhouse gas emissions generated from the proposed modifications to the Blakefield North Underground Mine (hereafter referred to as the Project).

This report incorporates the following aspects:

- A background to the project and a description of the proposed modifications;
- A review of the existing environment surrounding the project site;
- A description of the modelling approach used to assess impacts;
- Presentation of the predicted results;
- A discussion of the potential air quality impacts as a result of the proposed operations; and
- An estimation of the greenhouse gas emissions generated.

2 PROJECT SETTING AND DESCRIPTION

The Bulga Underground Operations presently comprise the Blakefield South Underground Mine (Blakefield seam) and the Blakefield North Underground Mine (Blakefield Seam) which is an approved but yet to be commenced mine. The Bulga Underground Operations form part of the Bulga Coal Complex which is managed by Bulga Coal Management Pty Ltd.

The Bulga Coal Complex is located approximately 12km southwest of Singleton and approximately 5km southeast of Bulga Village in the Hunter Valley Region of NSW. The local land-use is dominated by coal mining and agricultural activities.

Figure 2-1 presents a map showing the Bulga Mining Complex and nearby sensitive receptors. **Figure 2-2** presents a pseudo three-dimensional visualisation of the terrain in the general vicinity of the Bulga Coal Complex.

Bulga Coal Management is seeking to modify Development Consent DA 376-8-2003 under Section 75W of the EP&A Act to allow for the following:

- Realignment of the approved longwall layout of the Blakefield North Underground Mine;
- Increased pre and post-gas drainage infrastructure for the Blakefield seam in the Blakefield North Underground Mine;
- Construction of a gas drainage plant at the top of the Whybrow Highwall, including goaf plant, gas compressors, workshop, offices, hardstand areas, buried pipelines, five relocated pre-mining gas drainage flares and five relocated goaf gas flares;
- Modified ventilation for the Blakefield North Underground Mine by relocating the two approved ventilation fans to the base of the Whybrow Highwall;
- Changed coal clearance infrastructure utilising temporary truck haulage of development coal which will be replaced by conveyor haulage once longwall mining commences;
- Construction of a small-scale power generation plant (up to 30 or 32MW) and associated buried pipeline, five new gas drainage flares, compressors and ancillary infrastructure, to

manage the increased methane production from gas drainage included within this modification proposal; and,

- Ongoing exploration activities undertaken during the life of the Blakefield North Underground Mine.

The proposal will use the same longwall mining methods, type of equipment and infrastructure already in use by Bulga Underground Operations. No changes are proposed to the pit top workshop areas, the Coal Handling Preparation Plant (CHPP), coal handling techniques, approved operating hours, or mining methods currently in use at the mine. No extension or reduction to the life of the current development consent is proposed, and the proposed modification would not require any additional tailings or coarse rejects storage.

In regard to air quality impacts, as detailed later in this report, the dust emissions from the proposed modifications are equivalent to a few percent of the emissions from the adjacent open cut mine and thus are likely to generate only negligible changes in dust levels at the nearby sensitive receptors when compared to the existing situation.

In regard to Greenhouse gas emissions, the project is about reducing the quantity of methane emissions and as detailed later in this report, would result in a net emissions decrease compared to the currently approved Blakefield North Underground Mine.

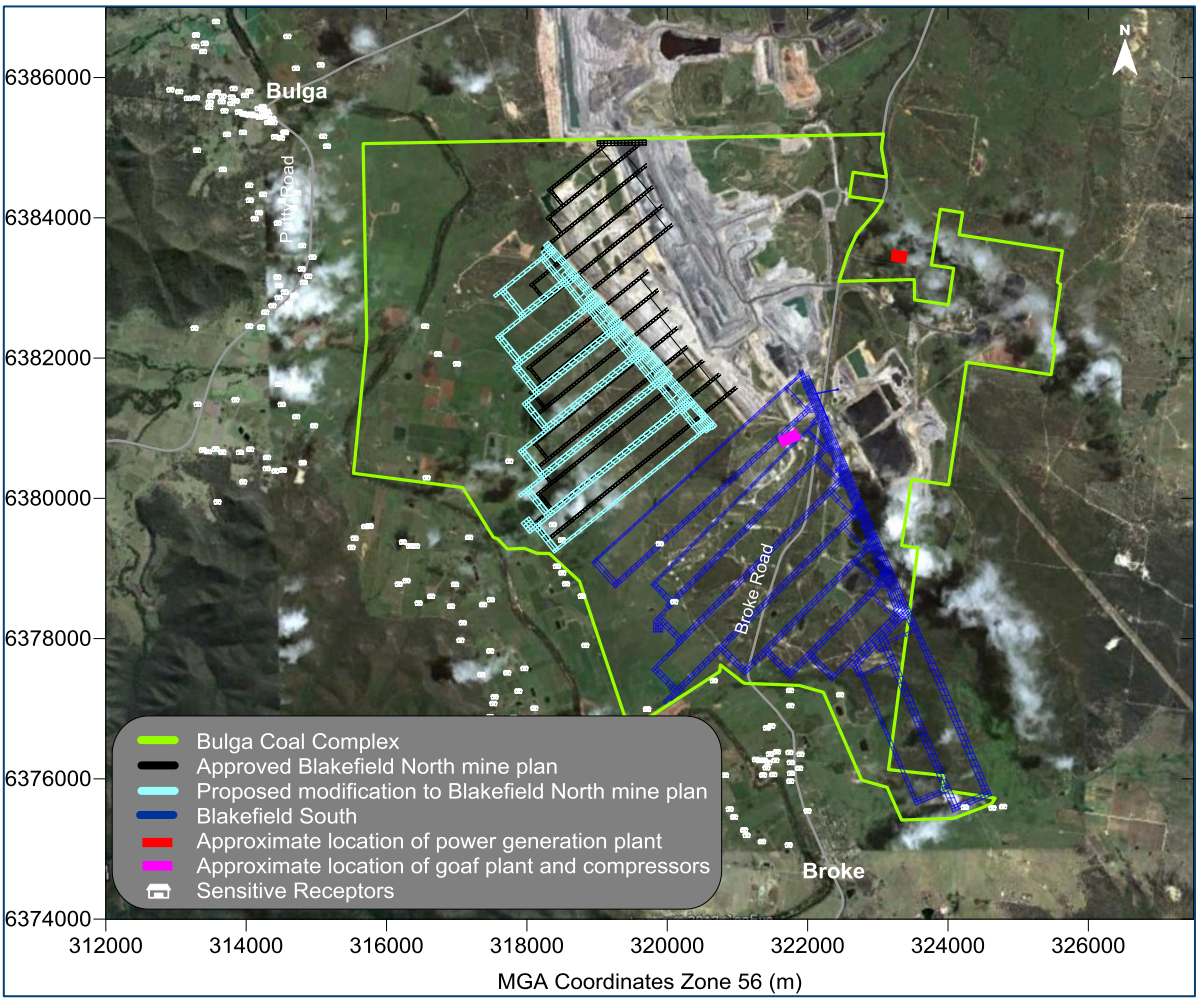

Figure 2-1: Project location

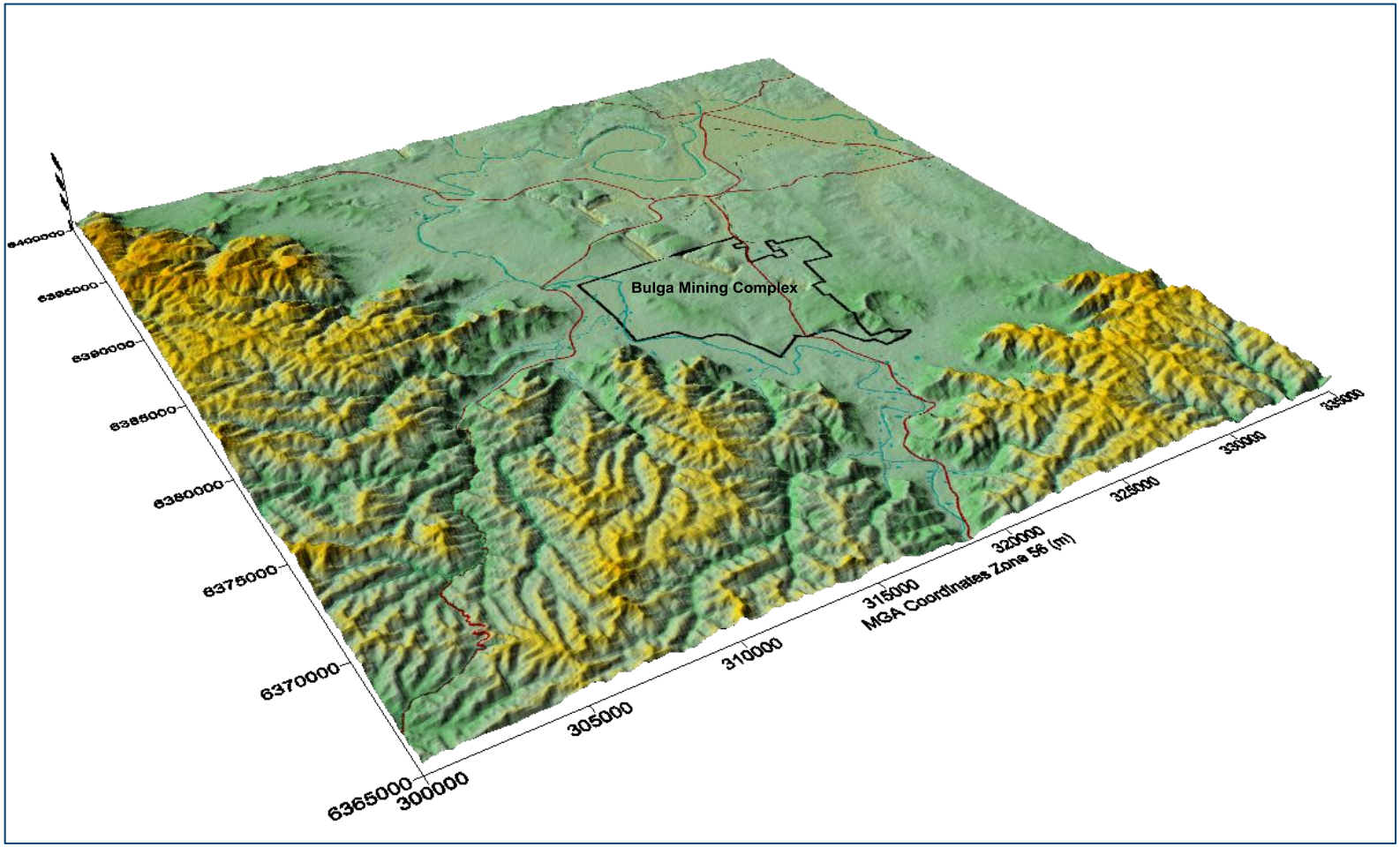

Figure 2-2: Pseudo three dimensional terrain of Project area

3 AIR QUALITY ASSESSMENT CRITERIA

3.1 Preamble

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the potential air emissions generated by the proposed operation and the applicable air quality criteria.

3.2 Particulate Matter

Particulate matter consists of dust particles of varying size and composition. Air quality goals refer to measures of the total mass of all particles suspended in air defined as the Total Suspended Particulate matter (TSP). The upper size range for TSP is nominally taken to be 30µm as in practice particles larger than 30 to 50µm will settle out of the atmosphere too quickly to be regarded as air pollutants.

The TSP is defined further into two sub-components. They are PM_{10} particles, particulate matter with aerodynamic diameters of 10µm or less, and $PM_{2.5}$, particulate matter with aerodynamic diameters of 2.5µm or less.

Mining activities generate particles in all the above size categories. The great majority of the particles generated are due to the abrasion or crushing of rock and coal and general disturbance of dusty material. These particulate emissions will be generally larger than 2.5µm as these fine particulates are often only generated through combustion processes.

Combustion particulates can be more harmful to human health as the particles have the ability to penetrate deep into the human respiratory system and generally include acidic and carcinogenic substances.

A study of the distribution of particle sizes near mining dust sources in 1986 found that the average of approximately 120 samples showed $PM_{2.5}$ comprised 4.7% of the TSP, and PM_{10} comprised 39.1% of the TSP in the samples (**SPCC, 1986**). The emissions of $PM_{2.5}$ occurring from mining activities are small in comparison to the total dust emissions and in practice, the concentrations of $PM_{2.5}$ in the vicinity of mining dust sources are likely to be low.

3.2.1 Office of Environment and Heritage impact assessment criteria

Table 3-1 and **Table 3-2** summarise the air quality goals that are relevant to this study as outlined in the Office of Environment and Heritage (OEH) document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**). The air quality goals relate to the total dust burden in the air and not just the dust from the project. Consideration of background dust levels needs to be made when using these goals to assess potential impacts.

Table 3-1: OEH air quality impact assessment criteria

Pollutant	Averaging Period	Impact	Criterion	Source
Total suspended particulates (TSP)	Annual	Total	90µg/m^3	NHMRC (1996)
Particulate Matter < 10µm (PM_{10})	Annual	Total	30µg/m^3	EPA (1998)
	24 hours	Total	50µg/m^3	NEPC (1998)

Source: **NSW DEC, 2005**

The criteria for 24-hour average PM_{10} originate from the National Environment Protection Measure (NEPM) goals (**NEPC, 1988**). These goals apply to the population as a whole, and are not recommended to be applied to "hot spots" such as locations near industry, busy roads or mining. However, in the absence of alternative measures, OEH does apply the criteria to assess the potential for impacts to arise at such locations. The NEPM permits five days annually above the 24-hour average PM_{10} criterion to allow for bush fires and similar events. Similarly, it is normally the case that

on days where ambient dust levels are affected by such events they are excluded from assessment as per the OEH criterion.

3.2.2 Department of Planning and Infrastructure acquisition criterion for particulate matter

While the OEH applies the maximum 24-hour average PM_{10} level in any year to assess the potential for impacts from the project, the Department of Planning and Infrastructure (DP&I) in contemporary project approvals have invoked requirements for acquisition and negotiated agreements if there are systemic exceedances of the OEH criterion. In the context of impact assessments for approval of new projects and modifications to existing projects, this is interpreted to mean where the OEH criterion is exceeded on more than five days in any year (nominally a 98.6 percentile level of compliance). This DP&I criterion and other relevant acquisition criteria are outlined in **Table 3-2**.

Table 3-2: DP&I acquisition criteria for particulate matter

Pollutant	Averaging Period	Impact	Criterion
Total suspended particulates (TSP)	Annual	Total	90µg/m^3
Particulate Matter < 10µm (PM_{10})	Annual	Total	30µg/m^3
	24 hours	Incremental	50µg/m^3
	24 hours	Total	150µg/m^3
Deposited dust	Annual	Incremental	2g/m^2/month
		Total	4g/m^2/month

3.3 Deposited Dust (insoluble solids)

In addition to an assessment for potential health impacts, airborne dust is also assessed due to the potential to cause nuisance by depositing on surfaces. **Table 3-3** shows the OEH criteria for maximum acceptable increases in dust deposition over existing dust levels from an amenity perspective (**NSW DEC, 2005**).

Table 3-3: OEH criteria for insoluble solids

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level	Source
Deposited dust	Annual	2g/m^2/month	4g/m^2/month	NERDDC (1988)

3.4 Other Air Pollutants

Emissions of carbon monoxide (CO), nitrogen dioxide (NO_2) and hydrocarbons can be expected from the combustion and flaring of coal seam methane.

CO enters the bloodstream and reduces oxygen delivery to the body's organs and tissues, and can impair health due to prolonged exposure at high levels. CO is an odourless gas formed from the partial oxidation of carbon-containing compounds, commonly as a result of incomplete or inefficient combustion of fuels containing carbon. CO in the atmosphere is relatively unstable and reacts with oxygen to form carbon dioxide and ozone.

NO_2 can irritate the lungs and lower resistance to respiratory infections such as influenza. NO_2 belongs to a family of reactive gases called nitrogen oxides (NOx). These gases form when fuel is burned at high temperatures, mainly from motor vehicles, power stations and industrial boilers (**USEPA 2011**).

Volatile Organic Compounds (VOC) is a term given to various organic chemical components, several of which are considered air toxics. Formaldehyde is a VOC which is formed from the combustion of methane.

Table 3-4 summarises the air quality goals for other air pollutants that are relevant to this study. The impact assessment criteria refer to the total pollutant load in the environment and impacts from new sources of these pollutants must be added to existing background levels when assessing for compliance.

Table 3-4: OEH criteria for other air pollutants

Pollutant	Averaging period	Criterion	Source
Nitrogen dioxide	1 hour	246 µg/m^3	NEPC (1998)
	Annual	62 µg/m^3	NEPC (1998)
Carbon monoxide	15 minute	100 mg/m^3	WHO (2000)
	1 hour	30 mg/m^3	WHO (2000)
	8 hour	10 mg/m^3	NEPC (1998)
Formaldehyde	1 hour	0.02 mg/m^3	Victorian Government Gazette (2001)

4 EXISITING ENVIRONMENT

This section describes the existing climate and air quality in the area surrounding the Project.

4.1 Local Meteorology

4.1.1 Dispersion meteorology

Site specific meteorological data have been obtained from the Bulga Complex weather station and have been used in the air dispersion models for this assessment. Annual and seasonal windroses prepared from data collected during the period 15 September 2010 till 14 September 2011 are presented in **Figure 4-1**.

Analysis of the windroses in **Figure 4-1** shows the most common winds on an annual basis are from the south and northwest with few winds originating from the northeast quadrant. During summer winds from the east-southeast dominate with a lesser portion of winds from the south. In autumn winds from the south are most common. During the winter months winds predominately occur from the northwest with a spread of winds from the southwest quadrant. The spring windrose has a wind distribution similar to the annual windrose with winds originating from the south, northwest and southeast.

The pattern of winds presented in the windroses is broadly typical of the seasonal wind patterns experienced in the Hunter Valley. The annual average wind speed for this data set is 4.15m/s and annual percentage of calms is 1.3%.

Table 4-1 presents a summary of the stability class distribution from the weather data. This distribution (Class A to Class F) is a measure of the stability of the atmosphere with Class A associated with highly unstable or turbulent conditions and Class E and F related to stable conditions, typically at night. The high frequency of Class D conditions (60.4%) suggests that emissions will disperse rapidly for a significant portion of time.

Table 4-1: Stability class distribution

Stability Class	Frequency of occurrence (%)
A	8.1
B	4.1
C	6.9
D	60.4
E	16.2
F	4.4

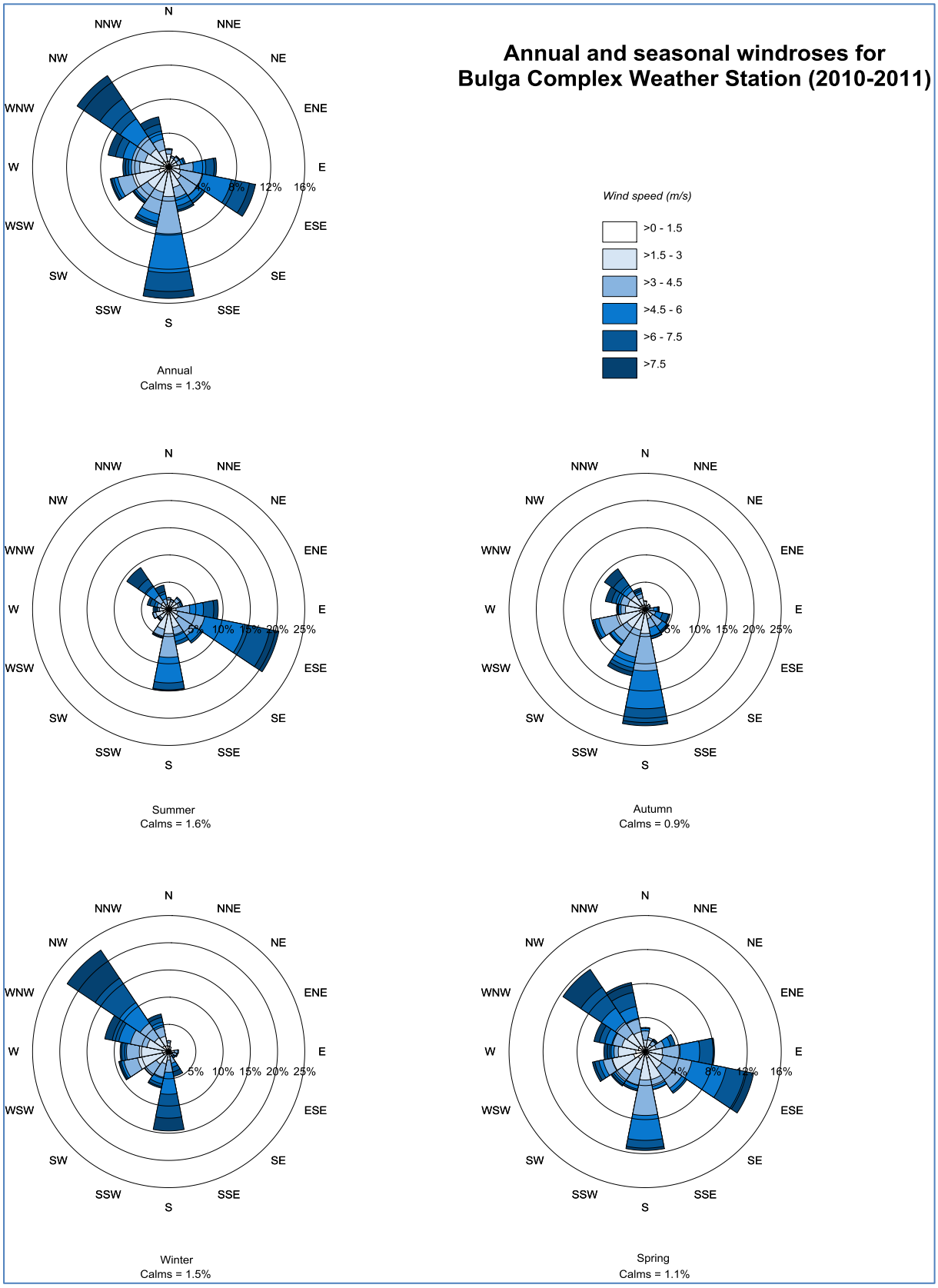

Figure 4-1: Annual and seasonal windroses for the Bulga Complex weather station

4.1.2 Climate data

Long-term climatic data from the closest Bureau of Meteorology weather station at Jerrys Plains Post Office (Site No. 061086) characterise the local climate in the proximity of the Project. The Jerrys Plains Post Office station is located approximately 25km northeast of the Project.

Table 4-2 and **Figure 4-2** present a summary of data from Jerrys Plains Post Office collected over a 125-year period. The data indicate that January is the hottest month with a mean maximum temperature of 31.7ºC and July as the coldest month with a mean minimum temperature of 3.8ºC. Rainfall data show January is the wettest month with an average rainfall of 77.0mm over 6.4 days and August is the driest month with an average rainfall of 36.5mm over 5.2 days.

Table 4-2: Monthly climate statistics summary - Jerrys Plains Post Office

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Mean max. temperature (ºC)	31.7	30.9	28.9	25.3	21.3	18	17.4	19.4	22.9	26.2	29.1	31.3
Mean min. temperature (ºC)	17.1	17.1	15	11	7.5	5.3	3.8	4.4	7	10.3	13.2	15.7
Rainfall												
Rainfall (mm)	77	72.4	58.3	44.5	40.9	48.1	43.5	36.5	42	52.1	61.2	68.2
Mean No. of rain days (≥1mm)	6.4	5.9	5.7	4.9	4.9	5.5	5.2	5.2	5.2	5.9	6.2	6.4
9am conditions												
Mean temperature (ºC)	23.4	22.7	21.2	18	13.6	10.6	9.4	11.4	15.3	19	21.1	23
Mean relative humidity (%)	67	72	72	72	77	80	78	71	65	59	60	61
Mean wind speed (km/h)	9.6	9	8.8	8.6	9	9.4	10.6	11	11.7	10.9	10.5	9.9
3pm conditions												
Mean temperature (ºC)	29.8	28.9	27.2	24.1	20.1	17.1	16.4	18.2	21.2	24.2	26.9	29
Mean relative humidity (%)	47	50	49	49	52	54	51	45	43	42	42	42
Mean wind speed (km/h)	13.2	13	12.4	11.3	11	11.5	13	14.3	14.7	14.1	14.2	14.2

Source: **Bureau of Meteorology, 2011**

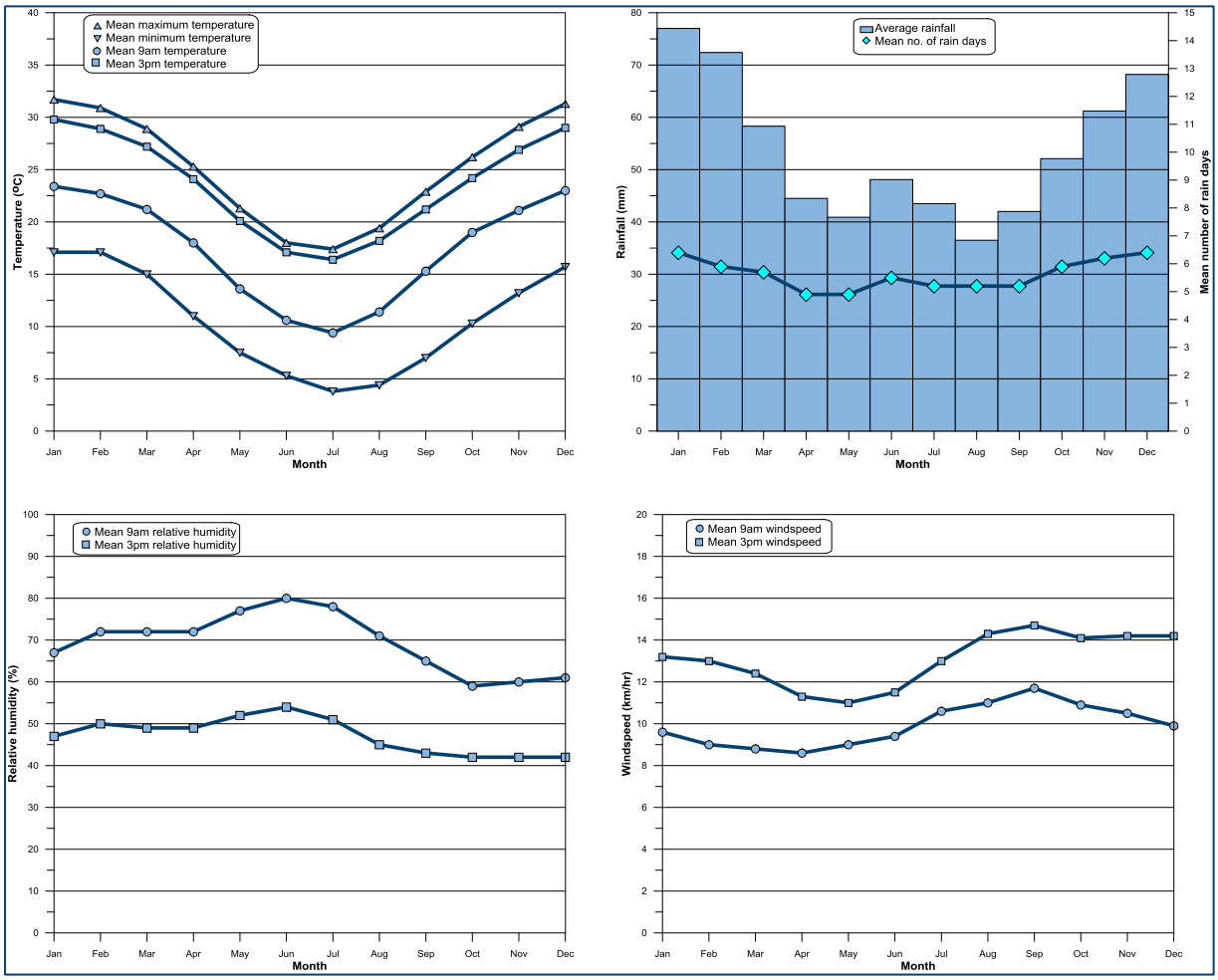

Figure 4-2: Monthly climate statistics summary - Jerrys Plains Post Office

4.2 Local Air Quality

The main sources of particulate matter in the wider area of the Project include mining activities, traffic on unsealed roads, construction activities, farming and animal grazing, traffic from other local roads and other anthropogenic sources such as domestic wood-fired heaters power generation.

This section reviews the data collected from the Bulga Mining Complex ambient monitoring program between 2008 and 2011 to characterise the existing background levels of particulate matter and deposited dust in the study area.

The Bulga Mining Complex air quality monitoring network consists of six High Volume Air Samplers (HVAS) measuring either TSP or PM_{10} and 30 dust deposition gauges sited in locations surrounding the mine. **Figure 4-3** shows the approximate location of the monitoring stations reviewed from the Bulga Mining Complex air quality monitoring network. **Appendix A** provides a summary of all the monitoring data reviewed.

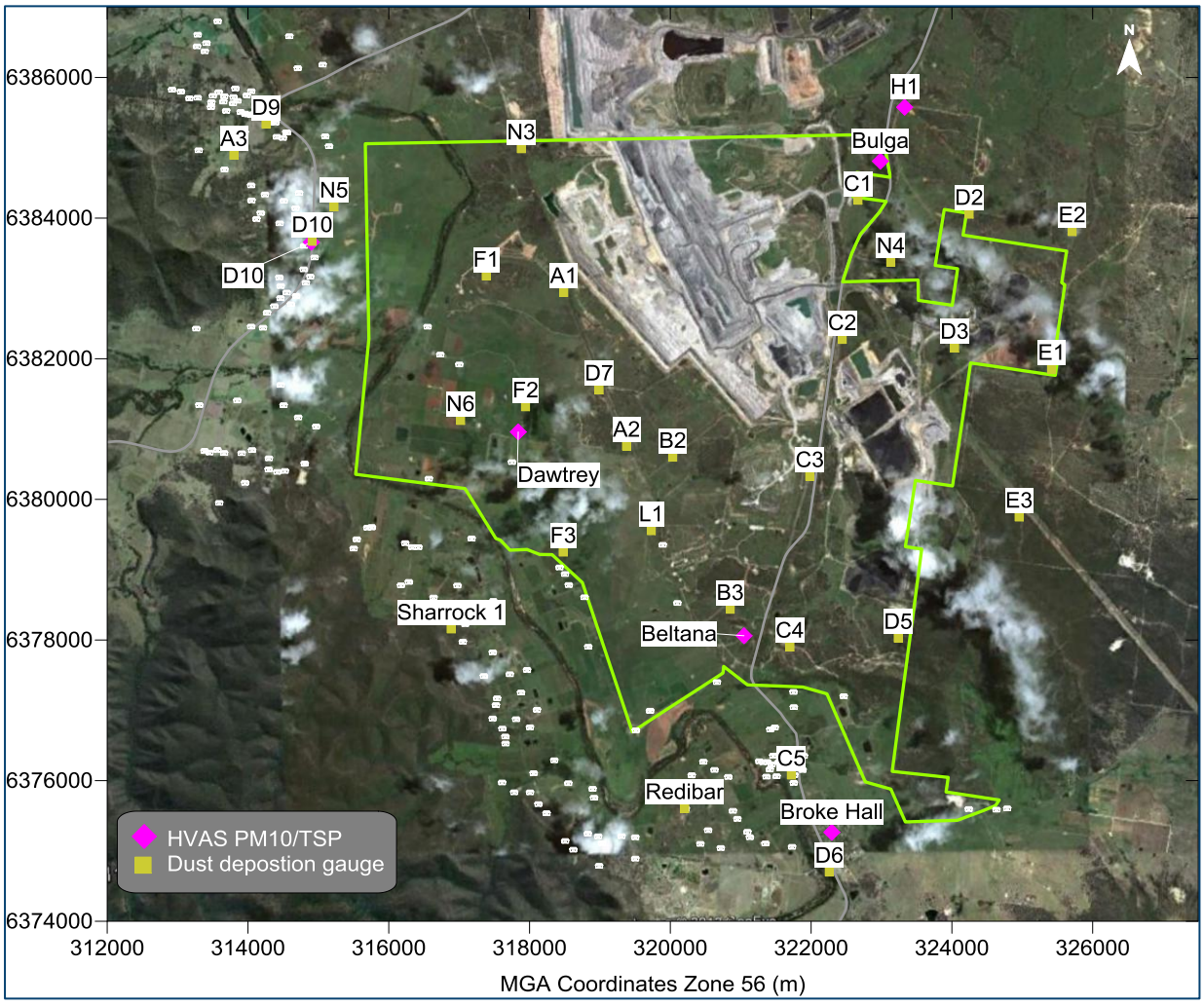

Figure 4-3: Location of monitoring stations

4.2.1 PM_{10} monitoring

The Bulga Mining Complex conducts PM_{10} monitoring using five HVAS monitors. A summary of the results collected from these monitors between January 2008 and November 2011 are presented in **Table 4-3** and **Figure 4-4**.

It can be seen from **Figure 4-4** that the monitored concentrations are nominally highest in the spring and summer months with the warmer weather raising the potential for drier ground elevating the windblown dust, the occurrence of bushfires and pollen levels.

The data presented in **Table 4-3** indicate that all monitors have recorded annual average PM_{10} concentration levels below the NSW OEH criteria of 30µg/m^3 with the exception of the H1 monitor during 2008 and 2009.

The levels recorded at H1 are above the criteria with annual average PM_{10} levels of 31 and 33 during 2008 and 2009 respectively. **Figure 4-4** indicates that H1 generally records higher concentrations when compared to the other HVAS monitors.

The elevated levels recorded at H1 have previously been assessed by air quality experts as not being attributable to Bulga Coal operations but largely the result of being located immediately adjacent to a heavily trafficked dirt road. Due to impacts of the dirt road the monitor has recently been moved to a more appropriate location. Given this the results from H1 are not considered to be representative of the dust levels at sensitive receptors.

The maximum 24-hour average PM_{10} concentrations at the other HVAS monitors indicate that exceedances of the NSW OEH criteria have occurred in 2008, 2009 and 2010. **Figure 4-4** indicates that the possible cause of these exceedances was due to regional events as all monitors recorded elevated levels on the exceedance days.

Table 4-3: PM_{10} concentrations from HVAS monitoring (µg/m^3)

Year	Annual average					Criteria
	H1	Dawtrey	D10	Beltana**	Broke Hall	
2008	**31**	17	17	-	16	30
2009	**33**	17	16	17	17	30
2010	27	13	13	17	13	30
2011*	28	12	13	17	13	30
Year	**Maximum 24-hour average**					**Criteria**
	H1	**Dawtrey**	**D10**	**Beltana****	**Broke Hall**	
2008	**119**	**61**	**58**	-	**57**	50
2009	**101**	49	50	**60**	48	50
2010	**69**	**55**	**51**	49	47	50
2011*	**121**	40	47	40	39	50

*Data available till November 2011
**Monitoring commenced June 2009

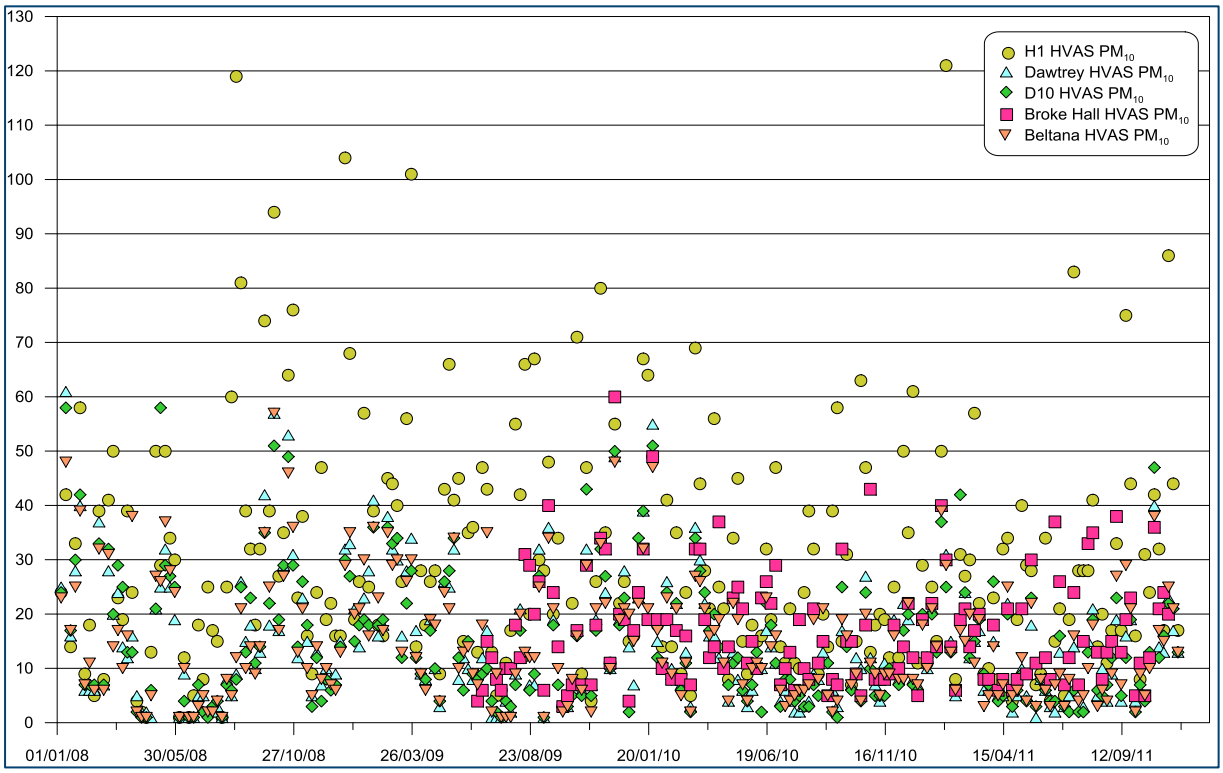

Figure 4-4: HVAS 24-hour average PM_{10} concentrations

4.2.2 TSP Monitoring

Ambient TSP monitoring is collected by the Bulga Mining Complex using three HVAS monitors. A summary of the results collected from these monitors between January 2008 and November 2011 are presented in **Table 4-4** and **Figure 4-5**.

The monitoring data presented in **Table 4-4** indicate that the annual average TSP concentrations for each monitoring station were below the OEH criteria of 90µg/m^3 with the exception of the Bulga HVAS monitor. During 2009 this monitor recorded an annual average TSP concentration of 92µg/m^3. **Figure 4-3** shows the location of the Bulga HVAS monitor situated close to the H1 HVAS monitor. **Figure 4-5** shows that generally the Bulga HVAS monitor records higher concentrations when compared to the other HVAS monitors. As outlined in the previous section, due to the location of this monitor near open cut mining operations, it would not collect data that is representative of background levels at sensitive receptors.

Table 4-4: TSP concentrations from HVAS monitoring (µg/m^3)

Year	Annual average			Criteria
	Dawtrey	D10	Bulga	
2008	33	35	88	90
2009	39	41	**92**	90
2010	27	29	76	90
2011*	28	35	83	90

*Data available till November 2011

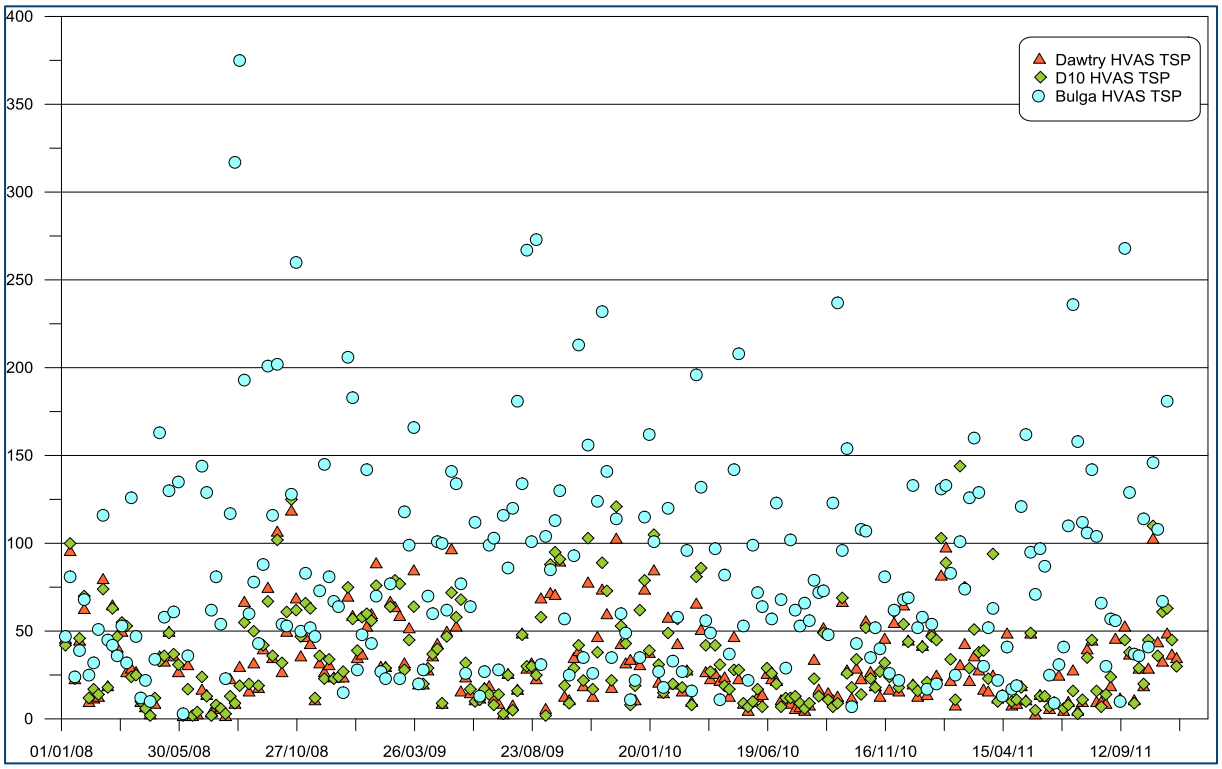

Figure 4-5: HVAS 24-hour average TSP concentrations

4.2.3 Dust deposition monitoring

Table 4-5 shows the annual average deposition levels at each gauge from 2008 to 2010. Partial results for 2011 are also shown covering the period up to October 2011. Field notes accompanying the monitoring data indicate that some of the samples were contaminated with materials such as bird droppings, insects or plant matter. This is a relatively common occurrence for this type of monitoring, and accordingly, contaminated samples have been excluded from the reported annual average results.

The dust deposition monitoring locations are separated between those on mine owned land around the operations (onsite) and offsite locations. The onsite locations generally record levels higher than the monitors at offsite locations and are commonly used to assist with characterising the sources and areas of dust generation. These monitors should not be considered when estimating backgrounds at nearby sensitive receptors. The grey highlighted cells in **Table 4-5** indicate those gauges located at offsite locations.

All offsite gauges recorded an annual average insoluble deposition level at or below 4g/m^2/month for 2008 to 2010, noting that 2011 results are incomplete at the time of analysis.

Table 4-5: Annual average dust deposition (g/m^2/month)

ID	2008	2009	2010	2011*	Criteria
Off site dust deposition gauges					
A3	1.7	1.7	1.6	1.7	4
C5	2	2.3	1.7	1.2	4
D2	1.8	3.4	2.6	2.9	4
D6	1.4	1.9	1.7	1.2	4
D9	2.1	2.8	1.6	1.6	4
E1	2.8	3.1	4	**5.4**	4
E2	2	2.6	2.5	2.1	4
E3	1.2	1.9	1.5	1.5	4
N5	1.5	1.8	1.2	0.9	4
D10	0.8	1.8	1.4	1.5	4
Redibar	1.1**	1.3	0.9	0.9	4
Sharrock 1	1.4	1.7	0.9	1	4
On site dust deposition gauges					
A1	1.8	2.7	2.1	2.6	4
A2	2.7	2.9	1.9	1.8	4
B2	2.2	3.3	2.1	2	4
B3	2.2	1.9	1.5	1.6	4
C1	3.2	**4.2**	**5.4**	**5.5**	4
C2	**4.3**	**7.6**	**10.1**	**7.9**	4
C3	2.9	3.3	3.2	2.5	4
C4	1.3	2.4	3	2.9	4
D3	3.2	4	**6.7**	**5.5**	4
D5	1.8	2.4	2.2	2.1	4
D7	2.2	2.6	1.8	2	4
F1	1.5	2.2	2.2	3.1	4
F2	0.8	2.4	2.1	2.2	4
F3	1.9	1.8	1.2	1.5	4
L1	0.9	1.6	1.5	1.8	4
N3	2	3.3	3.5	3.9	4
N4	2.1	3.5	**4.7**	**5.5**	4
N6	2.1	2.9	2.7	1.8	4

*Data presented is an average up to October 2011; this is not representative of the annual average and is only an indication.
**Data available from October 2008.

4.2.4 Other air pollutants

Ambient monitoring data for other air pollutants are not collected as part of the Project's ambient monitoring program and short time frame, electronic data are not readily available for these pollutants in the Upper Hunter Valley. It is noted that recently the NSW OEH has commissioned ambient monitors in the Upper Hunter Valley to monitor additional pollutants; however at the time of assessment for this report a complete year of data was not available from these sites.

Therefore to estimate the ambient level of other air pollutants, monitoring data from the nearest NSW OEH monitor was used to characterise the background levels of NO_2. This monitor is located at Beresfield.

4.2.4.1 Nitrogen dioxide

Figure 4-6 presents the 1-hour average NO_2 concentrations from the OEH Beresfield monitoring site from 2008 to December 2011. The data indicate that there were no exceedances of the NSW OEH 1-

hour average goal of 246µg/m^3 during this period and furthermore indicate that levels of NO_2 are relatively low, with a seasonal fluctuation.

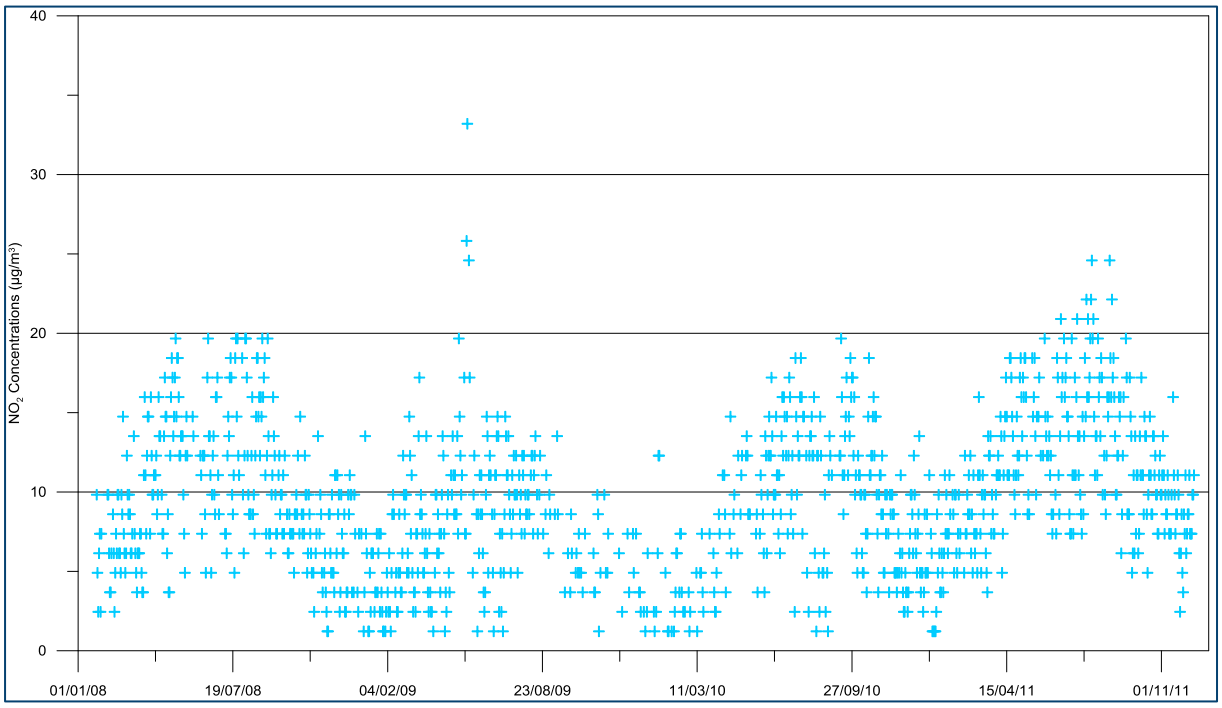

Figure 4-6: 1-hour NO_2 Concentrations - Beresfield

4.2.4.2 Carbon monoxide

The NSW OEH Beresfield monitor does not record ambient concentrations of CO. Combustion activities are the cause of CO emissions and spatially there is very little such activity in the area apart from power generation, motor vehicles and wood heaters. Therefore, ambient concentrations of CO are expected to be low.

Ambient air quality goals for CO are set at higher concentration levels than NO_2 goals. Based on the NO_2 monitoring data which is low compared to the goals, and consideration of the typical mix of ambient pollutant levels, the indication is that ambient levels of CO would similarly also be well below the air quality goals.

5 EMISSION ESTIMATION

5.1 Emissions from Mining Activities

Total dust emissions were estimated by analysing the dust generating activities taking place at the site for the proposed operations. Appropriate emission factors based on AP42 (**USEPA 1985 and Updates**) and **SPCC (1983**) were applied to estimate the potential dust emissions.

The focus of this assessment is to assess the effect of the proposed operations on the existing situation by careful consideration of the additional incremental dust impact that may be caused. This approach had been applied as there is no change proposed in the total ROM production rate from underground operation and no change proposed to the surface infrastructure associated with the storage and handling of ROM. The only proposed change is in the temporary transport by truck of development coal that is produced in the process of establishing the workings. Therefore only the following activities associated with the proposed mining activities may contribute additional impacts:

- Loading ROM to trucks;
- Hauling ROM to underground ROM stockpile; and
- Unloading ROM at underground ROM stockpile.

Total annual dust emissions from these activities are presented in **Table 5-1**, and the emission factors/equations applied to calculate these values are presented in **Section 5.1.1** and **5.1.2**.

Table 5-1: Estimated annual TSP emission rate

Activity	TSP emission (kg/year)
Loading ROM	28,072
Hauling ROM to Stockpile	64,788
Unloading ROM	28,072
Total	120,933

5.1.1 Loading/Unloading ROM

Dust emissions from loading/unloading activities were estimated using the following equation based on AP42 (**USEPA 1985 and updates**).

$$EF_{TSP} = \frac{0.58}{M^{1.2}}\ kg/tonne$$

Where M = moisture content (%) = 7% (Assumed)

Applying this equation for a 0.5 Mtpa (Million tonnes per annum) ROM production rate, total annual TSP emissions from loading and unloading activities (loading to trucks and unloading from trucks) were estimated to be 56,148 kg.

5.1.2 Hauling

ROM coal will be transported to the underground coal stockpile using haul trucks (135 tonnes Gross Vehicle Mass (GVM) and 55.5 tonnes of load capacity) on an unsealed road 6.3 km long. Dust emissions from hauling activities were estimated using the following equation based on AP42 (**USEPA 1985 and updates**).

$$EF = (\frac{0.4536}{1.6093} \times ((\frac{S}{12})^{0.7} \times 4.9) \times (M \times \frac{1.1023}{3})^{0.45}\ kg/VKT$$

Where;
S = Silt content = 2 % ; based on a well controlled main haul road, and M = GVM = 135 tonnes.

Applying this equation and considering 0.5 Mtpa (Million tonnes per annum) ROM production rate, annual TSP emissions from hauling activities were estimated to be 64,788 kg. As a conservative measure, the truck mass was kept at 135 tonnes on both legs of the trip.

5.2 Emissions from Power Generation

Air emissions associated with the proposed 32 MW power generation unit (8 units with 4 MW output) were estimated based on manufacturer's specifications and the applicable Clean Air Regulations (**POEO, 2005**) regulatory limit for emissions from stationary reciprocating internal combustion engines operated on gaseous fuel.

Emissions associated with the proposed 30 MW power generation unit (10 units with 3 MW output) were estimated based on manufacturer's specifications provided in an air quality impact assessment for similar power generation units (**Heggies, 2010**).

Two scenarios were included in the assessment to outline the different power generation options available. Scenario 1 incorporates the 8 power generation units with 4 MW outputs for a total of 32 MW. Scenario 2 incorporates the 10 power generation units with 3 MW outputs for a 30 MW total.

Exhaust volumetric flow rate (m^3/s) for each engine unit was calculated based on the designed exhaust mass flow rate (kg/hr) and flue gas analysis for natural gas combustion. As a conservative approach, it was assumed that the density of dry exhaust gas is equivalent to air at STP. **Table 5-2** presents the exhaust flow rate, regulatory limits and calculated emission rates of NO_x and CO for the proposed power generation unit. Typically, reciprocating engines produce NO_x emissions comprising 5% to 10% NO_2, which over time will react in the atmosphere to a greater fraction of NO_2. The rate of this reaction is governed by zone and other factors such as temperature. The reactions are complicated, but are most pronounced in urban areas with high ozone and other levels of pollution, which do not arise in this situation. However, in this assessment we have conservatively assumed the NOx emissions comprise 20% NO_2 at the emission point, as outlined in **Table 5-2**.

Table 5-2: Exhaust gas parameters for each engine

Parameter	Scenario 1	Scenario 2	Unit
Exhaust mass flow (wet)	22,217	-	kg/hr
Exhaust vol flowrate (dry)	3.89	-	m^3/s
Area of exhaust	0.19	0.28	m^2
Diameter of stack	0.5	0.6	m
NO_x regulatory limit	450	450	mg/m^3
NO_x emission rate	1.75	1.17	g/s
CO emission rate	0.49	2.23	g/s

5.3 Emissions from Flares

Air emissions associated with all flare operations have been included. The flares are located at the top of the Whybrow Highwall (five pre-mining gas drainage flares and five new goaf gas flares), at the proposed power plant site (five new pre-mining gas drainage flares) and at the Blakefield South (9 MW power plant site (7 pre-mining gas drainage flares). Flare emissions were based on the estimated stack concentration and associated exhaust flowrate.

Typically, NO_x emissions from flares comprise 5% to 10% NO_2, which over time will react in the atmosphere to a greater fraction of NO_2. The rate of this reaction is governed by ozone and other factors such as temperature. The reactions are complicated, but are most pronounced with high ozone and other levels of pollution, which do not arise in this situation. However, in this assessment we have conservatively assumed the NO_x emissions comprise 20% NO_2 at the emission point, as outlined in **Table 5-3**.

Table 5-3: Exhaust gas parameters for each flares

Parameter	Pre-drainage Flares	Post-drainage Flares	Unit
Methane Capacity	1800	900	L/s
Nitrogen Oxides concentration	150	150	mg/m³
Carbon Monoxide concentrations	125	125	mg/m³
Area of exhaust	50	113	m²
Exit temperature	800	800	°C
Flare height	6	10	m
Exit velocity	1	1	m/s
Nitrogen dioxide emission rate	0.85	0.38	g/s
Carbon Monoxide emission rate	3.53	1.57	g/s

5.4 Odour

Odour emissions from the proposed ventilation shaft operation were estimated based on the measured odour data (2009 and 2010) from the existing ventilation shaft at Beltana Coal mine. Analysis of the available odour data presented in **Table 5-4** shows significant variation in the measured odour emission rate. Therefore, as a conservative approach, the highest measured odour emission rate was used in the modelling.

Table 5-4: Measured odour emission rate

Odour samples	Measured odour emission rate (ou.m³/s)
2009	19,671
2010	32,527
Modelling	**32,527**

6 MODELLING METHODOLOGY

6.1 Dust

The dust impact assessment for this study is based on a similar modelling methodology to that used previously in the air quality assessment for the Bulga Coal Continued Underground Operations (**Umwelt**, **2003**). A version of the USEPA ISCST3 model, modified specifically for modelling dust impacts from Hunter Valley coal mines, and referred to as ISCMOD was used in predicting the dust impact. This model has been accepted for use in NSW coal mine assessments for many years.

The modelling was based on the application of three particle-size categories, namely; $PM_{2.5}$ (particles in size range 0 to 2.5 μm), $PM_{2.5\text{-}10}$ (particles in size range 2.5 to 10 μm) and $PM_{10\text{-}30}$ (particles in size range 10 to 30 μm). The distribution of particles for each particle size category was derived from measurements in the **SPCC (1986)** study of dust from Hunter Valley coal mines and is presented in **Table 6-1**.

Table 6-1: Distribution of particles

Particle category	Size range	Distribution	Geometric mean diameter
Fine particulates (FP)	0 to 2.5 μm	4.68% of TSP	1
Coarse matter (CM)	2.5 to 10 μm	34.4% of TSP	5
Rest (RE)	10 to 30 μm	60.92% of TSP	17.3

Emissions from each activity were represented by a series of volume sources and were included in the ISCMOD model via an hourly varying emission file. Meteorological conditions associated with dust generation (such as wind speed) and level of dust generating activity was considered in calculating the hourly varying emission rate for each source. It should be noted that as a conservative measure, the effect of the precipitation rate (rainfall) in reducing dust emissions has not been considered in this assessment. The modelling results are used to predict short-term and long-term average PM_{10} and TSP concentrations and dust depositions.

6.2 NO_2, CO and Odour

NO_2, CO and odour impact assessment for the proposed power plant and ventilation shaft operations were conducted following the Office of Environment and Heritage (OEH) document "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**).

AUSPLUME Version 6.0 was used in predicting the NO_2, CO and odour impact for this study. AUSPLUME is an advanced Gaussian dispersion model developed by the Victorian EPA (**VEPA, 1986)** and is based on the US EPA's ISC model. The model has been improved to include the recommendations of the American Meteorological Society's expert panel on dispersion modelling, presented in a paper by **Hanna et al. (1977)**. AUSPLUME is regarded as a "State of the Art" model and has been used extensively for assessing air and odour impacts throughout Australia.

The stack parameters used in the modelling are presented in **Table 6-2** to **Table 6-4**.

Table 6-2: Stack parameters for power plant

Parameter	Scenario 1	Scenario 2	Unit
Number of stacks	8	10	
Stack height	12	12.5	m
Stack diameter	0.5	0.6	m
Exit velocity	20	32.41	m/s
Exit temperature	476	375	°C
NO_x emission rate	1.75	1.17	g/s
CO emission rate	0.49	2.23	g/s

Table 6-3: Stack parameters for ventilation fans

Parameter	Data	Unit
Number of ventilation fans	2	
Stack height	9	m
Stack diameter	3.5	m
Exit velocity	17	m/s
Exit temperature	16	°C
Odour emission rate	32,527	Ou.m³/s

Table 6-4: Stack parameters for flares

Parameter	Pre-drainage Flares	Post-drainage Flares
Number of Flares	15*	5
Flare diameter (m)	4	6
Exit temperature (°C)	800	800
Flare height (m)	6	10
Exit velocity (m/s)	1	1
Nitrogen dioxide emission rate (g/s)	0.85	0.38
Carbon Monoxide emission rate (g/s)	3.53	1.57

* Includes 7 approved flares at the Blakefield South power station not associated with the project in order to conservatively assess cumulative impacts

6.2.1 Maximum cumulative NO_2 and CO case

To assess the potential cumulative impacts arising from the operation of the Project in conjunction with similar equipment at the existing and proposed Blakefield South operations, a maximum cumulative case has also been assessed. The cumulative modelling considers a worst-case operational scenario for all potential sources that can operate at the same time.

It should be noted that the operation of the full suite of Whybrow Highwall flares would not occur concurrently with the full suite of Blakefield South Flares. Many of these flares will be translocated from one site to the other, and therefore could not operate in two places at once. It is important to consider the flare location most likely to have the greatest impact therefore some initial modelling was conducted to determine the worst-case flare location to include in the cumulative assessment. A

similar approach was applied to the two potential scenarios for the BFN power station, and the most impacting case was included in the cumulative assessment.

The flares can potentially operate over a range of exit velocities from 1m/s to 20m/s, depending on the nature and volume of the methane gas mixture. A range of different operating scenarios across this range were modelled to determine the condition that leads to the greatest impact, which was found to arise when flaring with an exit velocity of 15m/s.

In summary, the maximum cumulative case includes emissions from: the Blakefield North power station and flares; the Blakefield South power station and flares; the VAM; and additional Blakefield South Flare units.

Whilst other emissions sources such as flares at the Whybrow Highwall will operate at various times, they cannot generate any greater cumulative impact than would occur for the assessed cumulative case above.

7 ANALYSIS OF MODELLING RESULTS

Spatial distribution of the dispersion model predictions for PM_{10}, TSP, dust deposition, CO, NO_2 and odour are presented as contour plots in **Figure 7-1** to **Figure 7-20**. Each of the sensitive receptors shown in **Figure 2-1** and detailed in **Appendix B** were assessed individually as discrete receptors with the results presented in tabular form for the privately owned receptors.

7.1 Dust

Analysis of the predicted incremental particulate impact levels presented in **Figure 7-1** to **Figure 7-4** shows minimal incremental impact at all privately owned residential receptors.

Table 7-1 presents the predicted incremental impact from the proposed operation at the worst impacted receptor. The receptor is identified as receptor 217s and located to the west of the project within the Bulga mine lease boundary, coordinates 317001 E, 6381819 N, MGA 56 (m).

It can be observed from **Table 7-1** that incremental impacts from the proposed operation are small and would not cause impacts at any receptor.

It can also be observed that cumulative dust impacts are unlikely to occur at any privately owned residential receptor locations.

The predicted maximum impact at the receptor is shown in **Table 7-1**. The predicted maximum level of impact due to the project is approximately 1% of the criteria level for 24-hour PM_{10}; less than 0.033% of the annual average PM_{10} criteria; and approximately 0.1% of the TSP criteria. The predicted level of impact would be much lower at any other residential receptor location.

The predicted level of impact due to this project would not be discernible cumulatively:

- as the dust generated would be too low. For example this project is estimated to generate 120,933 kg of dust annually, which is 0.4% of the 27,463,479 kg of dust generated by the three nearby open cut mines, Bulga, Mt Thorley and Warkworth;
- in any measured background data as the additional dust level in the area due to the project is below the reliable range of precision of the monitoring instruments that could be used; and,
- within the most recent cumulative dust modelling predictions in this area. For example, the additional impact of this project is well below the modelling accuracy (e.g. 95% overestimation to 85% underestimation for annual average PM_{10}) in the air dispersion modelling for the Bulga Western Modification project. Adding this project's maximum predicted impacts, which are

less than 0.033% of the criteria, would be of no consequence in regard to compliance with criteria in this situation.

Therefore further, detailed modelling of potential cumulative dust impacts is not warranted.

Table 7-1: Predicted particulate impact at worst impacted receptor

Parameter	Averaging Period	Unit	Predicted Increment
PM_{10}	24 hour	µg/m³	0.6
PM_{10}	Annual	µg/m³	0.0
TSP	Annual	µg/m³	0.1
Dust deposition	Annual	g/m²/month	0.0

7.2 Nitrogen Dioxide and Carbon Monoxide

Analysis of the predicted NO_2 and CO impacts for both Scenario 1 and Scenario 2 presented in

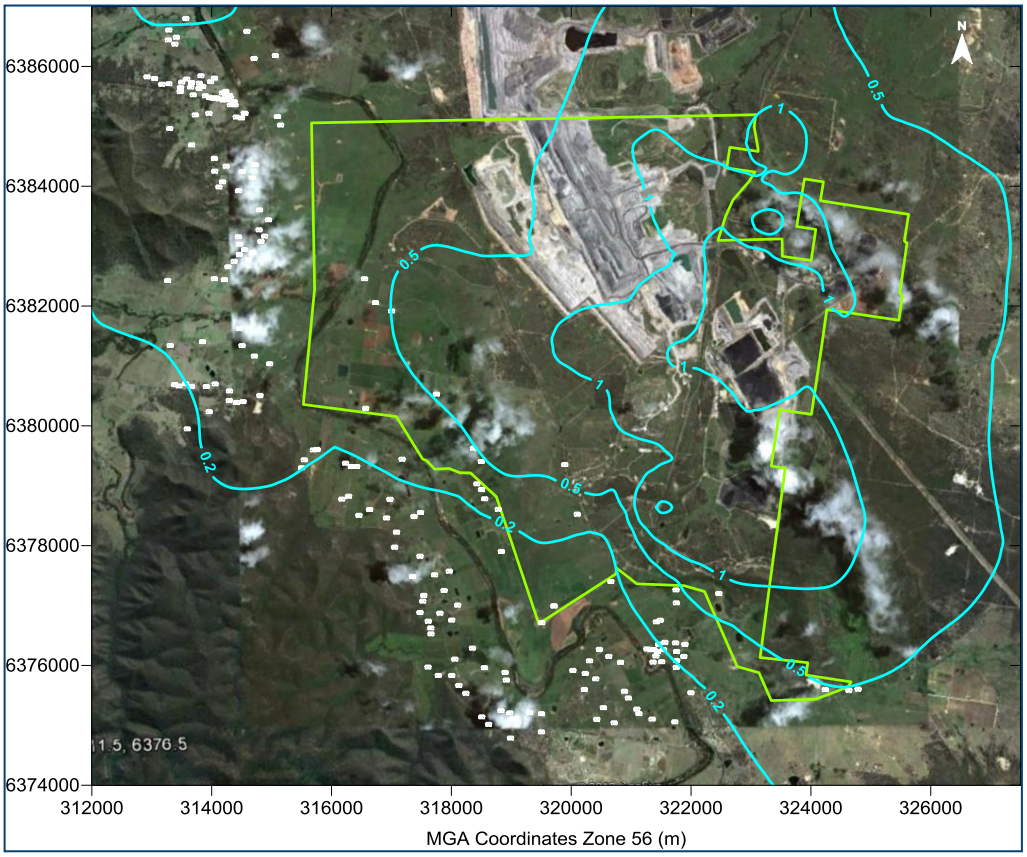

Figure 7-5 to **Figure** 7-14 shows minimal incremental impact at all privately owned residential receptors. Although not reflected in these figures it should be noted that the flares account for much of the incremental impact, rather than the power plant. This would be expected given the low exit velocity and the emission rate.

It should be noted that the assessment has been undertaken with all flares and power stations operating at once. In practice the flare will only be used to combust the captured methane supplementary to the power generation consumption requirements or when the power generation is not operating. Once the power stations are constructed and operating only a small number of flares or none would be required to combust the supplementary methane. It should also be noted that the flares modelled at the Blakefield South 9MW power generation site include an additional seven

approved flares not associated with this project, but part of the Bulga complex. This was done as a conservative measure in the assessment, given the potential for the flares to be significant and the lack of site specific background monitoring data.

Table 7-2 and **Table 7-3** present a comparison of predicted NO_2 and CO impacts from the proposed Scenario 1 and Scenario 2 respectively, at the worst impacted receptor. It can be observed from **Table 7-2** and **Table 7-3** that predicted impacts from the proposed operation are unlikely to cause any exceedance of OEH criteria for NO_2 and CO.

It is noted that site specific CO monitoring is not available for this assessment. However comparison of the predicted incremental CO concentrations with the OEH criteria for CO shows that the Project contribution would be approximately 0.1% of the criteria. As it is improbable that existing background levels of CO would be more than 99.9% of the criteria levels, it is clear that any exceedance of the OEH criterion for CO at any residential receptor location is unlikely to occur.

Table 7-2 Scenario 1 Predicted NO_2 and CO impact at worst impacted receptor

Parameter	Averaging Period	Unit	Receptor ID	Predicted Increment	Background	Cumulative	Criteria
CO	15 minute	mg/m³	10	0.48	NA	NA	100
CO	1 hour	mg/m³	10	0.36	NA	NA	30
CO	8 hour	mg/m³	56	0.07	NA	NA	10
NO_2	1 hour	µg/m³	10	107	33	140	246
NO_2	Annual	µg/m³	56	1.1	8.9	10.0	62

Table 7-3 Scenario 2 Predicted NO_2 and CO impact at worst impacted receptor

Parameter	Averaging Period	Unit	Receptor ID	Predicted Increment	Background	Cumulative	Criteria
CO	15 minute	mg/m³	56	0.43	NA	NA	100
CO	1 hour	mg/m³	56	0.33	NA	NA	30
CO	8 hour	mg/m³	10	0.07	NA	NA	10
NO_2	1 hour	µg/m³	56	79	33	112	246
NO_2	Annual	µg/m³	10	0.74	8.9	9.64	62

7.2.1 Maximum cumulative case

Analysis of the predicted NO_2 and CO impacts for the maximum cumulative case presented in **Figure 7-15** to **Figure 7-19** shows minimal impact from the Project at all privately owned residential receptors.

Table 7-4 presents the predicted NO_2 and CO impacts from the maximum cumulative case, at the most impacted receptor, and also the cumulative impact from the Project including the maximum measured background level. It can be observed in **Table 7-4** that predicted impacts from the proposed operation are below criteria levels and are unlikely to exceed OEH criteria for NO_2 and CO.

Pollutant transformation of NOx to NO_2 was conducted using an empirical equation for estimating the oxidation rate of NO in power plant plumes as outlined in the "*Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*" (**NSW DEC, 2005**) and developed by **Janssen et al. (1988)**.

Per the method, a Level 1 assessment was carried out by adding maximum predicted and maximum background concentrations to determine the total impact of NO_2. This assumed the emissions comprise 100% NO_2 at the source and most impacted point. The predicted maximum impacts were found to occur approximately 8.8km from the source during the spring season. Using this distance

and conservative values for the Janssen A and α constants, the ratio of NO_2 to NO_x at receptors due to the operations was calculated to be 37%.

With the addition of the maximum 1-hour background NO_2 levels measured at the Muswellbrook and Singleton monitors in 2012 of 82.7µg/m³ and 75.2µg/m³ respectively, the total predicted impact at the sensitive receptors would be below the applicable criterion level. The annual average NO_2 levels measured at these sites during 2012 were 40.4µg/m³ and 34.1µg/m³ respectively. Hence, the predicted annual average NO_2 impact is also below the relevant criteria.

It is noted that the predicted CO impact for all modelled sources is lower than predicted in Scenario 1 and 2. This arises due to the overly conservative approach for Scenario 1 and 2 which assumes the maximum predicted impacts from every source occur simultaneously at each receptor, which of course could not occur. The cumulative modelling case approach allowed for the spatial and temporal impacts of all source to be considered realistically. Regardless however, the predicted CO impact remains low and is well below the relevant criteria.

Table 7-4 Maximum Cumulative Case Predicted NO_2 and CO impact at worst impacted receptor

Parameter	Averaging Period	Unit	Receptor ID	Predicted impact all modelled sources	Background	Cumulative impact including background	Criteria
NO_2	1 hour	µ g/m³	10	134.9	82.7	217.6	246
NO_2	Annual	µ g/m³	5	1.7	40.4	42.1	62
CO	15 minute	mg/m³	65	0.21	NA	NA	100
CO	1 hour	mg/m³	65	0.16	NA	NA	30
CO	8 hour	mg/m³	10	0.03	NA	NA	10

7.3 Odour

Figure 7-20 presents a spatial distribution of predicted 99th percentile incremental nose response average odour concentration. It can be observed from **Figure 7-20** that the predicted maximum nose-response odour level that may be caused by operation of the proposed ventilation shaft is 0.05 OU and is below the odour detection threshold of 1 OU, and below any potentially applicable criteria. Therefore, it is unlikely that the proposed operation would cause any odour nuisance at the surrounding sensitive receptor locations.

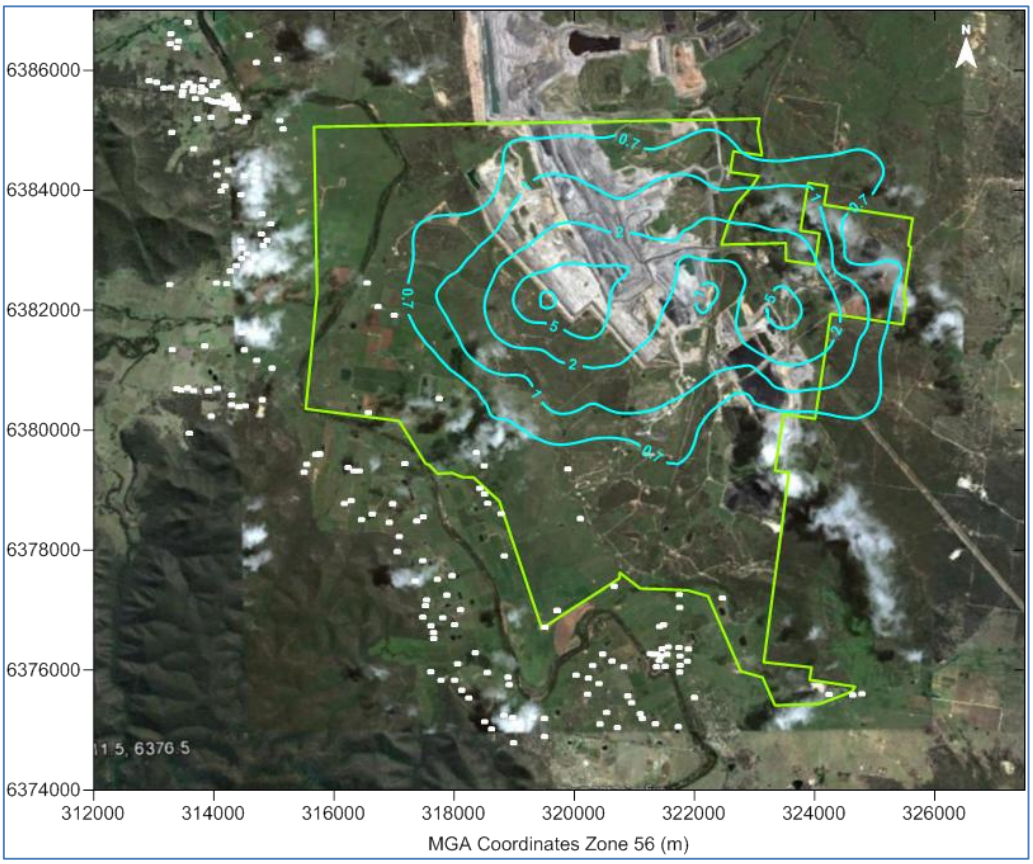

Figure 7-1: Predicted incremental 24-hour average PM_{10} concentrations (µg/m³)

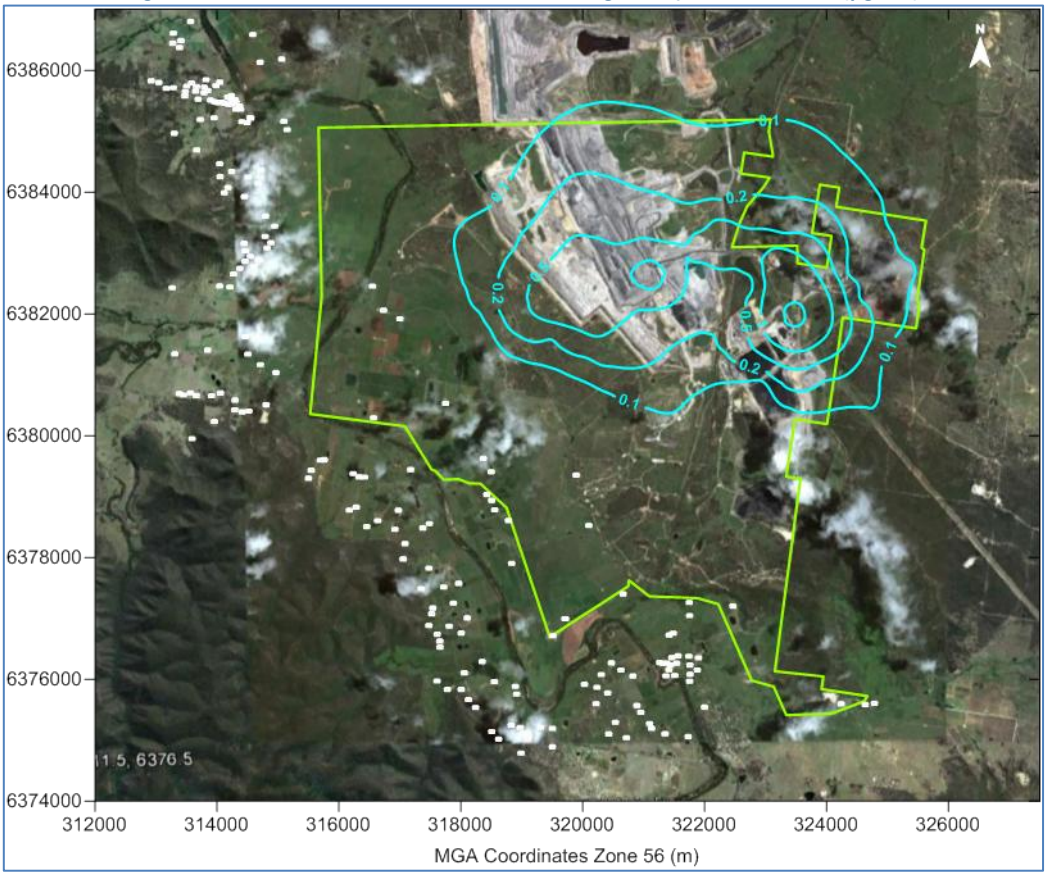

Figure 7-2: Predicted incremental annual average PM_{10} concentrations (µg/m³)

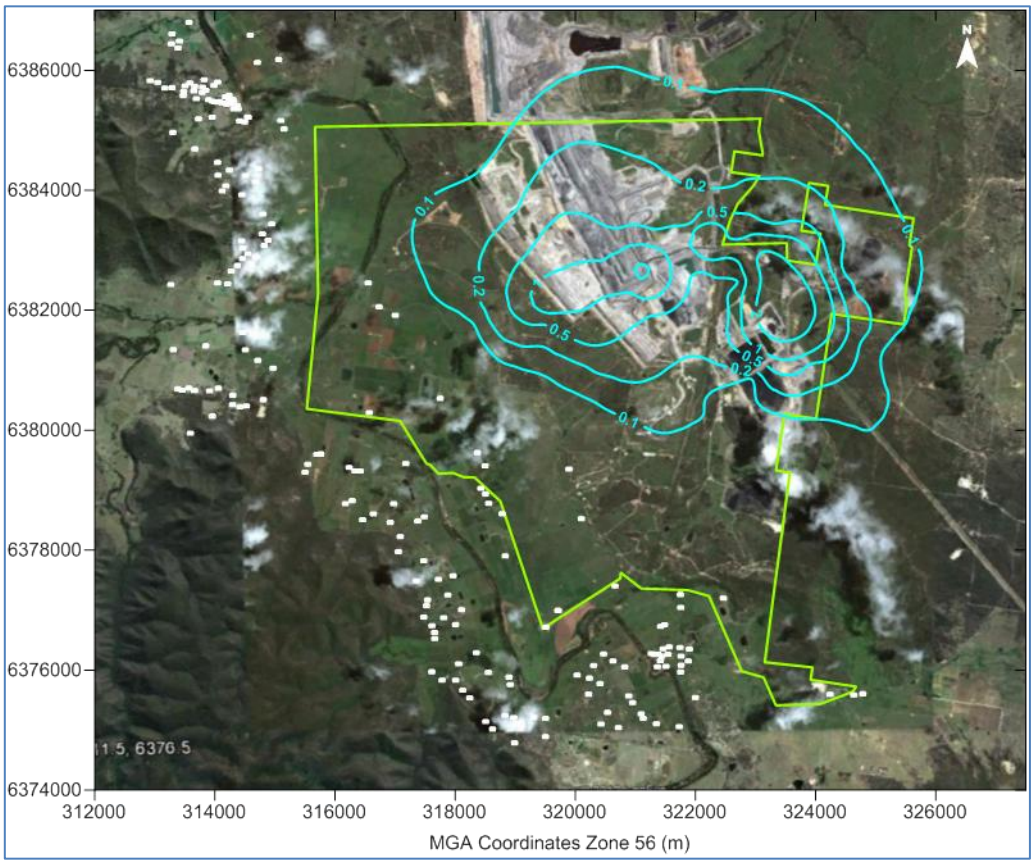

Figure 7-3: Predicted incremental annual average TSP concentrations (µg/m³)

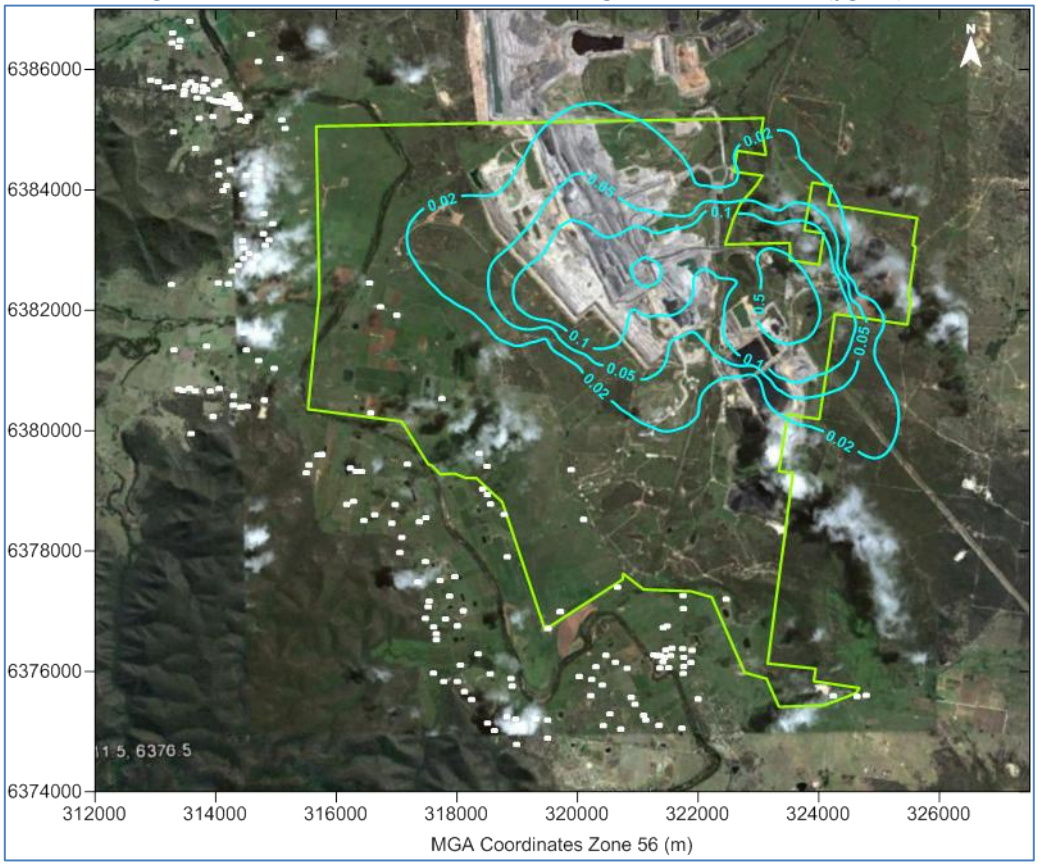

Figure 7-4: Predicted incremental annual average dust deposition (g/m²/month)

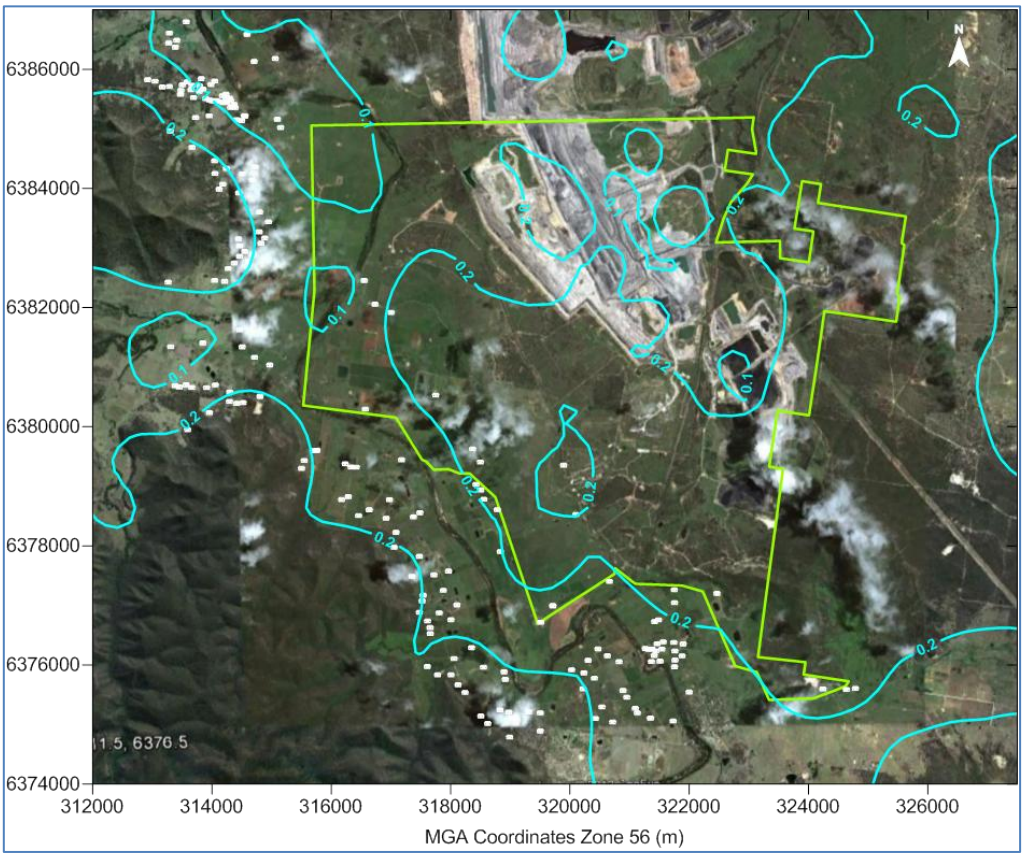

Figure 7-5: Scenario 1 Predicted incremental 15 minute average CO concentrations (mg/m³)

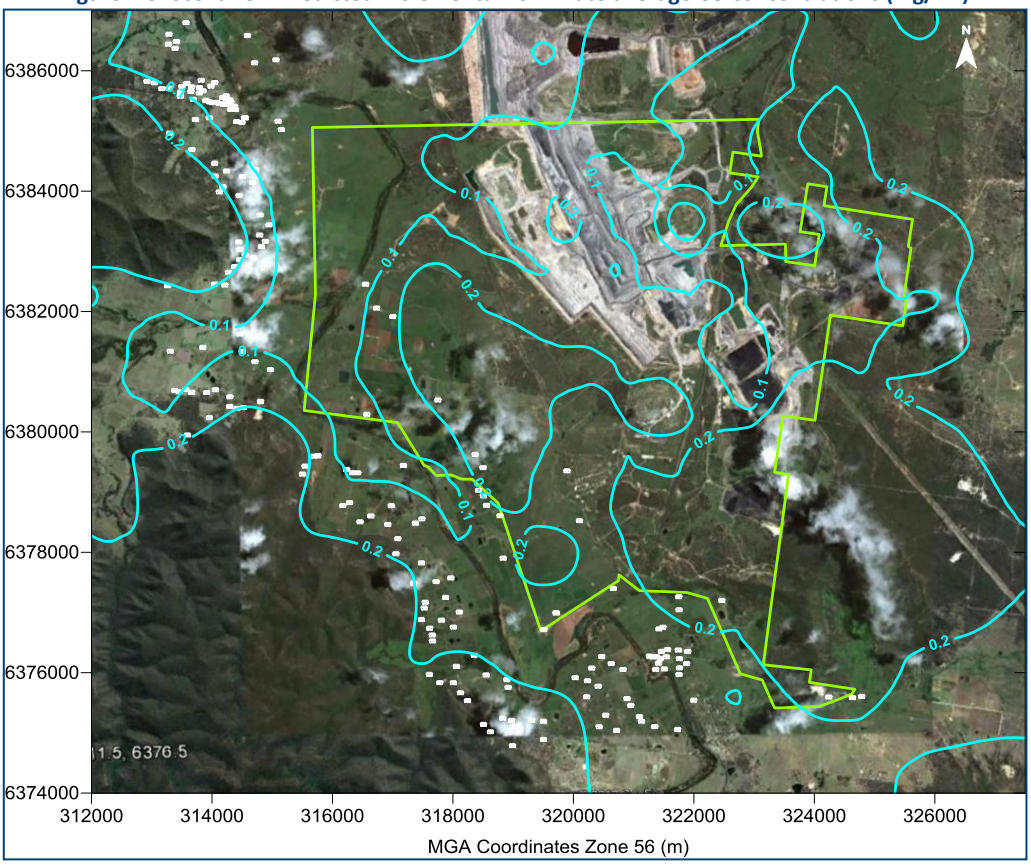

Figure 7-6: Scenario 2 Predicted incremental 15 minute average CO concentrations (mg/m³)

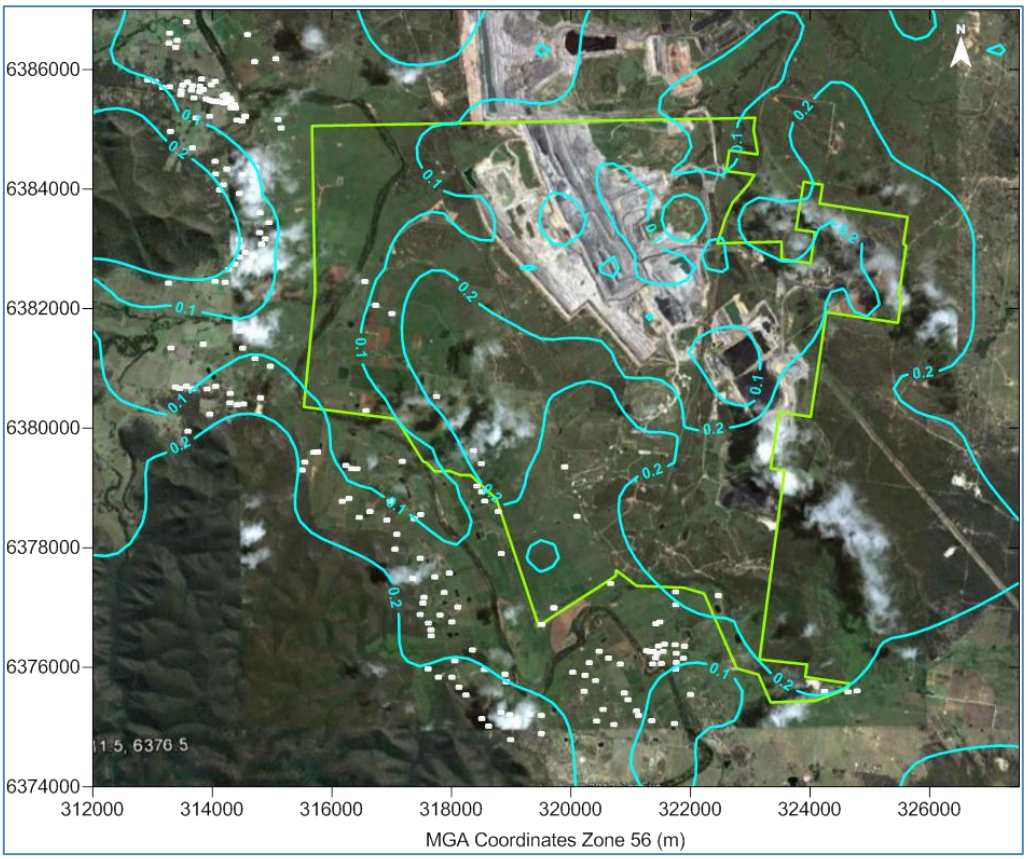

Figure 7-7: Scenario 1 Predicted incremental 1-hour average CO concentrations (mg/m³)

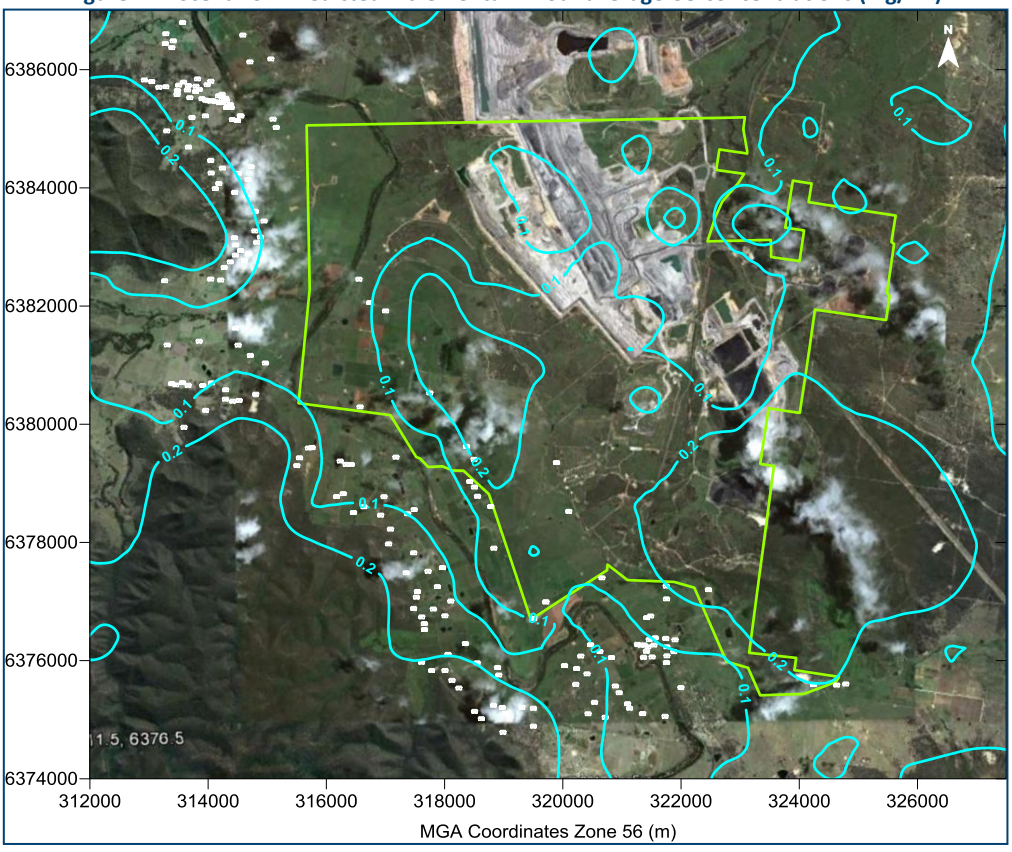

Figure 7-8: Scenario 2 Predicted incremental 1-hour average CO concentrations (mg/m³)

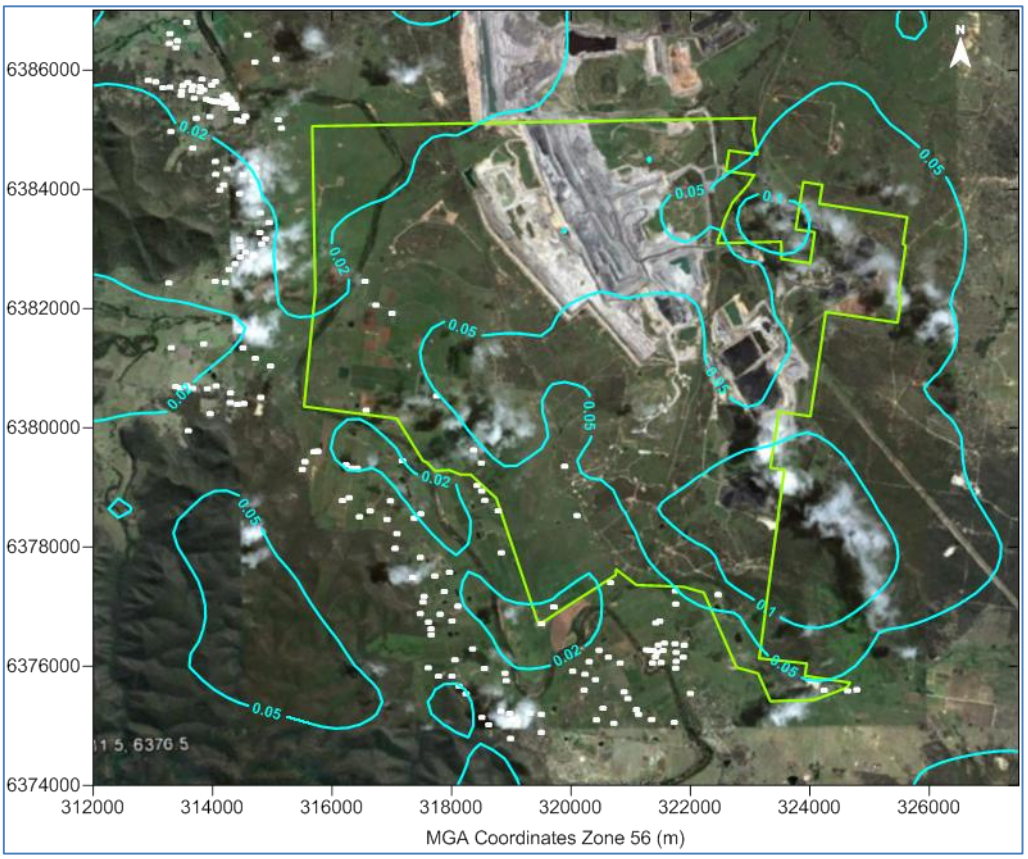

Figure 7-9: Scenario 1 predicted incremental 8-hour average CO concentrations (mg/m³)

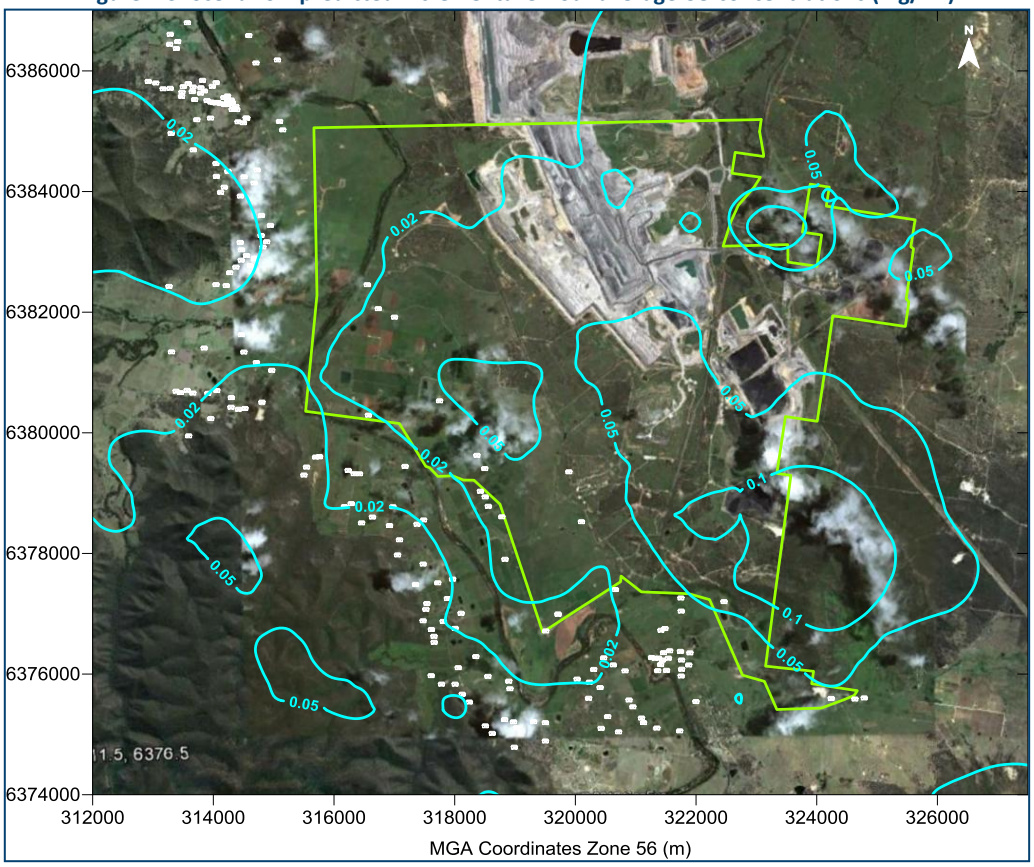

Figure 7-10: Scenario 2 Predicted incremental 8-hour average CO concentrations (mg/m³)

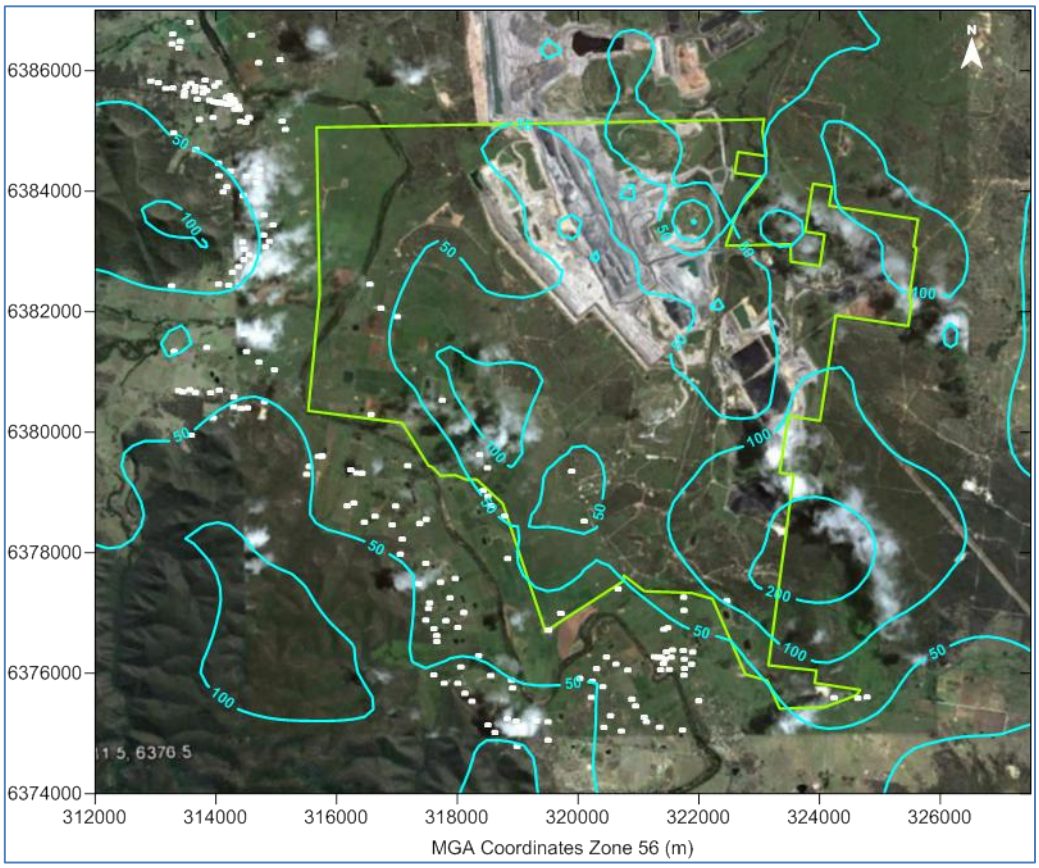

Figure 7-11: Scenario 1 predicted incremental 1-hour average NO_2 concentrations (µg/m³)

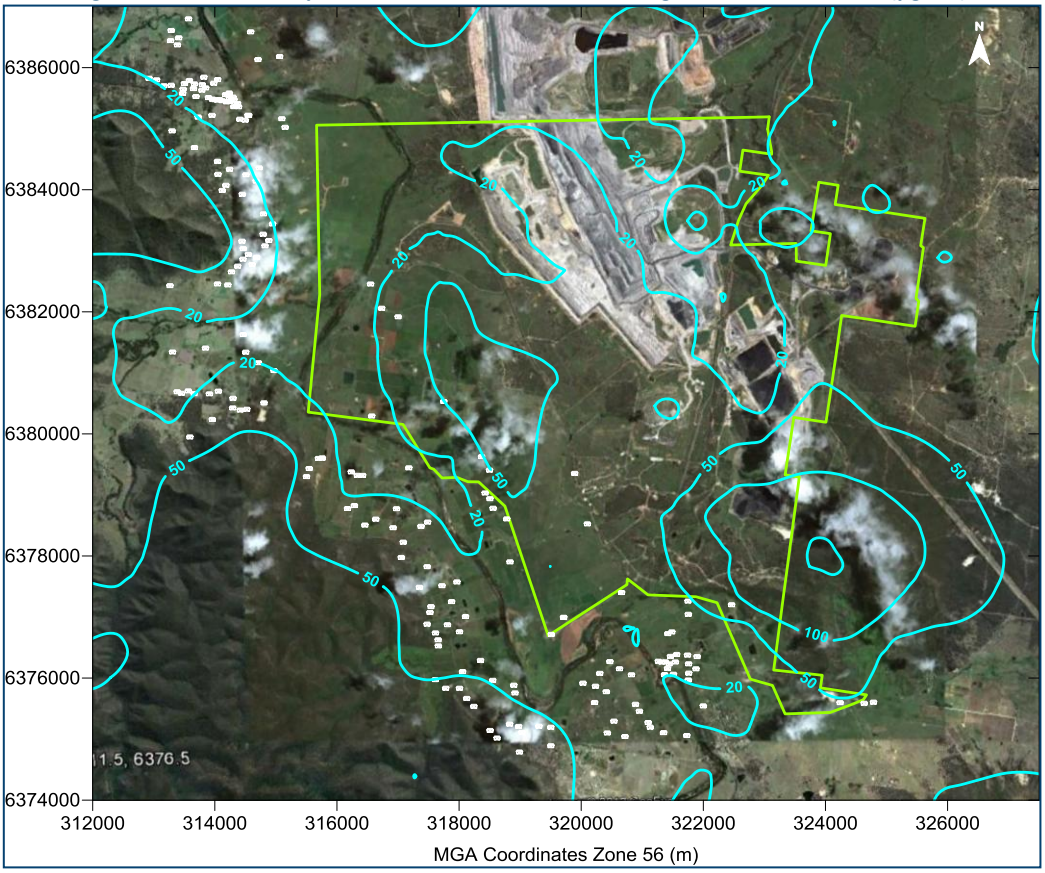

Figure 7-12: Scenario 2 Predicted incremental 1-hour average NO_2 concentrations (µg/m³)

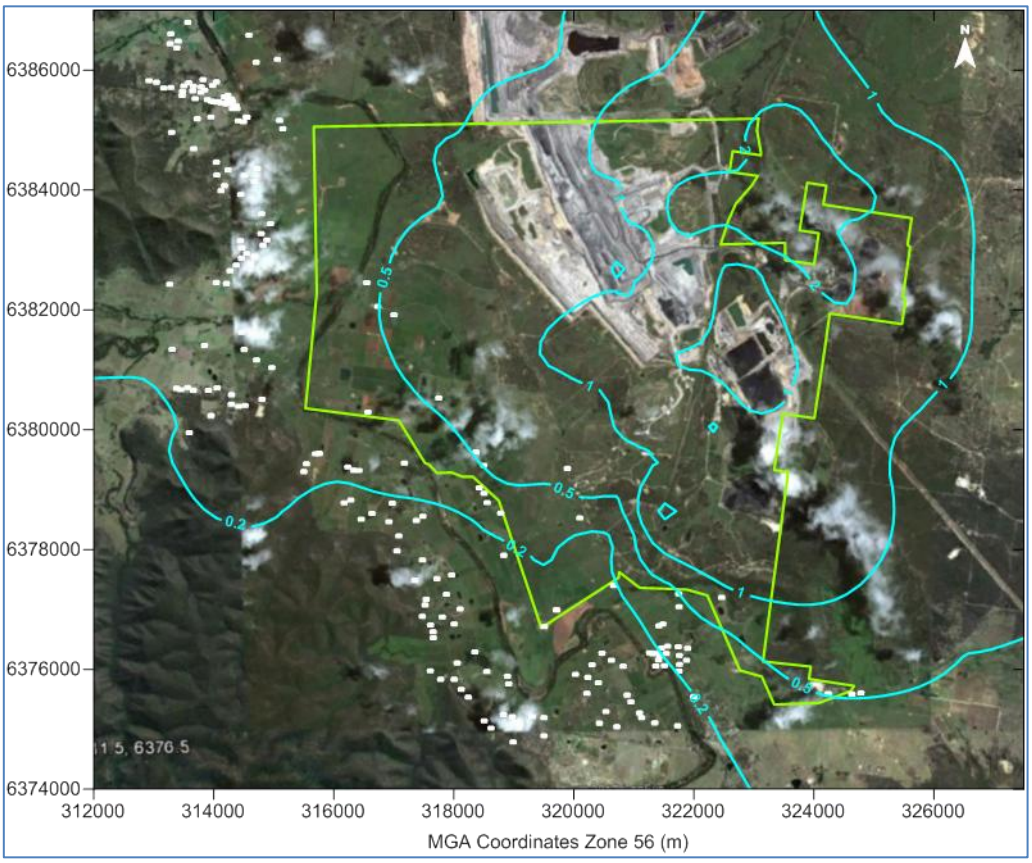

Figure 7-13: Scenario 1 Predicted incremental annual average NO_2 concentrations (µg/m³)

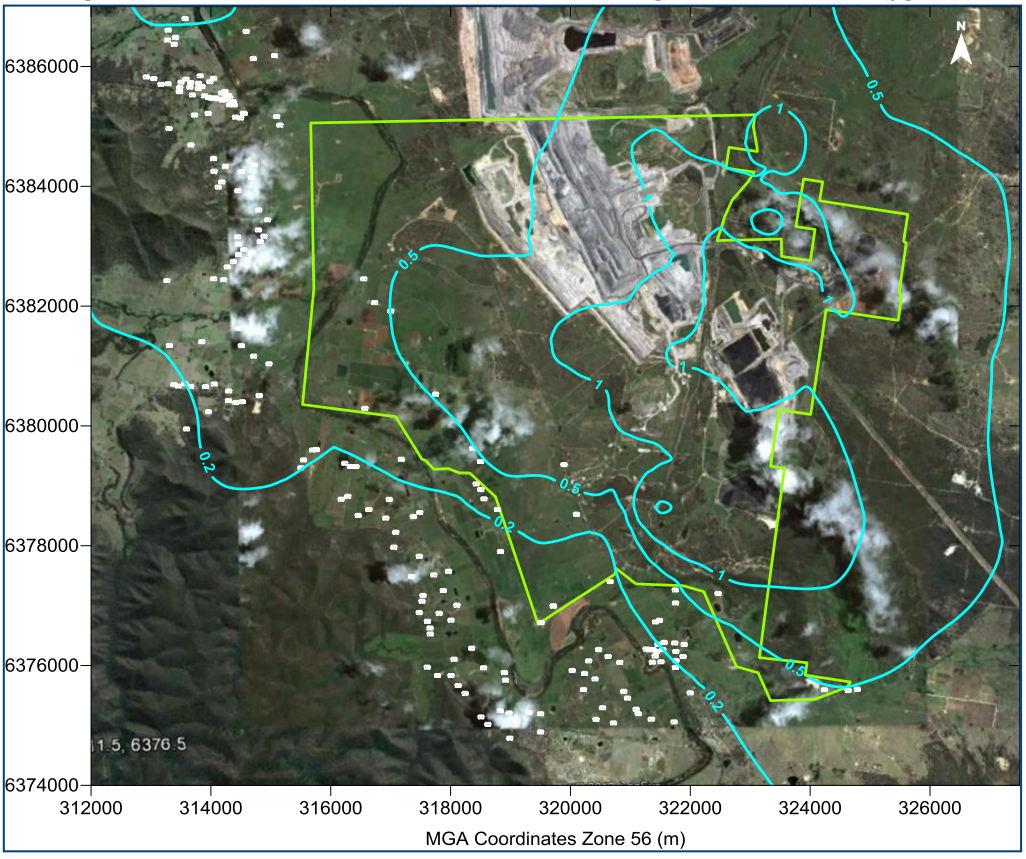

Figure 7-14: Scenario 2 predicted incremental annual average NO_2 concentrations (µg/m³)

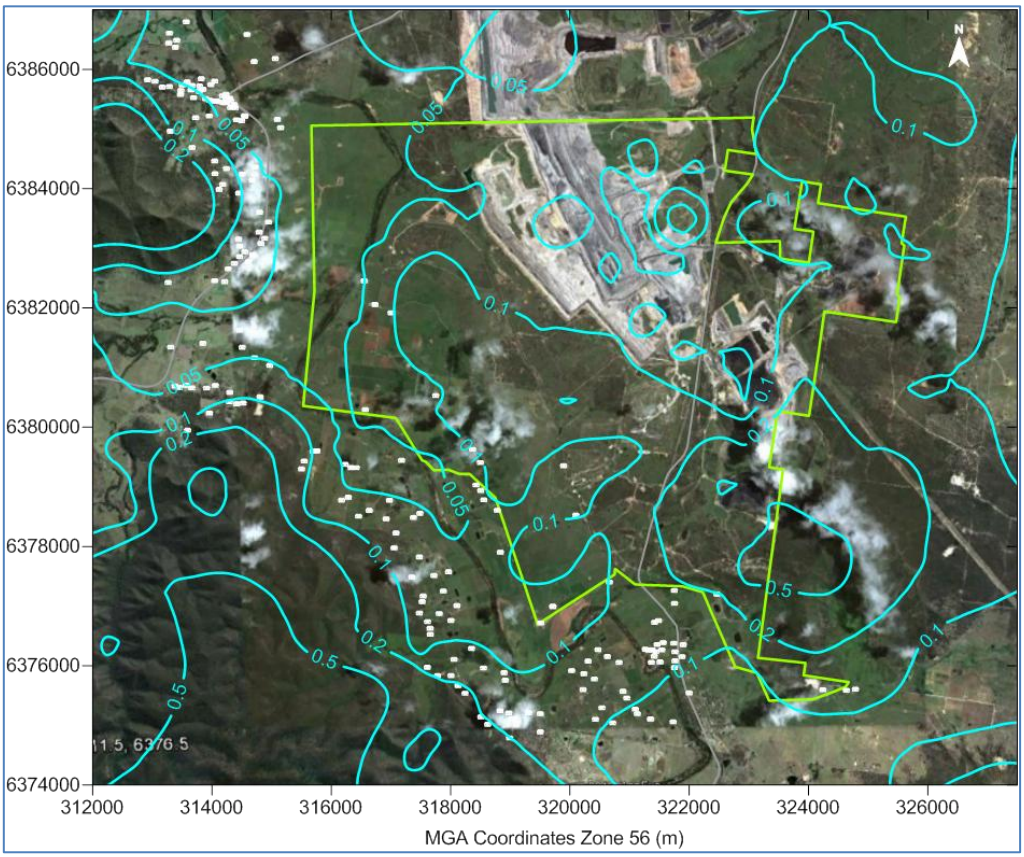

Figure 7-15: Maximum Cumulative Case predicted incremental 15 minute average CO concentrations (mg/m³)

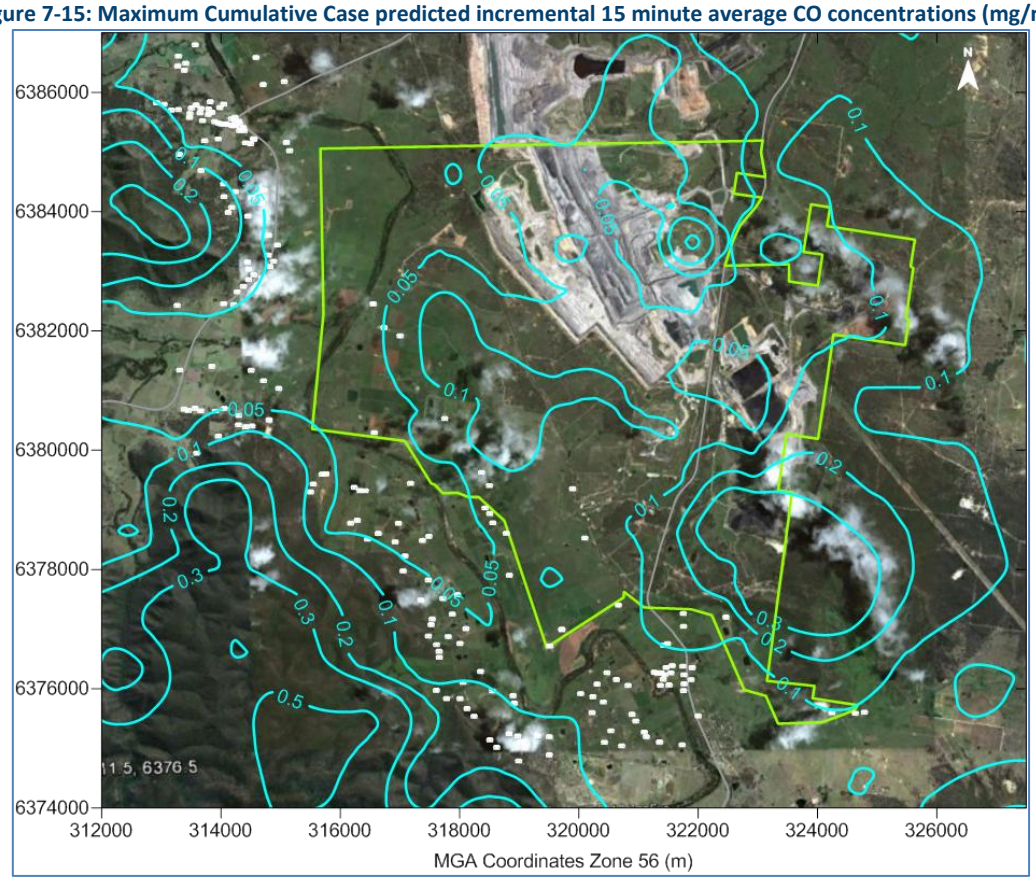

Figure 7-16: Maximum Cumulative Case predicted incremental 1-hour average CO concentrations (mg/m³)

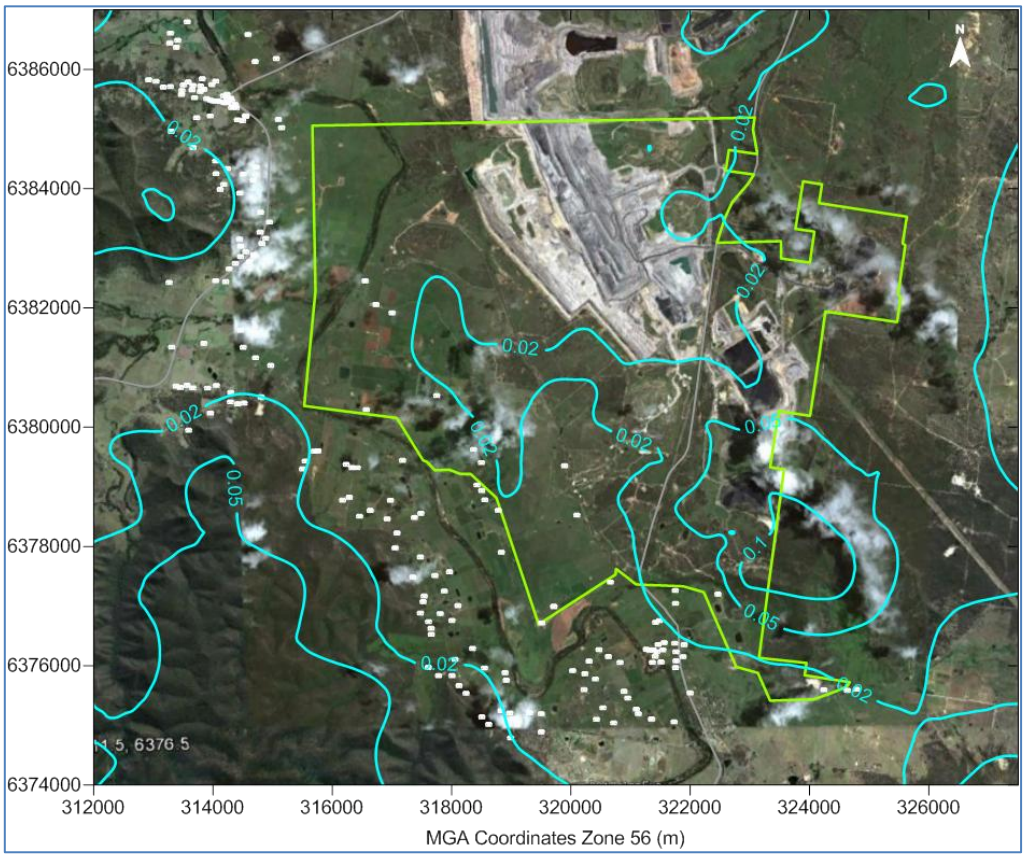

Figure 7-17: Maximum Cumulative Case predicted incremental 8-hour average CO concentrations (mg/m³)

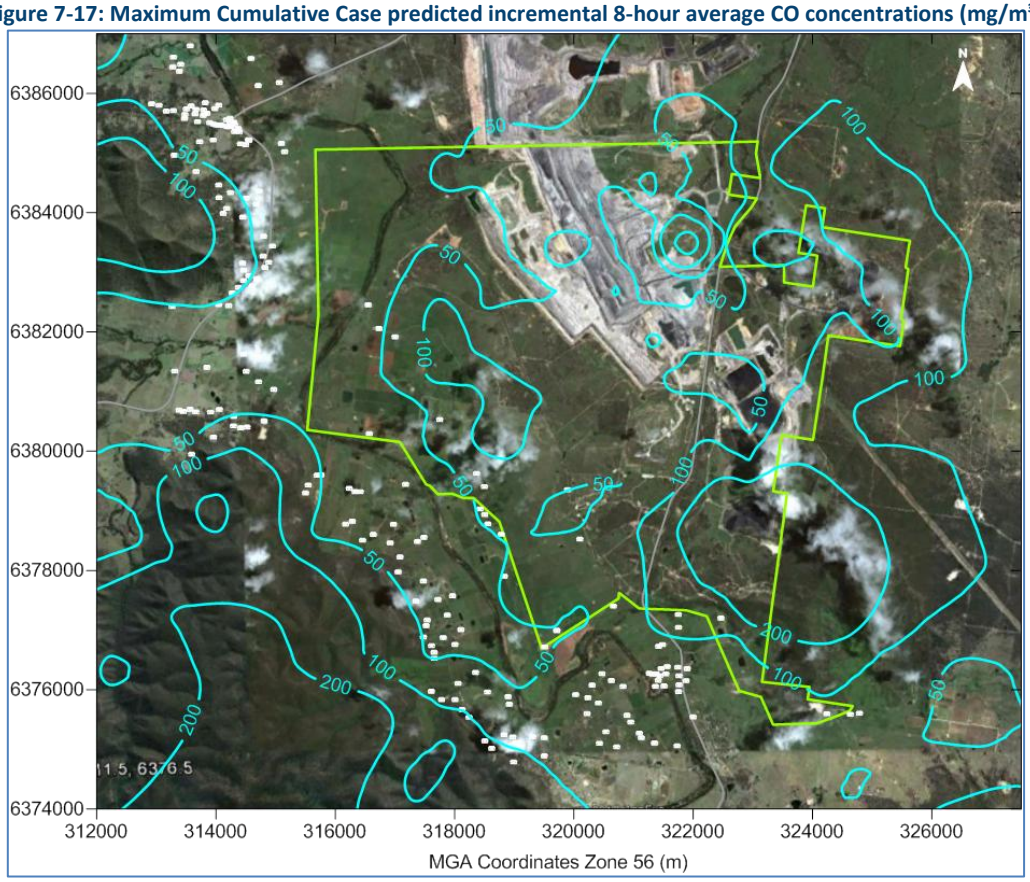

Figure 7-18: Maximum Cumulative Case predicted incremental 1-hour average NO_2 concentrations (µg/m³)

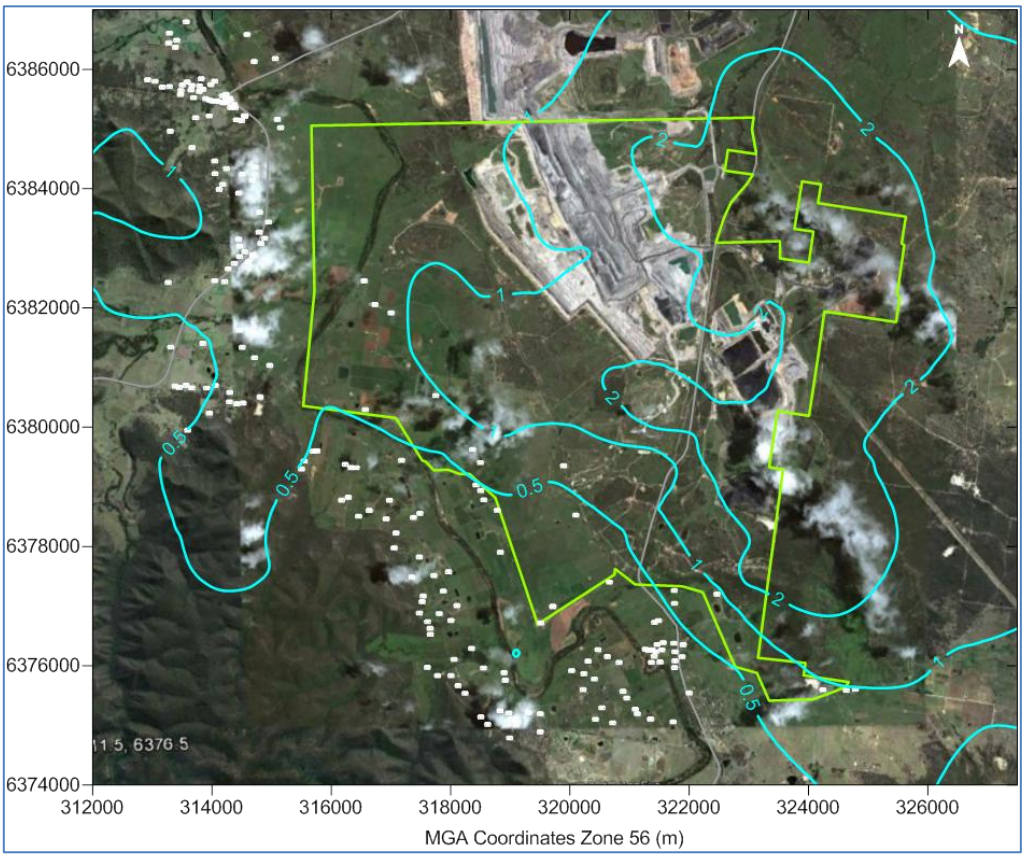

Figure 7-19: Maximum Cumulative Case predicted incremental annual average NO_2 concentrations (µg/m³)

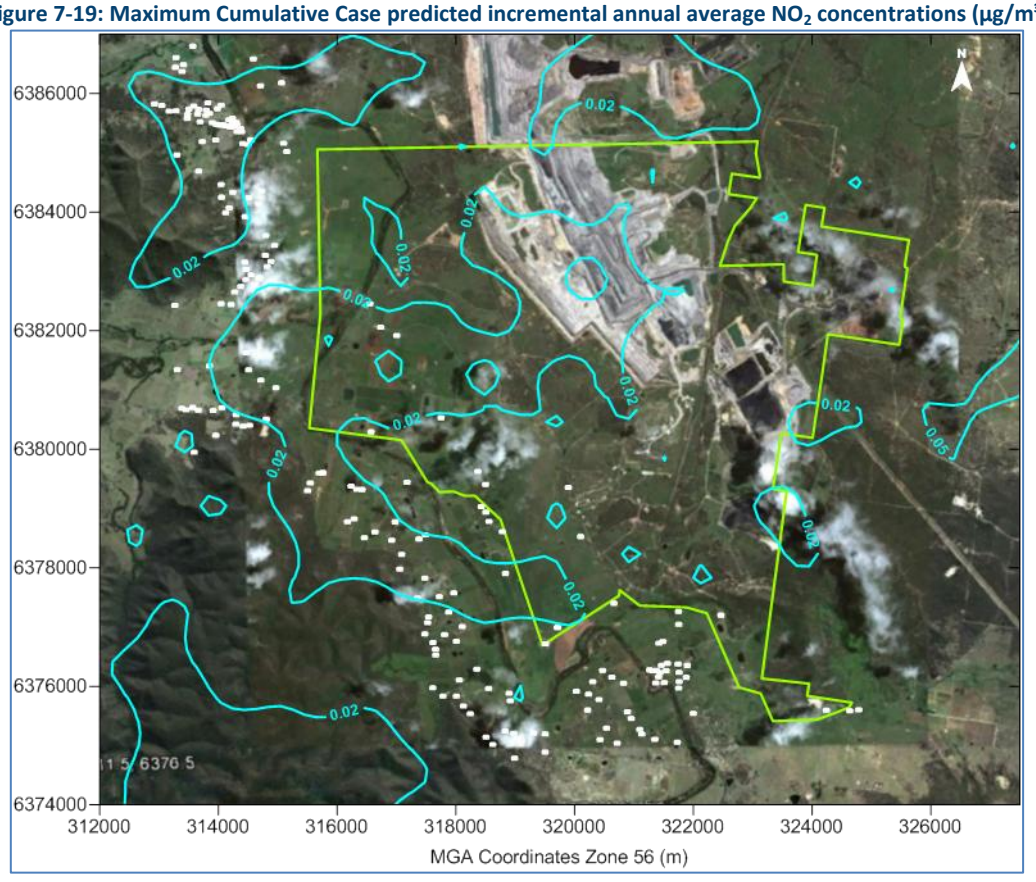

Figure 7-20: Predicted incremental 99th percentile nose-response average odour concentration (ou)

8 GREENHOUSE GAS ASSESSMENT

8.1 Introduction

Dynamic interactions between the atmosphere and surface of the earth create the unique climate that enables life on earth. Solar radiation from the sun provides the heat energy necessary for this interaction to take place, with the atmosphere acting to regulate the complex equilibrium. A large part of this regulation occurs from the "greenhouse effect" with the absorption and reflection of the solar radiation dependent on the composition of specific greenhouse gases in the atmosphere.

Over the last century, the composition and concentration of greenhouse gases in the atmosphere has increased due to increased anthropogenic activity. Climatic observations indicate that the average pattern of global weather is changing as a result. The measured increase in global average surface temperatures indicate an unfavourable and unknown outcome if the rate of release of greenhouse gas emissions remain at the current rate.

This assessment aims to estimate the potential incremental increase in the generation of greenhouse gases emitted to the atmosphere due to activity associated with the Blakefield North modification.

Subsequent to the greenhouse gas assessment completed for the Blakefield North Underground mine (**Umwelt, 2003**), it was found that that the methane quantities generated are much greater than previously assessed. Therefore the focus of this project is to manage the additional methane generated through utilisation in flaring and power generation, subsequently reducing the total greenhouse gas emissions from the Bulga Complex as a whole.

8.2 Greenhouse Gas Inventories

The National Greenhouse Accounts (NGA) Factors document published by the Department of Climate Change and Energy Efficiency (DCCEE) provide calculations suitable to estimate greenhouse gas emissions from various industry sources.

The NGA Factors document defines three scopes (Scope 1, 2 and 3) for different emission categories based on whether the emissions generated are from "direct" or "indirect" sources.

Scope 1 and 2 emissions encompass the direct sources from the proposed modification defined as:

"...from sources within the boundary of an organisation as a result of that organisation's activities" (**DCCEE, 2011a**).

Scope 3 emissions occur due to the indirect sources from the proposed modification as:

"...emissions generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation" (**DCCEE, 2011a**).

Scope 3 emissions have the potential to arise from a greater number of sources associated with the operation of Project, but as they are often difficult to quantify due to the diversity of sources they have not been considered further. These emissions are understood to be considered in the Scope 1 and 2 emissions from other various organisations related to the proposed modification.

The Scope 3 emissions generated from the transport and final use of the coal would not change from those assessed in previous assessments for the Project, as the modifications proposed in this assessment do not affect these outcomes, as such, they have not been considered further. We note however that there will be some additional Scope 3 emissions as a result of the proposed Project.

8.2.1 Emission Sources

Scope 1 and 2 greenhouse gas emission (GHG) sources identified from the modifications of the proposed Project are the on-site combustion of diesel fuel necessary for hauling of development coal, emissions from the operation of the flares and power station, consumption of additional electricity for the proposed modifications and fugitive emissions of methane released through the mining process. The Scope 3 emissions identified in this assessment would not change other than for additional minor emissions associated with the purchase and delivery of additional diesel temporarily, and electricity for use on-site.

The estimated quantity of additional diesel required to operate the haul trucks temporarily transporting development coal is approximate based on the manufacturer's stated fuel consumption of 55 litres per hour (pers comm.) and the assumption that the haul trucks would complete three return trips per hour, i.e. averaging 37.8 km per hour. This equates to a diesel fuel consumption at a rate of 145.5L/100km. Thus the calculated annual fuel requirement for this activity is estimated to be 165,165L.

GHG emissions from the operation of the flares and power station have been estimated from the quantities of ventilation air methane consumed by this equipment. The estimates have conservatively assumed that a direct stoichiometric reaction occurs with all the methane consumed converted to CO_2 and H_2O. These estimates are likely to be conservative and during actual operation are likely to be lower.

For Scenario 1, the estimated annual quantities of methane consumed by the flares are assumed to be 18,879 tonnes of methane per year and by the power station is assumed to be 44,050 tonnes of methane per year. Excess ventilation air methane released to atmosphere has been estimated to be approximately 18,797 tonnes of methane per year.

For Scenario 2, the estimated annual quantities of methane consumed by the flares are assumed to be 21,632 tonnes of methane per year and by the power station is assumed to be 41,297 tonnes of methane per year. Excess ventilation air methane released to atmosphere has been estimated to be approximately 18,797 tonnes of methane per year.

The Proponent has estimated that the increase in electricity usage from the proposed modifications would be approximately 2000kW of the electricity. It is noted that with the operation of the proposed power plant onsite any surplus electricity would be fed back into the public power grid.

8.2.2 Emission Factors

To quantify the amount of carbon dioxide equivalent (CO_2-e) material generated from the proposed modification, emission factors obtained from the National Greenhouse Accounts (NGA) Factors (**DCCEE, 2011a**) were applied, as summarised in **Table 8-1.**

Table 8-1: Summary of emission factors

Type	Energy content factor	Emission Factor (kg CO2-e/GJ)			Scope	Source
		CO_2	CH_4	N_20		
Diesel usage	38.6 GJ/kL	69.2	0.2	0.5	1	Table 4 (DCCEE, 2011a)
	-	5.3	-	-	3	Table 38 (DCCEE, 2011a)
Electricity usage	-	0.89	-	-	2	Table 5 (DCCEE, 2011a)
	-	0.17	-	-	3	Table 39 (DCCEE, 2011a)

The global warming potential used to convert methane gases to a carbon dioxide equivalent is 21 (**DCCEE, 2011a**).

8.3 Summary of GHG Emissions

On the whole the operation of the flares and power station onsite would result in a reduction of GHG emissions through the destruction of methane which would otherwise be vented to the atmosphere in the approved project. **Table 8-2** below provides a summary of the potential estimated emissions for the approved project, i.e. without the operation of the proposed flares and power station.

Table 8-2: Summary of CO_2-e emissions without flaring and power station (t CO_2-e)

Source	Scope 1	Scope 2	Scope 3	Scope 1+2
Electricity usage		15,593	3	15,593
Fugitive methane	1,716,246			1,716,246
Total	**1,716,246**	**15,593**	**3**	**1,731,839**

The combined Scope 1 and Scope 2 emissions generated without the proposed flares and power station would result in a significant amount of fugitive methane and hence GHG emissions.

The Proponent has estimated that the proposed modifications in this assessment would approximately require an additional 2000kW of the electricity usage. The proposed Scenario 1 power station is estimated to generate approximately 32MW of electricity and the proposed Scenario 2 power station is estimated to generate approximately 30MW of electricity. As a result, for both scenarios, surplus electricity will be generated and fed back into the grid which would result in a net reduction in potential GHG emissions.

Table 8-3 summarises the estimated annual CO_2-e emissions from the operation of the proposed Scenario 1 modifications.

Table 8-3: Summary of CO_2-e emissions for Scenario 1 (t CO_2-e)

Source	Scope 1	Scope 2	Scope 3	Scope 1+2
Diesel usage	443		34	443
Electricity usage		15,593	3	15,593
Flares	51,916			51,916
Power Station	121,138			121,138
Fugitive methane	394,737			394,737
Electricity generated*		-212,062		-212,062
Total	**568,235**	**-196,469**	**37**	**371,766**

*Electricity generated as a result of onsite power stations, excess electricity is fed back into the grid.

Table 8-4 summarises the estimated annual CO_2-e emissions from the operation of the proposed Scenario 2 modifications.

Table 8-4: Summary of CO_2-e emissions for Scenario 2 (t CO_2-e)

Source	Scope 1	Scope 2	Scope 3	Scope 1+2
Diesel usage	443		34	443
Electricity usage		15,593	3	15,593
Flares	59,488			59,488
Power Station	113,567			113,567
Fugitive methane	394,737			394,737
Electricity generated*		-198,808		-198,808
Total	**568,235**	**-183,215**	**37**	**385,020**

*Electricity generated as a result of onsite power stations, excess electricity is fed back into the grid.

From **Table 8-3** and **Table 8-4** it can be seen that there would be a decrease in the Scope 2 emissions, due to the difference in the amount of electricity generated by the onsite power station and the amount of electricity required by the Project.

Table 8-5: Net change in total CO_2-e emissions as a result of the Project (t CO_2-e)

Source	Scope 1	Scope 2	Scope 3	Scope 1+2
Total without Project	1,716,246	15,593	3	1,731,839
Total with Project Scenario 1	568,235	-196,469	37	371,766
Total with Project Scenario 2	568,235	-183,215	37	385,020
Net Project benefit - Scenario 1	**1,148,011**	**212,062**	**-34**	**1,360,073**
Net Project benefit - Scenario 2	**1,148,011**	**183,215**	**-34**	**1,346,819**

Table 8-5 shows that the use of the proposed flares and power station (Scenario 1 or Scenario 2) would result in an approximate 78% reduction in GHG emissions compared with the approved project. This significant net benefit in reducing annual GHG emissions arises mainly as fugitive methane emissions would be captured and destroyed through flaring and power generation.

In 2010, the estimated greenhouse emissions for Australia were 543Mt CO_2-e (**DCCEE, 2011b**). In comparison, the net project benefit in terms of annual average greenhouse gas emissions (Scope 1 and 2) is a reduction of 1.35 to 1.36 Mt CO_2-e, and therefore the project would result in a net annual reduction of greenhouse emissions equivalent to approximately 0.25% of the 2010 Australian greenhouse emissions.

9 CONCLUSIONS

An assessment of the potential effects of a proposed modification to the Blakefield North modification project has been made. The proposed modification would not change the rate of coal extraction or any surface infrastructure for receiving and processing the coal. The only changes with potential for additional dust impact include:

- the temporary use of trucks to transport development coal, which would occur until a re-aligned conveyor can be established; and,
- The development of either a 32MW power generation plant or 30MW power generation plant that would operate to generate electricity from methane from the coal.

The predicted additional air quality impacts arising from the proposed modification would be negligible at the worst impacted receptor. The change in impacts is unlikely to be detectable and the predictions show that levels would be below criteria at the privately owned receptors.

The assessment also conservatively considers the hypothetical situation of all existing and proposed NO_2 emitting sources at the Blakefield North modification project and the Blakefield South project operating at maximum emissions rates, and adds to this the maximum measured background level (which includes the existing NO_2 sources). The analysis found that even if this overly conservative scenario did occur, the NO_2 levels would remain below the applicable impact assessment criteria at the most affected point in the modelling domain.

The assessment of greenhouse gas emissions is considered to be conservative and shows a large net decrease in emissions compared with the approved case (i.e. without the proposed modification).

Therefore, it is concluded that the proposed modifications would result in a beneficial outcome.

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VEPA (1986)

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Appendix A

Sample AUSPLUME file

```
Simulation Title
{}
Concentration(1)/Deposition(0),    Emission    rate    units,    Concentration/Deposition    units,Background
Concentration, Variable Background flag,Variable Emission Flag
{True grams/second milligrams/m3 0 False False }

Terrain influence tag, 0-ignore, 1 - include
{2}
Egan coefficients
{0.5 0.5 0.5 0.5 0.7 0.7 }
Number of source groups
{1}
Total number of sources (Stack + Area + Volume sources)
{8}

Source Group information
Total Number of Sources in Group 1
{8}
Sources in Source Group 1
{1      2      3      4      5      6      7      8      }
BPIP Run (1-True, 0-False)
{0 }
Total number of buildings
{0 }

Source Information

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{1 1 323282.5 6383480 75 }
Stack height and diameter
{12 0.5 }
Stack temperature, Velocity, Cross, Height
{749 20 0 0 }
Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-
temperarture), Number of particle fractions
{1 0 }
Constant emission rate
{1}

Source ID, Source Type (1 - stack, 2 - area, 3- volume) and X, Y, Z coordinates
{2 1 323284.5 6383475 75 }
Stack height and diameter
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Stack temperature, Velocity, Cross, Height
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Constant emission rate
{1}

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Constant emission rate
{1}

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{12 0.5 }
Stack temperature, Velocity, Cross, Height
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Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-
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Constant emission rate
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Stack temperature, Velocity, Cross, Height
{749 20 0 0 }
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temperarture), Number of particle fractions
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Constant emission rate
{1}
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Stack temperature, Velocity, Cross, Height
{749 20 0 0 }
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Constant emission rate
{1}

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Stack temperature, Velocity, Cross, Height
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Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-
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Constant emission rate
{1}

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Stack temperature, Velocity, Cross, Height
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Emission type (1-constant, 2-monthly, 3-hours of the day, 4-wind and stability, 5-hour and season, 6-
temperarture), Number of particle fractions
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Constant emission rate
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Receptor information

Discrete receptors
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{310040.7088 6387995.644 0 }
X, Y coordinates and Elevation
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X, Y coordinates and Elevation
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Model settings and parameters
Emission conversion factor, Averaging Time
{1000 0 }

Land use (surface roughness)
{0.4}

Averaging time flags (1,2,3,4,6,8,12,24 hrs, 7, 90 days, 3 month, All hrs
{1 0 0 0 0 1 0 0 0 0 0 0 }

Statistical output options
{0 0 }

Output options (All meteodata, Every concentration/deposition, Highest/2nd highest, 100 worst case table,
Save all calculations
{0 0 0 1 1 0 }
Write concentration (1-yes, 0-no), Concentration rank, Write frequency, Frequency Level
{1 1 0 -1 }

Disregard exponents (1-yes, 0-no), Exponent Scheme (1-Irvin urban, 2-Irvin rural, 3-ISCST, 4-User Defined
{0 2 }
Dispersion exponents
{0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.2 0.2 0.2 0.2 0.2 0.2 0.25 0.25 0.25 0.25
0.25 0.25 0.4 0.4 0.4 0.4 0.4 0.4 0.6 0.6 0.6 0.6 0.6 0.6 }

Building wake effects (1-include,0-not) , Default decay coefficient, Anemometr height, Sigma-theta
averaging period, Roughness at vane site, Smooth stability changes, ConvectivePDF)
{1 0 10 60 0.3 0 0 }

Deposition options, Depletion options
```

```
{False False False False False False }

Stability class adjustments (0-None, 1-Urban1, 2-Urban2)
{0}
Building wake algorithms (1-Huber-Sneider, 2-Hybrid, 3-Schulman-Scire)
{4}

Gradual plume rise (1-yes,0-no), Stack tip downwash (1-yes,0-no), Disregard Temperature Gradient (1-yes,0-
no), Partial Penetration, Temp Gradient,  Adiabatic Entrainment, Stable Entrainment
{1 1 0 0 0.004 0.6 0.6 }
Temperature Gradients for Wind and Stability categories
{0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0.02 0.02 0.02 0.02 0.02 0.02 0.035 0.035 0.035 0.035
0.035 0.035 }

Dispersion curves (1-Pasquill Gifford, 2- Briggs rural,  3-Sigma theta) horizontal < 100 m, ditto vertical
< 100 m, ditto horizontal > 100 m, ditto vertical > 100 m
{1 1 2 2 }
Adjust PG curves for roughness - Horizontal, Vertical (1-yes,0-no)
{1 1 }
Enhance plume for buyoancy - Horizontal, Vertical (1-yes,0-no)
{1 1 }
Adjust for wind direction shear
{0}
Shear rates
{0.005 0.01 0.015 0.02 0.025 0.035 }

Wind Speed categories
{1.54 3.09 5.14 8.23 10.8 }

Output file
{'C:\Jobs\Beltana\AUSPLUME\AUSPLUME.TXT'}
Meteorological file
{'C:\Jobs\Beltana\Met\BCCWS.aus'}
Receptor file
{'C:\Jobs\Beltana\AUSPLUME\dis_receptor.ter'}
Concentration file
{'C:\Jobs\Beltana\AUSPLUME\AUS_C.dat'}
SaveAll file
{'C:\Jobs\Beltana\AUSPLUME\AUS_C.cal'}
```

Appendix B

Predicted incremental impact at surrounding receptors

Table B-1: Predicted impact at surrounding private residential locations

ID	Easting	Northing	PM_{10}		TSP	DD	CO (Scenario 1)			NO_2 (Scenario 1)	
Averaging period			24 hr	Annual	Annual	Annual	15 min	1 hr	8 hr	1 hr	Annual
Criteria			50	30	90	2	100	30	10	246	62
Unit			µg/m³			g/m²/mth	mg/m³			µg/m³	
1	323510	6388970	0.18	0.03	0.04	0.00	0.12	0.09	0.02	33.66	0.74
2	314822	6383082	0.24	0.02	0.03	0.01	0.18	0.13	0.02	45.37	0.39
3	324015	6388706	0.18	0.03	0.04	0.00	0.15	0.12	0.02	41.33	0.76
4	324011	6388489	0.19	0.04	0.04	0.00	0.16	0.12	0.02	44.40	0.81
5	323740	6387363	0.25	0.05	0.06	0.01	0.17	0.13	0.03	50.67	1.07
6	326416	6387627	0.20	0.03	0.03	0.00	0.20	0.16	0.03	55.08	0.51
7	324787	6375605	0.20	0.02	0.02	0.00	0.24	0.18	0.04	57.98	0.52
8	324634	6375588	0.20	0.02	0.02	0.00	0.25	0.19	0.04	60.37	0.51
9	324240	6375597	0.21	0.02	0.02	0.00	0.27	0.21	0.04	65.46	0.51
10	322464	6377201	0.27	0.02	0.03	0.00	0.47	0.36	0.07	106.96	0.83
11	321750	6377262	0.23	0.02	0.02	0.00	0.30	0.22	0.05	68.63	0.50
12	321754	6377045	0.22	0.02	0.02	0.00	0.25	0.19	0.04	59.94	0.42
13	321898	6376352	0.18	0.01	0.02	0.00	0.15	0.12	0.03	39.83	0.29
14	321880	6376152	0.17	0.01	0.01	0.00	0.14	0.10	0.03	36.39	0.25
15	321461	6376356	0.19	0.01	0.01	0.00	0.15	0.11	0.03	38.61	0.21
16	321563	6376387	0.19	0.01	0.01	0.00	0.15	0.11	0.03	39.26	0.23
17	321741	6376377	0.18	0.01	0.02	0.00	0.15	0.12	0.03	39.75	0.26
18	321541	6376264	0.18	0.01	0.01	0.00	0.14	0.11	0.03	37.71	0.21
19	321511	6376063	0.18	0.01	0.01	0.00	0.14	0.10	0.03	36.03	0.19
20	321759	6376234	0.18	0.01	0.01	0.00	0.14	0.11	0.03	37.46	0.24
21	321761	6376081	0.17	0.01	0.01	0.00	0.13	0.10	0.03	35.70	0.22
22	321753	6375969	0.17	0.01	0.01	0.00	0.13	0.10	0.03	34.66	0.21
23	321263	6376277	0.19	0.01	0.01	0.00	0.14	0.11	0.03	37.79	0.18
24	321320	6376262	0.19	0.01	0.01	0.00	0.14	0.11	0.03	37.63	0.18
25	321379	6376265	0.19	0.01	0.01	0.00	0.14	0.11	0.03	37.66	0.19
26	321440	6376233	0.18	0.01	0.01	0.00	0.14	0.11	0.03	37.37	0.20
27	321414	6376160	0.18	0.01	0.01	0.00	0.14	0.11	0.03	36.88	0.19
28	321366	6376058	0.18	0.01	0.01	0.00	0.14	0.10	0.03	36.40	0.17
29	321998	6375545	0.15	0.01	0.01	0.00	0.12	0.09	0.02	31.42	0.20
30	321730	6375059	0.15	0.01	0.01	0.00	0.12	0.09	0.02	31.58	0.16
31	321351	6375107	0.16	0.01	0.01	0.00	0.13	0.10	0.02	32.76	0.14
32	321130	6375196	0.16	0.01	0.01	0.00	0.14	0.10	0.02	34.78	0.13
33	321096	6375272	0.17	0.01	0.01	0.00	0.14	0.10	0.02	35.49	0.13
34	320953	6375458	0.18	0.01	0.01	0.00	0.15	0.11	0.02	38.12	0.13
35	320889	6375571	0.18	0.01	0.01	0.00	0.15	0.11	0.02	39.40	0.13
36	320824	6376054	0.20	0.01	0.01	0.00	0.15	0.11	0.02	40.10	0.13
37	320717	6375043	0.17	0.01	0.01	0.00	0.16	0.12	0.03	39.38	0.12
38	320536	6375295	0.18	0.01	0.01	0.00	0.18	0.14	0.03	44.68	0.12
39	320410	6375777	0.20	0.01	0.01	0.00	0.19	0.14	0.02	48.13	0.13
40	320628	6376153	0.20	0.01	0.01	0.00	0.15	0.12	0.02	41.56	0.13
41	320470	6376270	0.21	0.01	0.01	0.00	0.16	0.12	0.02	41.67	0.12
42	320662	6377402	0.27	0.01	0.02	0.00	0.18	0.14	0.02	45.69	0.19
43	320427	6375101	0.18	0.01	0.01	0.00	0.19	0.15	0.03	46.32	0.12
44	320220	6375600	0.20	0.01	0.01	0.00	0.20	0.15	0.03	51.02	0.12
45	320028	6375917	0.21	0.01	0.01	0.00	0.19	0.15	0.02	48.87	0.12
46	320234	6375867	0.21	0.01	0.01	0.00	0.19	0.15	0.02	49.69	0.13
47	320304	6376078	0.21	0.01	0.01	0.00	0.18	0.13	0.02	46.17	0.12
48	319713	6376994	0.26	0.01	0.01	0.00	0.17	0.13	0.02	39.47	0.12
49	319509	6376716	0.24	0.01	0.01	0.00	0.15	0.11	0.02	36.13	0.11
50	319713	6376994	0.26	0.01	0.01	0.00	0.17	0.13	0.02	39.47	0.12
51	319502	6375195	0.18	0.01	0.01	0.00	0.32	0.24	0.03	71.74	0.12
52	319308	6375211	0.18	0.01	0.01	0.00	0.35	0.26	0.04	76.43	0.12
53	319503	6374891	0.17	0.01	0.01	0.00	0.37	0.28	0.04	81.00	0.13
54	319030	6375112	0.17	0.01	0.01	0.00	0.41	0.31	0.04	87.49	0.13
55	318975	6375209	0.17	0.01	0.01	0.00	0.39	0.30	0.04	84.41	0.13
56	318988	6374789	0.16	0.01	0.01	0.00	0.48	0.36	0.05	101.65	0.14
57	318622	6375018	0.15	0.01	0.01	0.00	0.46	0.35	0.05	96.80	0.14
58	318828	6375246	0.17	0.01	0.01	0.00	0.40	0.31	0.04	85.83	0.13
59	318916	6375757	0.18	0.01	0.01	0.00	0.27	0.20	0.03	58.00	0.12
60	318897	6375884	0.19	0.01	0.01	0.00	0.24	0.18	0.03	51.25	0.11
61	318551	6375964	0.17	0.01	0.01	0.00	0.28	0.21	0.03	58.27	0.12
62	318058	6376107	0.15	0.01	0.01	0.00	0.28	0.21	0.03	59.15	0.13
63	318351	6376291	0.17	0.01	0.01	0.00	0.22	0.17	0.03	47.56	0.12

ID	Easting	Northing	PM_{10}		TSP	DD	CO (Scenario 1)			NO_2 (Scenario 1)	
Averaging period			24 hr	Annual	Annual	Annual	15 min	1 hr	8 hr	1 hr	Annual
Criteria			50	30	90	2	100	30	10	246	62
Unit			µg/m³			g/m²/mth	mg/m³			µg/m³	
64	318508	6375142	0.15	0.01	0.01	0.00	0.45	0.34	0.05	94.82	0.14
65	318242	6375537	0.15	0.01	0.01	0.00	0.44	0.34	0.05	91.24	0.14
66	318126	6375667	0.15	0.01	0.01	0.00	0.44	0.33	0.05	89.37	0.15
67	318007	6375834	0.14	0.01	0.01	0.00	0.38	0.29	0.04	77.70	0.14
68	317610	6375974	0.13	0.01	0.01	0.00	0.29	0.22	0.04	60.46	0.13
69	317781	6375834	0.13	0.01	0.01	0.00	0.36	0.27	0.04	74.37	0.14
70	317659	6376528	0.15	0.01	0.01	0.00	0.19	0.14	0.02	40.44	0.12
71	317657	6376628	0.15	0.01	0.01	0.00	0.19	0.14	0.02	39.98	0.12
72	317613	6376740	0.15	0.01	0.01	0.00	0.19	0.14	0.02	40.65	0.13
73	318006	6376759	0.16	0.01	0.01	0.00	0.17	0.13	0.02	37.31	0.12
74	318106	6377008	0.17	0.01	0.01	0.00	0.15	0.12	0.02	34.07	0.12
75	317809	6376874	0.16	0.01	0.01	0.00	0.17	0.13	0.02	38.03	0.13
76	317476	6376884	0.15	0.01	0.01	0.00	0.20	0.15	0.03	43.56	0.13
77	317878	6377253	0.17	0.01	0.01	0.00	0.16	0.12	0.02	36.11	0.13
78	317540	6377171	0.16	0.01	0.01	0.00	0.20	0.15	0.03	42.98	0.14
79	317523	6377075	0.16	0.01	0.01	0.00	0.20	0.15	0.03	43.20	0.14
80	317720	6377514	0.18	0.01	0.01	0.00	0.17	0.13	0.02	38.63	0.14
81	317351	6377488	0.17	0.01	0.01	0.00	0.22	0.17	0.03	47.95	0.16
82	317477	6377825	0.18	0.01	0.01	0.00	0.19	0.14	0.03	41.81	0.16
83	317965	6377575	0.19	0.01	0.01	0.00	0.15	0.12	0.02	34.60	0.14
84	318834	6377904	0.28	0.02	0.02	0.00	0.20	0.15	0.03	44.87	0.18
85	320101	6378526	0.41	0.02	0.03	0.00	0.20	0.15	0.03	46.83	0.28
86	319892	6379354	0.58	0.03	0.04	0.00	0.17	0.13	0.05	42.93	0.73
87	318781	6378608	0.35	0.02	0.02	0.00	0.23	0.17	0.03	52.55	0.29
88	318557	6378783	0.31	0.02	0.02	0.00	0.22	0.17	0.03	51.73	0.31
89	318505	6378939	0.32	0.02	0.02	0.00	0.24	0.18	0.03	55.89	0.35
90	318426	6379033	0.31	0.02	0.02	0.00	0.23	0.17	0.03	55.37	0.36
91	318499	6379407	0.39	0.02	0.03	0.00	0.34	0.25	0.04	79.11	0.51
92	318369	6379628	0.44	0.02	0.03	0.00	0.33	0.25	0.04	80.34	0.53
93	317485	6378556	0.21	0.01	0.01	0.00	0.12	0.09	0.02	31.38	0.18
94	317086	6378227	0.19	0.01	0.01	0.00	0.17	0.13	0.02	41.31	0.17
95	317053	6377976	0.18	0.01	0.01	0.00	0.21	0.16	0.03	47.37	0.17
96	316919	6378463	0.20	0.01	0.01	0.00	0.16	0.12	0.02	38.99	0.18
97	317377	6378486	0.21	0.01	0.01	0.00	0.13	0.10	0.02	33.31	0.18
98	316636	6378604	0.19	0.01	0.01	0.00	0.16	0.12	0.02	39.09	0.18
99	316975	6378775	0.22	0.01	0.01	0.00	0.13	0.10	0.02	34.37	0.19
100	316458	6378507	0.19	0.01	0.01	0.00	0.17	0.13	0.02	42.06	0.18
101	316285	6378827	0.20	0.01	0.01	0.00	0.14	0.11	0.02	37.24	0.19
102	316173	6378778	0.19	0.01	0.01	0.00	0.15	0.11	0.02	38.35	0.18
103	315501	6379301	0.21	0.01	0.01	0.00	0.25	0.19	0.03	54.82	0.23
104	315545	6379433	0.23	0.01	0.01	0.00	0.23	0.18	0.03	52.31	0.23
105	317177	6379444	0.29	0.01	0.02	0.00	0.11	0.09	0.02	30.90	0.26
106	316334	6379322	0.23	0.01	0.01	0.00	0.12	0.09	0.02	32.10	0.21
107	316421	6379321	0.23	0.01	0.01	0.00	0.12	0.09	0.02	32.07	0.22
108	316234	6379378	0.24	0.01	0.01	0.00	0.12	0.09	0.02	31.68	0.22
109	315758	6379606	0.25	0.01	0.01	0.00	0.18	0.13	0.02	41.20	0.23
110	315696	6379599	0.25	0.01	0.01	0.00	0.19	0.14	0.03	43.88	0.24
111	315758	6379602	0.25	0.01	0.01	0.00	0.18	0.13	0.02	41.24	0.23
112	314524	6380405	0.21	0.01	0.01	0.00	0.23	0.18	0.03	55.26	0.27
113	314416	6380391	0.20	0.01	0.01	0.00	0.23	0.18	0.03	55.25	0.27
114	314292	6380426	0.20	0.01	0.01	0.00	0.22	0.17	0.03	52.42	0.26
115	313959	6380237	0.18	0.01	0.01	0.00	0.22	0.17	0.03	52.14	0.24
116	313592	6379950	0.18	0.01	0.01	0.00	0.22	0.17	0.03	52.28	0.21
117	317751	6380531	0.49	0.03	0.03	0.00	0.33	0.25	0.05	75.92	0.59
118	316570	6380295	0.35	0.02	0.02	0.00	0.11	0.08	0.02	27.89	0.32
119	314968	6381037	0.28	0.01	0.02	0.00	0.14	0.11	0.02	36.69	0.30
120	314806	6380509	0.23	0.01	0.01	0.00	0.21	0.16	0.03	51.00	0.28
121	314713	6381166	0.26	0.01	0.02	0.00	0.14	0.10	0.02	35.35	0.29
122	314298	6380585	0.21	0.01	0.01	0.00	0.19	0.15	0.03	47.46	0.27
123	314058	6380702	0.21	0.01	0.01	0.00	0.16	0.12	0.02	39.78	0.25
124	313910	6380657	0.20	0.01	0.01	0.00	0.15	0.12	0.02	38.02	0.24
125	313661	6380660	0.19	0.01	0.01	0.00	0.13	0.10	0.02	32.91	0.23
126	313565	6380705	0.19	0.01	0.01	0.00	0.12	0.09	0.02	30.33	0.22
127	313455	6380667	0.18	0.01	0.01	0.00	0.11	0.09	0.02	29.22	0.22
128	313383	6380691	0.18	0.01	0.01	0.00	0.11	0.08	0.02	27.88	0.21

ID	Easting	Northing	PM_{10}		TSP	DD	CO (Scenario 1)			NO_2 (Scenario 1)	
Averaging period			24 hr	Annual	Annual	Annual	15 min	1 hr	8 hr	1 hr	Annual
Criteria			50	30	90	2	100	30	10	246	62
Unit			µg/m³			g/m²/mth	mg/m³			µg/m³	
129	314506	6381340	0.26	0.01	0.02	0.00	0.12	0.09	0.02	32.06	0.29
130	314465	6381628	0.26	0.01	0.02	0.00	0.12	0.09	0.02	30.94	0.30
131	313848	6381407	0.23	0.01	0.01	0.00	0.09	0.07	0.02	22.51	0.26
132	313308	6381342	0.19	0.01	0.01	0.00	0.08	0.06	0.02	19.80	0.23
133	317002	6381919	0.61	0.04	0.05	0.01	0.22	0.17	0.03	53.84	0.56
134	316733	6382059	0.55	0.04	0.05	0.01	0.15	0.12	0.03	38.49	0.49
135	316551	6382456	0.45	0.04	0.05	0.01	0.11	0.09	0.02	28.15	0.45
136	314272	6382655	0.22	0.02	0.02	0.00	0.26	0.20	0.03	62.09	0.37
137	314045	6382458	0.22	0.02	0.02	0.00	0.25	0.19	0.03	58.08	0.35
138	314610	6382776	0.24	0.02	0.03	0.00	0.21	0.16	0.03	51.69	0.38
139	314374	6382748	0.23	0.02	0.02	0.00	0.25	0.19	0.03	61.24	0.38
140	313265	6382429	0.19	0.01	0.02	0.00	0.23	0.18	0.03	54.83	0.32
141	314684	6382894	0.24	0.02	0.03	0.00	0.20	0.15	0.02	50.32	0.38
142	314462	6382864	0.23	0.02	0.02	0.00	0.25	0.19	0.03	60.30	0.39
143	314549	6382942	0.23	0.02	0.03	0.00	0.23	0.18	0.03	57.20	0.39
144	314464	6383035	0.22	0.02	0.03	0.00	0.26	0.20	0.03	62.66	0.39
145	314885	6383168	0.24	0.02	0.03	0.01	0.16	0.12	0.02	42.84	0.39
146	314445	6383157	0.22	0.02	0.03	0.00	0.27	0.20	0.03	64.27	0.40
147	314947	6383440	0.25	0.03	0.03	0.01	0.15	0.11	0.02	39.82	0.39
148	314791	6383272	0.24	0.02	0.03	0.01	0.18	0.14	0.02	46.73	0.39
149	314798	6383606	0.24	0.02	0.03	0.01	0.16	0.12	0.02	42.54	0.39
150	314450	6383926	0.22	0.02	0.03	0.01	0.21	0.16	0.03	50.54	0.39
151	314121	6383989	0.21	0.02	0.03	0.00	0.27	0.21	0.03	63.50	0.39
152	314676	6384143	0.23	0.02	0.03	0.01	0.15	0.11	0.02	37.78	0.38
153	314181	6384074	0.21	0.02	0.03	0.00	0.25	0.19	0.03	58.18	0.39
154	314726	6384359	0.24	0.02	0.03	0.01	0.13	0.10	0.02	33.67	0.37
155	314511	6384246	0.23	0.02	0.03	0.01	0.17	0.13	0.02	41.29	0.38
156	314242	6384337	0.22	0.02	0.03	0.00	0.20	0.15	0.02	47.64	0.38
157	314052	6384253	0.21	0.02	0.03	0.00	0.25	0.19	0.03	56.92	0.38
158	314044	6384465	0.22	0.02	0.03	0.00	0.21	0.16	0.03	49.40	0.37
159	313667	6384692	0.21	0.02	0.02	0.00	0.22	0.17	0.03	49.56	0.36
160	313301	6384964	0.20	0.02	0.02	0.00	0.21	0.16	0.02	45.72	0.35
161	314214	6382442	0.23	0.02	0.02	0.00	0.23	0.17	0.03	54.24	0.35
162	313954	6385220	0.22	0.02	0.02	0.00	0.12	0.09	0.02	28.78	0.33
163	313727	6385192	0.22	0.02	0.02	0.00	0.13	0.10	0.02	30.83	0.33
164	314556	6385217	0.24	0.02	0.03	0.00	0.09	0.07	0.01	23.71	0.33
165	314543	6385221	0.24	0.02	0.03	0.00	0.09	0.07	0.01	23.76	0.33
166	314409	6385156	0.24	0.02	0.03	0.00	0.10	0.07	0.02	24.93	0.33
167	314497	6385141	0.25	0.02	0.03	0.00	0.09	0.07	0.01	24.33	0.33
168	314389	6385360	0.23	0.02	0.03	0.00	0.09	0.07	0.01	24.02	0.33
169	314355	6385378	0.23	0.02	0.03	0.00	0.09	0.07	0.01	24.18	0.33
170	314311	6385361	0.23	0.02	0.03	0.00	0.09	0.07	0.01	24.51	0.33
171	314373	6385414	0.22	0.02	0.03	0.00	0.09	0.07	0.01	23.96	0.32
172	314313	6385477	0.22	0.02	0.03	0.00	0.09	0.07	0.01	24.04	0.32
173	314296	6385518	0.21	0.02	0.03	0.00	0.09	0.07	0.01	23.95	0.32
174	314239	6385500	0.22	0.02	0.03	0.00	0.09	0.07	0.01	24.24	0.32
175	314234	6385548	0.21	0.02	0.02	0.00	0.09	0.07	0.01	24.14	0.32
176	314235	6385585	0.21	0.02	0.02	0.00	0.09	0.07	0.01	24.08	0.32
177	314251	6385448	0.22	0.02	0.03	0.00	0.09	0.07	0.01	24.45	0.32
178	314222	6385444	0.22	0.02	0.03	0.00	0.10	0.07	0.01	24.63	0.32
179	314189	6385440	0.22	0.02	0.02	0.00	0.10	0.07	0.01	24.84	0.32
180	314122	6385458	0.22	0.02	0.02	0.00	0.10	0.07	0.01	25.10	0.32
181	314079	6385477	0.21	0.02	0.02	0.00	0.10	0.07	0.01	25.20	0.32
182	314040	6385469	0.21	0.02	0.02	0.00	0.10	0.08	0.01	25.47	0.32
183	314001	6385475	0.21	0.02	0.02	0.00	0.10	0.08	0.01	25.63	0.32
184	313959	6385485	0.21	0.02	0.02	0.00	0.10	0.08	0.01	25.77	0.32
185	314176	6385559	0.21	0.02	0.02	0.00	0.09	0.07	0.01	24.37	0.32
186	313896	6385511	0.21	0.02	0.02	0.00	0.10	0.08	0.02	25.87	0.32
187	313851	6385669	0.20	0.02	0.02	0.00	0.10	0.07	0.01	25.40	0.31
188	313794	6385722	0.20	0.02	0.02	0.00	0.10	0.07	0.01	25.49	0.31
189	313983	6385746	0.20	0.02	0.02	0.00	0.09	0.07	0.01	24.64	0.31
190	313821	6385845	0.19	0.02	0.02	0.00	0.09	0.07	0.01	25.09	0.31
191	313789	6385632	0.20	0.02	0.02	0.00	0.10	0.08	0.01	25.92	0.31
192	313691	6385527	0.20	0.02	0.02	0.00	0.11	0.08	0.02	27.07	0.32

ID	Easting	Northing	PM_{10}		TSP	DD	CO (Scenario 1)			NO_2 (Scenario 1)	
Averaging period			24 hr	Annual	Annual	Annual	15 min	1 hr	8 hr	1 hr	Annual
Criteria			50	30	90	2	100	30	10	246	62
Unit			µg/m³			g/m²/mth	mg/m³			µg/m³	
193	313650	6385658	0.20	0.02	0.02	0.00	0.10	0.08	0.02	26.69	0.31
194	313664	6385734	0.19	0.02	0.02	0.00	0.10	0.08	0.01	26.25	0.31
195	313584	6385791	0.19	0.02	0.02	0.00	0.10	0.08	0.01	26.66	0.31
196	313481	6385649	0.19	0.02	0.02	0.00	0.11	0.09	0.02	28.40	0.31
197	313474	6385580	0.20	0.02	0.02	0.00	0.12	0.09	0.02	28.94	0.31
198	313285	6385713	0.18	0.02	0.02	0.00	0.12	0.09	0.02	30.45	0.31
199	313168	6385704	0.18	0.02	0.02	0.00	0.13	0.10	0.02	32.35	0.31
200	313047	6385801	0.17	0.02	0.02	0.00	0.13	0.10	0.02	32.77	0.30
201	312921	6385827	0.17	0.02	0.02	0.00	0.14	0.10	0.02	33.92	0.30
202	314047	6385806	0.19	0.02	0.02	0.00	0.09	0.07	0.01	24.39	0.31
203	315062	6386183	0.17	0.02	0.03	0.00	0.09	0.07	0.01	25.87	0.31
204	314707	6386133	0.17	0.02	0.02	0.00	0.09	0.07	0.01	25.13	0.31
205	313387	6386374	0.16	0.02	0.02	0.00	0.09	0.07	0.01	26.03	0.28
206	314587	6386587	0.15	0.02	0.02	0.00	0.10	0.07	0.01	27.59	0.30
207	313277	6386443	0.16	0.02	0.02	0.00	0.09	0.07	0.01	26.42	0.28
208	313409	6386489	0.15	0.02	0.02	0.00	0.09	0.07	0.01	25.80	0.28
209	313285	6386609	0.15	0.02	0.02	0.00	0.09	0.07	0.01	26.22	0.28
210	313570	6386800	0.14	0.02	0.02	0.00	0.09	0.07	0.01	25.28	0.27
211	315151	6385023	0.25	0.03	0.03	0.01	0.09	0.07	0.02	23.40	0.35
212	315098	6385164	0.24	0.03	0.03	0.01	0.09	0.07	0.01	23.11	0.34
213	321485	6376756	0.20	0.01	0.02	0.00	0.18	0.14	0.03	45.45	0.27
214	321419	6376728	0.20	0.01	0.02	0.00	0.17	0.13	0.03	44.04	0.25
215	326127	6388439	0.18	0.02	0.03	0.00	0.20	0.15	0.03	51.26	0.52
216	326523	6388306	0.18	0.02	0.03	0.00	0.18	0.14	0.03	47.07	0.46
217	326886	6388196	0.18	0.02	0.03	0.00	0.16	0.12	0.03	44.15	0.42
218	313501	6385740	0.19	0.02	0.02	0.00	0.11	0.08	0.02	27.64	0.31

APPENDIX 4

Soil Survey and Land Capability Assessment prepared by GSSE

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

SLR

Our Ref: Lt_633.10067_Soil Survey_Final

20th February 2013

Ralph Northey
Environment and Community Manager
Bulga Coal Complex
PMB 8 (567 Broke Road)
Singleton NSW 2330

Sent Via: Email Transmission

Dear Ralph,

RE: BULGA UNDERGROUND OPERATIONS – MODIFICATION PROJECT: SOIL SURVEY AND LAND CAPABILITY ASSESSMENT

1.0 INTRODUCTION

GSS Environmental (GSSE) was engaged by Bulga Coal Management Pty Ltd (BCM) in June 2012, on behalf of Bulga Joint Venture (BJV), to undertake a Land Capability Assessment for the Bulga Underground Operations (BUO) modification Project (the Project).

The Project is a modification to the approved Blakefield North Mine located approximately 12 kilometres (km) south-west of Singleton, in the Upper Hunter Valley of New South Wales (NSW). BCM is seeking to modify Development Consent DA 376-8-2003 pursuant to Section 75W of the Environmental Planning and Assessment Act, 1979 (EP&A Act) to allow for a revised longwall underground mine layout and associated infrastructure. The proposed Project modification area (Project Area) is approximately 710 ha (**Figure 1**). The Strategic Regional Land Use Plan (SRLUP) for the Upper Hunter (DPI, 2012) has mapped 252 hectares (ha) of land within the Project Area as potential Biophysical Strategic Agricultural Land (BSAL). The area under assessment is termed the Study Area and is 252 ha (**Figure 1**).

GSSE was commissioned to undertake an assessment to 'ground truth' the mapped BSAL within the Project Area according to Upper Hunter SRLUP. The assessment was comissioned prior to the release of the *Land and Soil Capability Assessment Scheme; Second approximation* (OEH, 2012a) and the *Interim Protocol for Site verification and Mapping of Biophysical Strategic Agriclural Land* (OEH, 2012b).

2.0 SOIL SURVEY ASSESSMENT: METHODOLOGY

2.1 Reference Map

An initial soil map (reference map) was developed using the following resources and techniques.

Aerial photographs and topographic maps

Aerial photo and topographic map interpretation was used as a remote sensing technique allowing detailed analysis of the landscape, and mapping of features expected to be related to the distribution of soils.

Reference information

Source materials were used to obtain correlations between pattern elements and soil properties that may be observable in the field. These materials included Cadastral data, prior and current physiographic, geological, vegetation, water resources studies, and the *Soil Landscapes of the Singleton 1:250,000 Sheet* (Kovac & Lawrie, 1991). A slope analysis of the Project Area was assessed to assist with soil distribution and Land and Soil Capability classification (**Figure 2**).

2.2 Field Survey Plan

The field survey was an integrated qualitative survey conducted in accordance with the *Guidelines for Surveying Soil and Land Resources* (NCST, 2008) and comprised of the following three survey observation types:

- Detailed profile descriptions (Class I observations);
- Laboratory assessed profiles (Class II observations); and
- Mapping observations (Class IV observations).

The type and density of survey observations across the Project Area that were utilised in this assessment are listed are shown in **Figure 3** and summarised in **Table 1**.

Table 1 – Soil Survey Observation Type and Density

Area	Survey Scale	Number and Types of Observation			
Description		Class I (cores)	Class II (laboratory)	Class IV (mapping)	Total
Soil Survey	1:25,000	20	11	20	**42**

Detailed Profile Description (Class I Observations)

Soil profiles were assessed in accordance with the *Australian Soil and Land Survey Field Handbook* (NCST, 2009). Each soil-profile exposure will be excavated by a soil corer to approximately 1.2 m, or to bedrock. After assessment, soil cores will be backfilled with the remaining soil. Detailed soil profile morphological descriptions recorded information that covered the parameters specified in **Table 2**.

Table 2 – Detailed Soil Profile Description Parameters

Descriptor	Application
Horizon depth	Weathering characteristics, soil development
Field colour	Permeability, susceptibility to dispersion/erosion
Field texture grade	Erodibility, hydraulic conductivity, moisture retention, root penetration
Boundary distinctness and shape	Erosional/dispositional status, textural grade
Consistence force	Structural stability, dispersion, ped formation
Structure pedality grade	Soil structure, root penetration, permeability, aeration
Structure ped and size	Soil structure, root penetration, permeability, aeration
Stones – amount and size	Water holding capacity, weathering status, erosional/depositional character
Roots – amount and size	Effective rooting depth, vegetative sustainability
Ants, termites, worms, etc.	Biological mixing depth

Soil Laboratory Assessment (Class II Observations)

The topsoil samples (0-10 cm) from 18 soil cores and 1 soil mapping observation were sent to the ALS Environmental Division (Brisbane Laboratory) for analysis. All samples were laboratory tested for the parameters in **Table 3**; the accompanying certificates of analysis are provided in **Attachment A**. The guide *Interpreting Soil Test Results* (Hazelton & Murphy, 2007) was used to interpret soil test results.

Table 3 – Detailed Soil Profile Description Parameters

Laboratory Analysis
• Electrical conductivity (EC) • pH • Cation Exchange Capacity (CEC) and exchangeable cations • Total Organic Carbon (TOC) • Nitrite plus Nitrate as N (NOx) • Total Nitrogen as N (TKN + NOx) • Total Sulfur Fluoride Extractable Phosphorus

Mapping Observations (Class IV Observations)

Mapping observations consisted of exposed cuttings (such as cut slopes), topsoil exposure of up to 0.3 m using a spade, vegetation cover associations, and rock outcrops. These were utilised to confirm mapping boundaries, soil type distributions and any other characteristics being mapped in the survey.

2.3 Soil Classification Nomenclature

The applicable technical standard for naming the types of soil identified is the *Australian Soil Classification* (ASC) system (Isbell, 1996).

Ref: **Figure 1**

Title:

Site Plan

Project: Bulga UG AIS

Client: Bulga Underground Operations Pty Ltd

Legend:

- Project Area
- Study Area
- SAL Biophysical

N

Source:

This map contains the Bing Maps aerial imagery web mapping service, which provides worldwide orthographic aerial and satellite imagery. Coverage varies by region.
(c) 2010 Microsoft Corporation and its data suppliers

Drawing No: 633.10067_Fg1_SitePlan_130220

Date: 20/02/2013 Drawing size: A4

Drawn by: NT Reviewed by: AC

Scale: 1:20,000

0 165 330 660
Meters

Maps and figures contained within this document may be based on third party data, may not be to scale and is intended for use as a guide only. GSSE does not warrant the accuracy of any such maps or figures.

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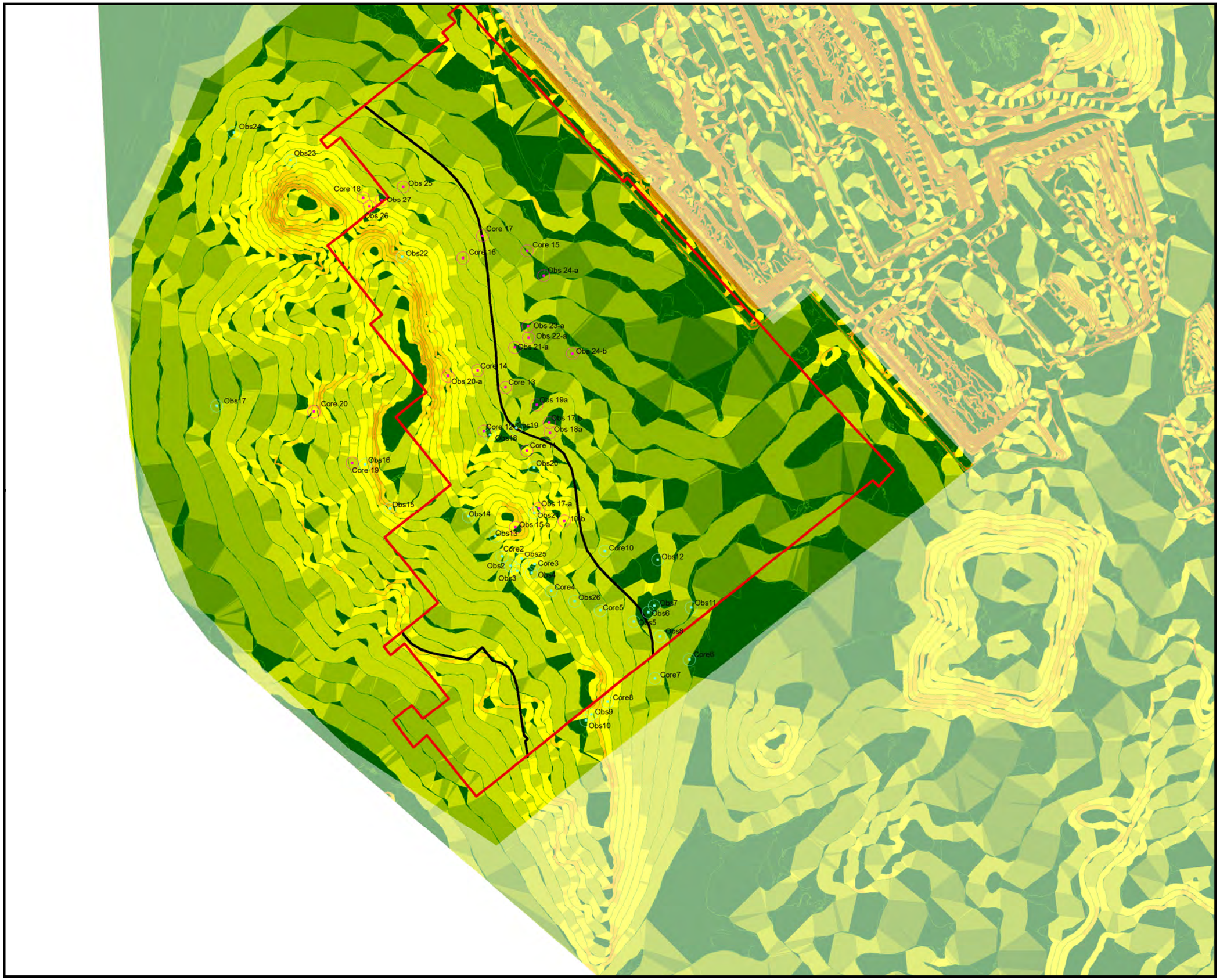
Path: V:\633.10067-Bulga UG AIS\Figures\GIS\ArcGIS\Map Documents\633.10067_Fg1_SitePlan_130220.mxd



Ref: **Figure 2**

Title: Slope Analysis

Project: Bulga UG AIS

Client: Bulga Undergorund Operation Pty Ltd

Legend:

- Extra Sampling Points
- Sampling Points
- Project Area
- Study Area
- Major Contours

Slope (%)

- 1
- 2
- 3
- 5
- 10
- 18
- 32
- 50
- 100
- 1000
- 1001

N

Source:

This map contains the Bing Maps aerial imagery web mapping service, which provides worldwide orthographic aerial and satellite imagery. Coverage varies by region.
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Drawing No: 633.10067_Fg2_SlopeAnalysis_130220

Date: 20/02/2013 Drawing size: A4

Drawn by: NT/LH Reviewed by: AC

Scale: 1:20,000

0 250 500 1,000
Meters

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Path: V:\633.10067-Bulga UG AIS\Figures\GIS\ArcGIS\Map Documents\633.10067_Fg2_SlopeAnalysis_130220.mxd

Ref: **Figure 3**

Title:

Field Survey Map

Project: Bulga UG AIS

Client: Bulga Underground Operations Pty Ltd

Legend:

- Extra Sampling Points
- Sampling Points
- Project Area
- SAL Biophysical

N

Source:

This map contains the Bing Maps aerial imagery web mapping service, which provides worldwide orthographic aerial and satellite imagery. Coverage varies by region.
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Drawing No: 633.10067_Fg3_FieldSurveyMap_130220

Date: 20/02/2013 Drawing size: A4

Drawn by: NT Reviewed by: AC

Scale: 1:20,000

0 165 330 660
Meters

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Path: V:\633.10067-Bulga UG AIS\Figures\GIS\ArcGIS\Map Documents\633.10067_Fg3_FieldSurveyMap_130220.mxd

3.0 SOIL SURVEY RESULTS

A total of 9 soil types were identified within the Study Area (**Figure 4**). Chromosols (54.9%) and Dermosols (24.5%) were the dominant soil types in the Study Area (**Table 4**). Representative soil samples for each soil type are described below.

Table 4 – Study Area: Soil Types Overview

Soil Type		Land Area	
		ha	%
1	Brown Chromosol	28	11.1
2	Yellowish-brown Chromosol / Sodosol	48	19.1
3	Reddish-brown Chromosol	8	3.2
4	Yellowish-brown Chromosol; shallow	44	17.5
5	Strong Brown Dermosol	18	7.1
6	Yellowish-red Chromosol	10	4.0
7	Reddish-brown Dermosol; moderate	22	8.7
8	Reddish-brown Dermosol; deep	22	8.7
9	Rudosol; Leptic	44	17.5
10	Tenosol; Leptic	8	3.2
Sub-total		**252**	**100.0**

3.1 Soil Type 1: Brown Chromosol

Brown Chromosols cover 28 ha (11.1%) of the Study Area. This representative soil profile is characterised by moderately structured sandy clay loam overlying strongly structured medium to heavy clay subsoil. Topsoil pH is neutral, non-sodic, non-saline and cation exchange capacity is moderate.

Table 5: Overview of Soil Type 1: Brown Chromosol

Plate 1: Profile (Core 5)

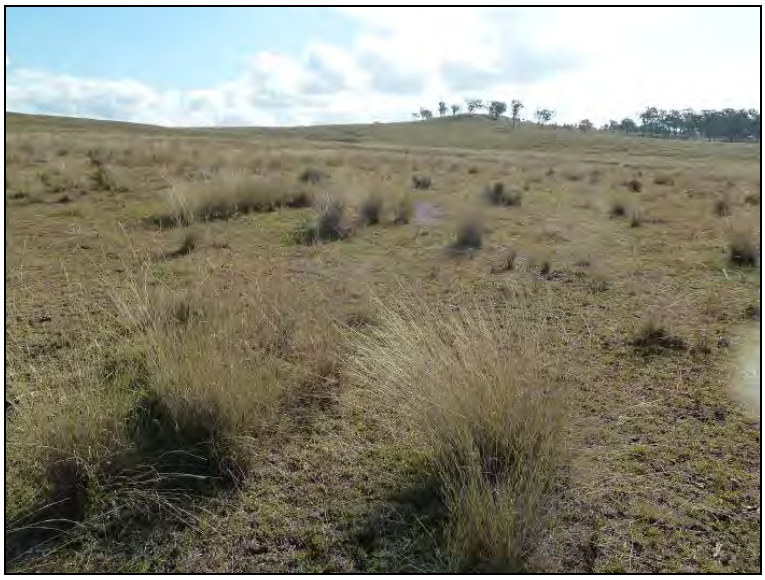

Plate 2: Landscape (Core 5)

Site Description	
ASC Name	Brown Chromosol
Great Soil Group	Brown Podzolic
Landscape Unit Association	Branxton
Slope Association	5-10%
Field Sites	2, 5, 6, 8 and 15
LSC Capability	Class 3; Main limitations – slope, soil acidity

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Brown sandy clay loam; moderate structure and 5-10 mm sub angular peds with moderate consistence; neutral pH (6.6). Rapidly drained with clear boundary.
B21	0.2-0.5	Brown medium to heavy clay; strong structure and blocky peds with very strong consistence. Nil segregations and stones; nil mottles. Gradual boundary.
B22	0.5-0.75+	Brown heavy clay; strong structure and blocky peds with very strong consistence. Ten percent small calcium carbonate nodules. Nil stones and nil mottles.

3.2 Soil Type 2: Yellowish-brown Chromosol / Sodosol

Yellowish-brown Chromosols / Sodosols cover 48 ha (19.1%) of the Study Area. This representative soil profile is characterised by apedal sandy loam overlying strongly structured heavy clay subsoil. Topsoil pH is slightly, non-sodic, slightly saline and cation exchange capacity is low.

Table 6: Overview of Soil Type 2: Yellowish-Brown Chromosol / Sodosol

Plate 3: Profile (Core 10b)

Plate 4: Landscape (Core 10b)

Site Description	
ASC Name	Yellowish-brown Chromosol / Sodosol
Great Soil Group	Yellow Soloth
Landscape Unit Association	Branxton
Slope Association	3-5%
Sampled Site(s)	9, 10a and 10b
LSC Capability	Class 4; Main limitations – soil acidity, soil depth

Physical Characteristics		
Description		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Very dark grayish-brown sandy loam; apedal structure and 5 mm granular peds with weak consistence. Slightly acidic (pH 6.1). Nil stones; nil mottles. Well drained with a clear and even boundary.
A2	0.2-0.3	Brown sandy clay loam; strong structure and 20 mm sub angular peds with moderate consistence. Nil stones; nil mottles. Well drained with an abrupt and even boundary.
B21	0.3-0.7	Yellowish-brown heavy clay; strong structure with strong consistence. Strongly acidic (pH 5.5*). Nil stones; some orange (20%) and grey (10%) mottling. Poorly drained with a gradual boundary.
BC	0.7+	Weathering rock.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.3 Soil Type 3: Reddish-brown Chromosol

Reddish-brown Chromosols cover 8 ha (3.2%) of the Study Area. This representative soil profile is characterised by strong structured loam overlying strongly structured heavy clay subsoil. Topsoil pH is neutral, non-sodic, non-saline and cation exchange capacity is moderate.

Table 7: Overview of Soil Type 3: Reddish-brown Chromosol

Plate 5: Profile (Core 13)

Plate 6: Landscape (Core 13)

Site Description	
ASC Name	Reddish-brown Chromosol
Great Soil Group	Red Podzolic
Landscape Unit Association	Branxton
Slope Association	5-10%
Sampled Site(s)	13
LSC Capability	Class 4; Main limitations – soil acidity

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Dark brown loam; moderate structure and 5 mm granular peds with moderate consistence. Neutral (pH 6.6). Nil stones; nil mottles. Well drained with an abrupt and even boundary.
B1	0.2-0.3	Dark reddish-brown light-medium clay; strong structure and 10-20 mm peds with moderate consistence. Nil stones; nil mottles. Well drained with a clear and even boundary.
B2	0.3-0.6	Reddish-brown heavy clay; strong structure and 100 mm peds with strong consistence. Moderately acidic (pH 6.0*). Some (10%) stones less than 20 mm; nil mottles. Well drained with a gradual boundary.
B3	60-80	Weathering bedrock.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.4 Soil Type 4: Yellowish-brown Chromosol; Shallow

Yellowish-brown Chromosols (Shallow) cover 44 ha (17.5%) of the Study Area. This representative soil profile is characterised by strong structured loam overlying moderately structured medium clay subsoil. Topsoil pH is moderately alkaline, non-sodic, moderately saline and cation exchange capacity is high.

Table 8: Overview of Soil Type 3: Reddish-brown Chromosol

Plate 7: Profile (Core 14)

Plate 8: Landscape (Core 14)

Site Description	
ASC Name	Yellowish-brown Chromosol; Shallow
Great Soil Group	Yellow Podzolic
Landscape Unit Association	Branxton
Slope Association	10-18%
Sampled Site(s)	14
LSC Capability	Class 4; Main limitations – slope, soil acidity, soil depth

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Brown loam; strong structure and 5 mm granular peds with moderate consistence. Well drained with an abrupt and even boundary and moderately alkaline (pH 7.9). Nil stones; nil mottles.
B2	0.2-0.5	Yellowish-brown medium clay; moderate structure and 20 mm angular peds with moderate consistence. Strongly acidic to neutral (pH 5.5*). Some (20%) stones 20-50 mm; nil mottles. Poorly drained with an abrupt boundary.
BC	0.5-0.6	Bedrock.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.5 Soil Type 5: Strong Brown Dermosol

Strong Brown Dermosols cover 18 ha (7.1%) of the Study Area. This representative soil profile is characterised by strong structured light clay overlying strongly structured medium clay subsoil. Topsoil pH is neutral, non-sodic, slightly saline and cation exchange capacity is moderate.

Table 9: Overview of Soil Type 5: Strong Brown Dermosol

Plate 9: Profile (Core 17)

Plate 10: Landscape (Core 17)

Site Description	
ASC Name	Strong Brown Dermosol
Great Soil Group	Chocolate Soils
Landscape Unit Association	Saxonvale influenced
Slope Association	5-10%
Sampled Site(s)	16 and 17
LSC Capability	Class 4; Main limitations – soil depth

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Dark grayish-brown light clay; strong structure and 10-20 mm sub angular peds with moderate consistence. Neutral (pH 6.9). Nil stones; nil mottles. Well drained with a clear boundary.
B2	0.2-0.5	Strong Brown medium clay; strong structure and 100 mm blocky peds with strong consistence. Moderately acidic to neutral (pH 6.0-7.0*). Some (5%) stones less than 5mm; some orange (20%) mottling. Gradual boundary
B3	0.5+	Weathering bedrock.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.6 Soil Type 6: Yellowish-red Chromosol

Yellowish-red Chromosols cover 140 ha (4.0%) of the Study Area. This representative soil profile is characterised by strongly structured clay loam overlying strongly structured medium clay subsoil. Topsoil pH is neutral, non-sodic, non-saline and cation exchange capacity is moderate.

Table 10: Overview of Soil Type 6: Yellowish-red Chromosol

Plate 11: Profile (Core 18)

Plate 12: Landscape (Core 18)

Site Description	
ASC Name	Yellowish-red Chromosol
Great Soil Group	Red Podzolic
Landscape Unit Association	Branxton
Slope Association	5-10%
Sampled Site(s)	18
LSC Capability	Class 4; Main limitations – soil acidity

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.1	Dark reddish-brown clay loam; strong structure and 20 mm sub angular peds with moderate consistence. Neutral (pH 6.6). Some stones (5%); nil mottles. Moderately drained with a clear boundary.
B1	0.1-0.3	Reddish-brown light clay; strong structure and 20-50 mm angular peds with strong consistence. Moderately acidic (pH 6.0*). Nil stones; Some (50%) orange / brown mottling. Moderate to poorly drained with a gradual boundary.
B2	0.3-0.5+	Yellowish-brown medium to heavy clay; strong structure and 20-50 mm angular peds with strong consistence. Moderately acidic (pH 6.0*). Nil stones; Some (20%) grey mottling. Poorly drained.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.7 Soil Type 7: Reddish-brown Dermosol; moderate

Reddish-brown Dermosols; moderate cover 22 ha (8.7%) of the Study Area. This representative soil profile is characterised by strongly structured sandy loam to sandy clay loam overlying strongly structured sandy clay subsoil. Topsoil pH is neutral, non-sodic, moderately non-saline and cation exchange capacity is moderate.

Table 11: Overview of Soil Type 7: Reddish-brown Dermosol; moderate

Plate 13: Profile (Core 19)

Plate 14: Landscape (Core 19)

Site Description	
ASC Name	Reddish-brown Dermosol; moderate
Great Soil Group	Red Podzolic
Landscape Unit Association	Branxton
Slope Association	5-10%
Sampled Site(s)	19
LSC Capability	Class 4; Main limitations – soil acidity, soil depth

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Dark reddish-brown sandy loam to sandy clay loam; strong structure and 20 mm sub angular peds with moderate consistence. Neutral (pH 6.7). Nil stones; nil mottles. Well drained.
B1	0.2-0.6	Reddish-brown sandy clay; strong structure and 20-50 mm sub angular peds with strong consistence. Moderately acidic (pH 6.0*). Nil stones; nil mottles. Poorly drained.
B3	0.6+	Weathering bedrock.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.8 Soil Type 8: Reddish-brown Dermosol; deep

Reddish-brown Dermosols; deep cover 22 ha (8.7%) of the Study Area. This representative soil profile is characterised by strongly structured clay loam overlaying a light-medium clay. Topsoil has a neutral pH, moderate to high salinity, non-sodic and cation exchange capacity is moderate.

Table 12: Overview of Soil Type 8: Reddish-brown Dermosol; deep

Plate 15: Profile (Core 20)

Plate 16: Landscape (Core 20)

Site Description	
ASC Name	Reddish-brown Dermosol; deep
Great Soil Group	Red Podzolic
Landscape Unit Association	Branxton
Slope Association	5-10%
Sampled Site(s)	20
LSC Capability	Class 4; Main limitations – soil acidity

Physical Characteristics		
Horizon	**Depth (m)**	**Description**
A1	0-0.2	Dark reddish-brown clay loam; strong structure. Neutral (pH 7.1). Nil stones; nil mottles. Well drained.
B1	0.2-1.0+	Reddish-brown light-medium clay. Moderately acidic (pH 6.0*). Nil stones; nil mottles.

** Correlated with Soil Landscapes of Singleton 1:250,000 Sheet (Kovac & Lawrie, 1991)*

3.9 Soil Type 9: Rudosol; Leptic

Rudosols; Leptic cover 44 ha (17.5%) of the Study Area. This representative soil type is associated with sedimentary sandstone outcrops.

Table 13: Overview of Soil Type 9: Rudosol; Leptic

Plate 17: Profile (Obs 15)

Plate 18: Landscape (Obs 15)

Site Description	
ASC Name	Rudosol; Leptic
Great Soil Group	Lithosol
Slope Association	10-18%
Sampled Site(s)	Obs 15
LSC Capability	Class 6; Main limitations - rock outcrop, soil depth

3.10 Soil Type 10: Tenosol; Leptic

Tenosols; Leptic cover 8 ha (3.2%) of the Study Area. This representative soil type is associated with crest of the dolerite sill.

Table 14: Overview of Soil Type 10: Tenosol; Leptic

Plate 19: Surface Rock

Plate 20: Landscape

Site Description	
ASC Name	Tenosol; Leptic
Great Soil Group	Lithosol
Slope Association	0-10%
LSC Capability	Class 6; Main limitations - rock outcrop, soil depth

Ref: **Figure 4**

Title:

Bulga Study Area - Soil Map

Project: Soils Classifications

Client: Bulga Underground Operations Pty Ltd

Legend:

- Extra Sampling Points
- Sampling Points
- Project Area
- Study Area

Study Area Soil Types

- Brown Chromasol
- Reddish-Brown Chromasol
- Yellowish-Brown Chromasol/Sodasol
- Yellowish-Red Chromosol
- Reddish-Brown Dermosol; Deep
- Reddish-Brown Dermosol; Moderate
- Yellowish-Brown Chromosol; Shallow
- Strong-Brown Dermosol
- Rudosol; Leptic
- Tenosol; Leptic

N

Source:

This map contains the Bing Maps aerial imagery web mapping service, which provides worldwide orthographic aerial and satellite imagery. Coverage varies by region.
(c) 2010 Microsoft Corporation and its data suppliers

Drawing No: 633.10067_Fg4_Soil Map_130220

Date: 20/02/2013 Drawing size: A4

Drawn by: NT/LH Reviewed by: AC

Scale: 1:20,000

0 165 330 660
Meters

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Path: V:\633.10067-Bulga UG AIS\Figures\GIS\ArcGIS\Map Documents\633.10067_Fg4_Soil Map_130220.mxd

4.0 Land Assessment

In NSW, rural lands are currently being mapped according the NSW Office of Environment and Heritage (OEH) *Land and Soil Capability Assessment Scheme; Second approximation* (OEH, 2012a) and classifies land into eight classes (Classes 1 to 8) known as LSC classes. The LSC classification then forms an integral part of BSAL Assessment. Therefore the Study Area has been assessed for both:

- Land and Soil Capability (LSC); and
- Biophysical Strategic Agricultural Land (BSAL).

4.1 Land and Soil Capability

4.1.1 Land and Soil Capability Methodology

The LSC classification applied to the Study Area was in accordance with the OEH guideline *The Land and Soil Capability Assessment Scheme; Second approximation* (OEH, 2012a) (referred to as the LSC Guideline). This scheme uses the biophysical features of the land and soil to derive detailed rating tables for a range of land and soil hazards. The scheme consists of eight classes, which classify the land based on the severity of long-term limitations. The LSC classes are described in **Table 15** and their definition has been based on two considerations:

- The biophysical features of the land to derive the LSC classes associated with various hazards; and
- The management of the hazards including the level of inputs, expertise and investment required to manage the land sustainably.

Table 15 – Land and Soil Capability Classes

Class	Land and Soil Capability
Land capable of a wide variety of land uses (cropping, grazing, horticulture, forestry, nature conservation)	
1	**Extremely high capability land**: Land has no limitations. No special land management practices required. Land capable of all rural land uses and land management practices.
2	**Very high capability land**: Land has slight limitations. These can be managed by readily available, easily implemented management practices. Land is capable of most land uses and land management practices, including intensive cropping with cultivation.
3	**High capability land**: Land has moderate limitations and is capable of sustaining high-impact land uses, such as cropping with cultivation, using more intensive, readily available and widely accepted management practices. However, careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation.
Land capable of a variety of land uses (cropping with restricted cultivation, pasture cropping, grazing, some horticulture, forestry, nature conservation)	
4	**Moderate capability land**: Land has moderate to high limitations for high-impact land uses. Will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture. These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology.
5	**Moderate–low capability land**: Land has high limitations for high-impact land uses. Will largely restrict land use to grazing, some horticulture (orchards), forestry and nature conservation. The limitations need to be carefully managed to prevent long-term degradation.
Land capable for a limited set of land uses (grazing, forestry and nature conservation, some horticulture)	
6	**Low capability land**: Land has very high limitations for high-impact land uses. Land use restricted to low-impact land uses such as grazing, forestry and nature conservation. Careful management of limitations is required to prevent severe land and environmental degradation
Land generally incapable of agricultural land use (selective forestry and nature conservation)	
7	**Very low capability land**: Land has severe limitations that restrict most land uses and generally cannot be overcome. On-site and off-site impacts of land management practices can be extremely severe if limitations not managed. There should be minimal disturbance of native vegetation.
8	**Extremely low capability land**: Limitations are so severe that the land is incapable of sustaining any land use apart from nature conservation. There should be no disturbance of native vegetation

Source: The Land and Soil Capability Assessment Scheme; second approximation (OEH, 2012a)

Calculating LSC Classes

The biophysical features of the land that are associated with various hazards are broadly soil, climate and landform and more specifically: slope, landform position, acidity, salinity, drainage, rockiness; and climate.

The eight (8) hazards associated with these biophysical features that are assessed by the scheme are:

1. Water erosion
2. Wind erosion
3. Soil structure decline
4. Soil acidification
5. Salinity
6. Water logging
7. Shallow soils and rockiness
8. Mass movement

Each hazard is assessed against set criteria tables, as described in the LSC Guideline; each hazard for the land is ranked from 1 through to 8 with the overall ranking of the land determined by its most significant limitation.

Hazard 1: Water Erosion

The Study Area lies within the Eastern and Central NSW Division, and the appropriate criteria for this division were used in the assessment. Assessment of water erosion hazard is almost solely dependent on the slope percentage of the land , based on each soil landscape unit. The only exception is land which falls within the slope range of 10-20%, which may be designated Class 4 or 5 depending on the presence of gully erosion and/or sodic/dispersible soils.

Hazard 2: Wind Erosion

There are four factors used to assess wind erosion hazard for each soil type. Three criteria were assessed to be consistent for each soil type:

- Wind erosive power for the Study Area has been mapped as 'low' (NSW Department of Trade and Investment);
- Exposure of the land to wind was also determined to be "Moderate" throughout the Study Area; and
- The average rainfall for the region is 655 mm (BOM, 2013), and therefore the Study Area lies within the "greater than 500 mm rainfall" category.

The determining factor with regard to wind erosion hazard was therefore the erodibility of each soil type as determined by soil texture according the LSC Guideline.

Hazard 3: Soil Structure Decline

Soil structure decline is assessed on soil characteristics, including surface soil texture, sodicity (laboratory tested) and degree of self-mulching (field tested). These parameters assess the soil structure, stability and resilience of the soil.

Hazard 4: Soil Acidification

The soil acidification hazard is assessed using three criteria, soil buffering capacity, pH and mean annual rainfall. In this assessment, soil buffering capacity was based on soil Great Soil Group; surface soil pH and a regional mean annual rainfall range of 700-900 mm.

Hazard 5: Salinity

The salinity hazard is determined through a range of data and criteria. The recharge potential for the site was determined based on an average annual rainfall of 655 mm, with annual evaporation of 1400-1600 mm (BOM, 2013). This would suggest a low recharge potential.

Based on the annual rainfall data (655 mm) and an average annual evapotranspiration of 800-900 mm, a moderate discharge potential for the site due to a likely balanced rate of water flow.

The Study Area according to the Salt Store Map of NSW, is located in area of low salt store. However, due the current available scale of this mapping, laboratory tested EC values were used to determine salt store.

Hazard 6: Water Logging

Water logging was determined by the soils drainage characteristics, specifically field sample evidence of mottling, soil texture attributes as well as slope and climate.

Hazard 7: Shallow Soils and Rockiness

The shallow soils and rockiness hazard is determined by an estimated exposure of rocky outcrops and average soil depth.

Hazard 8: Mass Movement

The mass movement hazard is assessed through a combination of three criteria; mean annual rainfall, presence of mass movement and slope class.

4.1.2 Land and Soil Capability Assessment

As listed in **Table 16**, the Study Area has been assessed and classified into the LSC Classes of 4 and 6. The limitations associated with each land Class are discussed below and shown in **Figure 5**.

Table 16 – Land and Soil Capability Assessment

Soil Types		Hazard Criteria								
		1	2	3	4	5	6	7	8	Overall
		Water erosion	Wind erosion	Struct -ure	Acidity	Salinity	Water-logging	Soil depth	Move -ment	Class
1	Brown Chromosol	3	1	3	3	1	2	1^	1	**3**
2	Yellowish-brown Chromosol / Sodosol	3	2	3	4	1	2	4	1	**4**
3	Reddish-brown Chromosol	3	1	3	4	1	2	3	1	**4**
4	Yellowish-brown Chromosol; shallow	4	1	3	4	3	2	4	1	**4**
5	Strong Brown Dermosol	3	1	3	3	1	2	4	1	**4**
6	Yellowish-red Chromosol	3	1	3	4	1	2	1^	1	**4**
7	Reddish-brown Dermosol; moderate	3	1	3	4	3	2	4	1	**4**
8	Reddish-brown Dermosol; deep	3	2	3	4	3	2	1	1	**4**
9	Rudosol; Leptic	4	2	3	*	*	2	6	1	**6**
10	Tenosol; Leptic	3	2	3	*	*	2	6	1	**6**

* *Insufficient information to assess.*

^ *Depth to bedrock not known assumed best case scenario*

Class 3 Land

This classification indicates that the land is highly capable of high-impact land uses, such as cultivation and grazing. Careful management of limitations is required for cropping and intensive grazing to avoid land and environmental degradation. The primary constraints to this land class are slope and soil acidity.

Class 4 Land

This classification indicates that the land is moderately capable for a range of land uses, and specialised practices are necessary to overcome very severe limitations. The primary constraints to this land class are soil acidity and soil depth.

Class 6 Land

This classification indicates that the land has low capability for a most land uses, and is limited to grazing, forestry and nature conservation. The primary constraint to this land class is rock outcrop and soil depth.

4.2 Biophysical Strategic Agricultural Land

The NSW Government recently released the Strategic Regional Land Use Policy to assist the development of a long-term strategy for continued progress of the mining industry that also ensures local community sustainability and on-going viability of existing industries. Part of this policy is the development of Strategic Regional Land Use Plans, which includes the determination of Biophysical Strategic Agricultural Land (BSAL), defined as areas with unique natural resource characteristics.

As discussed earlier, the *Strategic Regional Land Use Plan (SRLUP) for the Upper Hunter* (DP&I, 2012) has mapped 252 ha within the Project Area as being “Biophysical Strategic Agricultural Land (BSAL)”.

There are currently two documents pertaining to the assessment of BSAL, the Upper Hunter SRLUP (DP&I 2012) and the *Interim Protocol for Site verification and mapping of biophysical strategic agricultural land* (OEH, 2012b). Although there is significant overlap between the two documents, there is differing BSAL assessment criteria contained in both, therefore a BSAL assessment has been undertaken using both documents.

4.2.1 BSAL Assessment Using SRLUP for the Upper Hunter

The values and criteria that relate to BSAL are outlined in **Table 17**. This assessment used these criteria to assess BSAL in the Study Area according to the *SRLUP for the Upper Hunter* (DP&I, 2012).

Table 17 – BSAL Values and Criteria: SRLUP for Upper Hunter

	Criteria
•	Land that falls under soil fertility classes "high", "moderately high" under the Draft Inherent General Fertility of NSW (OEH, 2011a); and
•	Land capability classes I, II or III under the Land and Soil Capability Mapping of NSW (OEH); and
•	Reliable water of suitable quality, characterised by land having rainfall of greater than 350 mm per annum (9 out of 10 years) or land within 150 m of the following surface or groundwater resource: a regulated river; or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers, or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5 L/s and total dissolved solids of less than 1,500 mg/L.
	Or
•	Land that falls under soil fertility classes "moderate" under the Draft Inherent General Fertility of NSW (OEH, 2011a); and
•	Land capability classes I or II under the Land and Soil Capability Mapping of NSW (OEH); and
•	Reliable water of suitable quality, characterised by land having rainfall of greater than 350 mm per annum (9 out of 10 years) or land within 150 m of the following surface or groundwater resource: a regulated river; or unregulated rivers where there are flows for at least 95% of the time (i.e. the 95th percentile flow of each month of the year is greater than zero) or 5th order and higher rivers, or groundwater aquifers (excluding miscellaneous alluvial aquifers, also known as small storage aquifers) which have a yield rate greater than 5 L/s and total dissolved solids of less than 1,500 mg/L.

Source: DP&I, 2012

BSAL Assessment Results

The minimum requirement for rainfall reliability for the region was met for the Study Area (refer **Section 2.1**); therefore, the LSC and fertility class were further assessed in this section. To do this, this assessment compares the LSC Classes against the soil units fertility attributes to determine if the BSAL criteria, as specified in **Table 17**, are met in the Study Area. The soil fertility and the outcomes of the BSAL assessment are shown below in **Table 18**.

Table 18 – Applied BSAL Criteria: SRLUP for the Upper Hunter

Soil Type		Great Soil Group	LSC	Fertility*	BSAL	BSAL Limitation
1	Brown Chromosol	Brown Podzolic	**3**	Moderate	No	Fertility
2	Yellowish-brown Chromosol / Sodosol	Yellow Soloth	**4**	Moderately low	No	LSC class & fertility
3	Reddish-brown Chromosol	Red Podzolic	**4**	Moderately low	No	LSC class & fertility
4	Yellowish-brown Chromosol; shallow	Yellow Podzolic	**4**	Moderately low	No	LSC class & fertility
5	Strong Brown Dermosol	Chocolate soils	**4**	Moderately High	No	LSC class
6	Yellowish-red Chromosol	Red Podzolic	**4**	Moderately low	No	LSC class & fertility
7	Reddish-brown Dermosol; moderate	Red Podzolic	**4**	Moderately low	No	LSC class & fertility
8	Reddish-brown Dermosol; deep	Red Podzolic	**4**	Moderately low	No	LSC class & fertility
9	Rudosol; Leptic	Lithosol	**6**	Low	No	LSC class & fertility
10	Tenosol; Leptic	Lithosol	**6**	Low	No	LSC class & fertility

** Correlated based on Great Soil Group*

Whilst the Study Area both meet the minimum rainfall, the fertility class and LSC classifications for each soil type indicate that the soil resources do not qualify as BSAL.

4.2.2 BSAL Assessment Using Interim Protocol for Site Verification

This methodology used the twelve step site verification criteria listed within the Interim Protocol for Site Verification, which are summarised in **Table 19**. If a criterion fails to meet any of the BSAL conditions, the site is rejected as BSAL and the remaining conditions are not assessed.

Table 19 – Twelve Step Site Verification Criteria According to Interim Protocol

Step Number	Criteria	BSAL Definition
1	Reliable Water Supply	Greater than 350 mm annual rainfall (9 out of 10 years), or underlain by ground water acquifer with yield greater than 5L/s and total dissolved solids less than 1,500 mg/L
2a	Slope	Slope of less than or equal to 12%
2b	Slope	Slope of less than 5% (if yes, go to 3a – if no, go to 3b)
3a	Rock Outcrop	Are there nil rock outcrops (if yes, go to 4a – if no, go to 3b)
3b	Rock Outcrop	Rock outcrop of less than 30% (if yes, go to 4b)
4a	Soil Type	Soil which has naturally moderate fertility (if yes, go to 5 – if no, go to 4b)
4b	Soil Type	Soil which has naturally high or moderately high fertility
5	Surface Rockiness	Less than 20% of the area has unattached rock fragments greater than 60 mm diameter
6	Gilgai	Less than 50% of the area has gilgai depression that are deeper than 500 mm
7	Soil Depth	Soil depth greater than 750 mm
8	Drainage	Soil must not be poorly or very poorly drained soils
9	pH	pH within range of 5.0 to 8.9 when measured in water or pH within range of 4.2 to 8.1 when measured in calcium chloride.
10	Soil Salinity	Electrical conductivity in a saturated extract (ECe) less than or equal to 4 dSm/m or if gypsum is present, chlorides less than 800 mg/kg
11	Soil Water Storage	Soil must be able to store more than or equal to 75 mm of water to effective soil depth of 1 metre or less
12	Minimum Area	Soil must have a contiguous area of greater or equal to 20 Ha

Source: OEH, 2012b

BSAL Assessment Results

All Soil Types were rejected as BSAL at various steps of the *Interim Protocol for Site verification and mapping of biophysical strategic agricultural land* (OEH, 2012b); the limiting step(s) for each Soil Type is shown in **Table 20**.

Table 20 – Applied BSAL Criteria: Interim Protocol for Site Verification

Soil Type		Limiting Site Verification Criteria		BSAL
		Step	Reason(s)	
1	Brown Chromosol	4b	Slope greater than 5% Soil fertility is less than moderately high	No
2	Yellowish-brown Chromosol / Sodosol	4b	Soil fertility is less than moderate	No
3	Reddish-brown Chromosol	4b	Slope greater than 5% Soil fertility is less than moderately high	No
4	Yellowish-brown Chromosol; shallow	2a	Slope greater than 12%	No
5	Strong Brown Dermosol	7	Slope greater than 5% Soil depth is less than 750 mm	No
6	Yellowish-red Chromosol	4b	Slope greater than 5% Soil fertility is less than moderately high	No
7	Reddish-brown Dermosol; moderate	4b	Slope greater than 5% Soil fertility is less than moderately high	No
8	Reddish-brown Dermosol; deep	4b	Slope greater than 5% Soil fertility is less than moderately high	No
9	Rudosol; Leptic	3b	Rock outcrop greater than 30%	No
10	Tenosol; Leptic	3b	Rock outcrop greater than 30%	No

4.2.3 Biophysical Strategic Agricultural Land Summary

As discussed two BSAL assessments have been completed due to differing BSAL assessment criteria contained in both the *Strategic Regional Land Use Plan for the Upper Hunter* (DP&I, 2012) and the *Interim Protocol for Site verification and mapping of biophysical strategic agricultural land* (OEH, 2012b). Both assessments determined that no BSAL is present within the Study Area.

Ref: **Figure 5**

Title: Bulga Study Area - Land and Soil Capability

Project: Soils Classifications

Client: Bulga Underground Operations Pty Ltd

Legend:

- Extra Sampling Points
- Sampling Points
- Project Area
- Study Area

Land and Soil Capability

- Class 3
- Class 4
- Class 6

N

Source:

This map contains the Bing Maps aerial imagery web mapping service, which provides worldwide orthographic aerial and satellite imagery. Coverage varies by region.
(c) 2010 Microsoft Corporation and its data suppliers

Drawing No: 633.10067_Fg5_Land & Soil Capability_130220

Date: 20/02/2013 Drawing size: A4

Drawn by: NT/LH Reviewed by: AC

Scale: 1:20,000

0 165 330 660
Meters

GSS ENVIRONMENTAL
Environmental, Land and Project Management Consultants

Path: V:\633.10067-Bulga UG AIS\Figures\GIS\ArcGIS\Map Documents\633.10067_Fg5_Land & Soil Capability_130220.mxd

5.0 SUMMARY

This Soil Survey and Land Capability Assessment has been prepared in accordance with the *Guidelines for Surveying Soil and Land Resources* (NCST, 2008). The key findings of this assessment are listed below.

- The Study Area is 252 ha of land within the Bulga Underground Operations Modification Project Area that has been mapped as Biophysical Strategic Agricultural Land according to the *Strategic Regional Land Use Plan for the Upper Hunter* (DPI, 2012).

- The Study Area is covered by 8 different soil types, with Chromosols (54.9%) and Dermosols (24.5%) the most dominant.

- The Land and Soil Capability Assessment determined that the majority of the Study Area is Class 4 (172 ha, 68.3%), which is moderately capable land which has high limitations for high-impact land use such as cropping or high intensity grazing. The remaining land is Class 3 (28 ha, 11.1%), which has high capability for managed cultivation and grazing, and Class 6 (52 ha, 20.7%), which has low capability and only suitable for low-impact grazing, forestry or nature conservation.

- Using both the *Strategic Regional Land Use Plan for the Upper Hunter* (DPI, 2012) and *Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* (OEH, 2012b), the Study Area was determined not to be Biophysical Strategic Agricultural Land.

Yours Faithfully,
GSS ENVIRONMENTAL

Adele Calandra
Senior Environmental Scientist

6.0 REFERENCES

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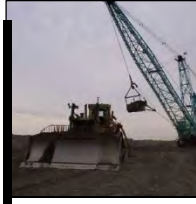
The National Committee on Soil and Terrain (NCST) (2008) *Guidelines for Surveying Soil and Land Resources* (CSIRO, Australia)

The National Committee on Soil and Terrain (NCST) (2009) *Australian Soil and Land Survey Field Handbook*, 3rd edition (CSIRO, Australia).

Certificate of Analysis:
Soil Laboratory Assessment








ATTACHMENT A

Environmental Division

CERTIFICATE OF ANALYSIS

Work Order	: **EB1216794**	Page	: 1 of 6
Client	: **GSS ENVIRONMENTAL**	Laboratory	: Environmental Division Brisbane
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Project	: XCN06-043	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 26-JUN-2012
Sampler	: AC & MH	Issue Date	: 11-JUL-2012
Site	: ----		
		No. of samples received	: 19
Quote number	: BN/039/12 V2	No. of samples analysed	: 19

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Metals Production Chemist	Brisbane Inorganics
Andrew Epps	Metals Production Chemist	Stafford Minerals - AY
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General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	Obs -25 0-10cm	C-02 0-10cm	C-03 0-10cm	C-04 0-10cm	C-05 0-10cm
			Client sampling date / time	14-JUN-2012 15:00	14-JUN-2012 15:00	14-JUN-2012 15:00	14-JUN-2012 15:00	14-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EB1216794-001	EB1216794-002	EB1216794-003	EB1216794-004	EB1216794-005
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.6	6.5	5.9	6.0	6.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	49	15	38	28	19
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	20.3	16.4	24.8	19.1	19.8
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	12.5	3.7	5.7	10.5	7.7
Exchangeable Magnesium	----	0.1	meq/100g	8.8	2.2	3.6	3.2	5.3
Exchangeable Potassium	----	0.1	meq/100g	1.4	0.9	1.0	0.8	1.1
Exchangeable Sodium	----	0.1	meq/100g	0.1	<0.1	<0.1	<0.1	0.1
Cation Exchange Capacity	----	0.1	meq/100g	22.8	6.9	10.5	14.6	14.2
Exchangeable Sodium Percent	----	0.1	%	0.6	0.7	0.6	0.3	0.9
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	0.01	0.03	0.02	0.02
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.4	0.5	7.4	7.1	0.5
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	1290	1820	3170	4340	1910
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	1290	1820	3180	4350	1910
EK074: Fluoride Extractable Phosphorus (Bray)								
Fluoride Extractable P (Bray)	----	1.0	mg/kg	<1.0	2.6	4.8	6.7	1.0
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	1.46	2.31	2.75	2.37	2.63

Analytical Results

Sub-Matrix: **SOIL** (Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	C-06 0-10cm	C-08 0-10cm	C-09 0-10cm	C-10a 0-10cm	C-10b 0-10cm
				Client sampling date / time	14-JUN-2012 15:00	14-JUN-2012 15:00	14-JUN-2012 15:00	21-JUN-2012 15:00	21-JUN-2012 15:00
					EB1216794-006	EB1216794-007	EB1216794-008	EB1216794-009	EB1216794-010
EA002 : pH (Soils)									
pH Value	----	0.1	pH Unit		6.5	6.1	6.4	6.1	6.1
EA010: Conductivity									
Electrical Conductivity @ 25°C	----	1	µS/cm		19	48	22	27	23
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1.0	%		16.4	17.9	17.2	16.7	11.8
ED008: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		5.3	7.0	3.2	3.2	4.6
Exchangeable Magnesium	----	0.1	meq/100g		4.2	3.0	3.2	2.3	2.9
Exchangeable Potassium	----	0.1	meq/100g		0.8	1.3	0.6	0.7	0.7
Exchangeable Sodium	----	0.1	meq/100g		<0.1	0.1	<0.1	<0.1	<0.1
Cation Exchange Capacity	----	0.1	meq/100g		10.3	11.4	7.1	6.3	8.2
Exchangeable Sodium Percent	----	0.1	%		0.7	1.0	1.1	0.9	0.9
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		0.01	0.02	0.02	0.02	0.02
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg		0.3	15.8	0.6	1.8	3.5
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	20	mg/kg		1340	3980	1840	1750	2450
EK062: Total Nitrogen as N (TKN + NOx)									
^ Total Nitrogen as N	----	20	mg/kg		1340	4000	1840	1750	2450
EK074: Fluoride Extractable Phosphorus (Bray)									
Fluoride Extractable P (Bray)	----	1.0	mg/kg		1.1	6.4	1.6	1.4	3.8
EP003: Total Organic Carbon (TOC) in Soil									
Total Organic Carbon	----	0.02	%		1.82	2.23	2.80	2.38	2.68

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	C-11 0-10cm	C-12 0-10cm	C-13 0-10cm	C-14 0-10cm	C-15 0-10cm
			Client sampling date / time	21-JUN-2012 15:00	21-JUN-2012 15:00	21-JUN-2012 15:00	21-JUN-2012 15:00	21-JUN-2012 15:00
Compound	CAS Number	LOR	Unit	EB1216794-011	EB1216794-012	EB1216794-013	EB1216794-014	EB1216794-015
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.4	5.6	6.6	7.9	6.8
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	35	19	17	79	31
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	12.1	16.8	18.9	17.5	12.4
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	5.9	12.1	7.6	31.3	5.5
Exchangeable Magnesium	----	0.1	meq/100g	5.3	2.4	7.2	4.7	5.6
Exchangeable Potassium	----	0.1	meq/100g	0.8	0.6	1.0	0.9	0.6
Exchangeable Sodium	----	0.1	meq/100g	0.1	<0.1	0.4	<0.1	0.4
Cation Exchange Capacity	----	0.1	meq/100g	12.1	15.2	16.2	37.0	12.0
Exchangeable Sodium Percent	----	0.1	%	0.9	0.4	2.2	0.2	3.0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	<0.01	0.01	0.01	<0.01
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.5	1.1	1.3	2.7	<0.1
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	1820	1320	1920	2300	1400
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	1820	1320	1920	2300	1400
EK074: Fluoride Extractable Phosphorus (Bray)								
Fluoride Extractable P (Bray)	----	1.0	mg/kg	<1.0	3.5	<1.0	<1.0	1.1
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	2.14	1.60	2.33	1.67	1.72

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	C-17 0-10cm	C-18 0-10cm	C-19 0-10cm	C-20 0-10cm	----
			Client sampling date / time	21-JUN-2012 15:00	21-JUN-2012 15:00	21-JUN-2012 15:00	21-JUN-2012 15:00	----
Compound	CAS Number	LOR	Unit	EB1216794-016	EB1216794-017	EB1216794-018	EB1216794-019	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.9	6.6	6.7	7.1	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	39	23	41	80	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	17.4	17.6	14.0	6.6	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	14.9	9.2	11.4	10.1	----
Exchangeable Magnesium	----	0.1	meq/100g	5.9	3.3	1.9	2.5	----
Exchangeable Potassium	----	0.1	meq/100g	1.1	0.9	1.5	1.4	----
Exchangeable Sodium	----	0.1	meq/100g	<0.1	<0.1	<0.1	<0.1	----
Cation Exchange Capacity	----	0.1	meq/100g	22.0	13.4	14.9	14.0	----
Exchangeable Sodium Percent	----	0.1	%	0.3	0.4	0.3	0.5	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.01	0.01	0.01	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.2	1.0	9.0	11.4	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	1590	1960	3880	1510	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	1590	1960	3890	1520	----
EK074: Fluoride Extractable Phosphorus (Bray)								
Fluoride Extractable P (Bray)	----	1.0	mg/kg	<1.0	1.5	153	40.4	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	1.56	2.03	1.85	1.68	----