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BULGA SURFACE OPERATIONS EASTERN EMPLACEMENT AREA MODIFICATION

Response to Submissions

FINAL

December 2016

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FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Bulga Coal Management Pty Ltd

Project Director: John Merrell
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Report No. 2869/R22/FINAL
Date: December 2016

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1.0 Introduction

The Statement of Environmental Effects (SEE) (Umwelt 2016) for the Bulga Surface Operations, Eastern Emplacement Area Modification was placed on public exhibition from 13 July 2016 to 27 July 2016. The proposed modification relates to the revised design of the Eastern Emplacement Area (EEA) and a proposed additional in pit tailings storage facility at the Bulga Surface Operations which forms part of the Bulga Coal Complex (BCC).

The BCC is an open cut and underground coal mining operation located approximately 12 kilometres south west of Singleton in the Hunter Valley, NSW. The BCC is operated by Bulga Coal Management Pty Ltd (BCM) which is seeking a modification to the existing development consent (SSD 4960). The proposed modifications include the refined design of the EEA and a revised tailings emplacement strategy, both of which are expected to achieve significant operational benefits.

In response to the public exhibition of the SEE, no submissions from the public were received. Eleven submissions from State government agencies were received of which seven agencies stated that they had no comments on the proposed modification or the SEE. Four agencies, the Department of Planning and Environment, Office of Environment and Heritage (Heritage Division), Department of Primary Industries and Department of Primary Industries, Division of Resources and Energy, provided comments that have been addressed in this response to submissions report. This report has been prepared in response to a written request from the Director of Resources within the Department of Planning and Environment.

1.1 Background and Overview of Modification

The BCC is located approximately 12 kilometres south west of Singleton in the Hunter Valley, NSW on a site where mining has taken place for over 30 years. BCM operates the BCC on behalf of the Bulga Joint Venture with the BCC consisting of both an open cut operation (Bulga Surface Operations) and an underground coal mining operation (Bulga Underground Operations). Both operations have shared use of the on-site coal washing and rail loading infrastructure.

BCM was granted approval for the Bulga Optimisation Project (SSD4960) by the Planning and Assessment Commission (under delegation from the Minister of Planning) on 1 December 2014. This Project relates to the ongoing operation of Bulga Surface Operations until 31 December 2035. Bulga Underground Operations operates under a separate development consent granted in 2004 (DA 376-8-2003).

The Bulga Surface Operations currently employs approximately 700 people and operates 24 hours a day, seven days a week. The Bulga Surface Operations are approved to mine approximately 230 million tonnes (Mt) of run-of-mine (ROM) coal at a rate of up to 12.2 Mt per annum. Mining operations are expected to continue until 2035 at which point rehabilitation and closure works will be carried out.

The Environmental Impact Statement submitted for the Bulga Optimisation Project (Umwelt 2013) (EIS) assessed the environmental impacts of the originally proposed Bulga Optimisation Project design. This design included an out-of-pit overburden emplacement area located to the north of the BCC Infrastructure known as the EEA; part of this emplacement area was on land owned by Mushroom Composters Pty Ltd (Mushroom Composters).

In a bid to address a number of environmental and social aspects raised during that assessment process, BCM submitted amendments to the project design which resulted in the current approved EEA design being identified. This revised design did not involve emplacement on land owned by Mushroom Composters.

Since the approval, ongoing consultation has occurred between BCM and Mushroom Composters which has led to the negotiation of an agreement which allows for a further revision to the EEA design that benefits both parties. That agreement being that on approval of the modification and the granting of the associated mining lease, BCM will purchase an area of land from the Mushroom Composters. This will negate the need for the construction of a haul road bridge across the access road to the Stage 1 Mushroom Composting Facility and reduce the direct interaction between the two operations. Additional benefits from the modification will include the EEA design being located further away from the residents to the north and north east on Mitchell Line of Road and reduced particulate matter from emissions as a result of shorter haul roads.

The revised EEA design, which is the subject of the proposed modification, is wholly within the footprint of the EEA assessed as part of the BOP EIS and has therefore been previously subject to a detailed environmental survey and assessment. The proposed modification will result in 86.5 hectares of native woodland and grassland vegetation requiring disturbance as a result of the relocation of the EEA; however the agreement with Mushroom Composters removes the need for emplacement of overburden in the northern portion of the EEA, which has resulted in 90 hectares of native woodland and grassland vegetation no longer requiring disturbance. The overall result of the modification will be that there is no net change in this regard.

The approved tailings emplacement strategy for the BCC includes the disposal of tailings in underground workings. Since the Bulga Optimisation Project development consent was granted in December 2014, the decision has been made to suspend mining operations at the Bulga Underground, with such suspension taking effect towards the end of 2017. As a result of this decision, underground mining will not be sufficiently advanced to implement the previously planned underground placement of tailings at the time it will be required. Another consequence of the suspension of underground mining is that the placement of tailings in the existing underground mining areas (i.e. those areas currently mined) would prevent the future underground mining of the underlying seams and therefore sterilise part of the coal resource. BCM has therefore developed a revised tailings management strategy for the BCC and in addition to the existing approved in pit tailings emplacement areas it is proposed to establish a tailings emplacement area in the Main Pit within the confines of the *in situ* mine void.

2.0 Responses to Submissions

2.1 Introduction

Of the eleven submissions that were received from government agencies, seven stated that they either had no further comment, or that they had no concerns in regards to the proposed modification. A summary of these seven is provided in **Table 2.1** below.

Table 2.1 Summary of agency responses where no further action is required

Agency	Comment
Australian Rail Track Authority	ARTC confirmed that it has no comments on the SEE as there is no change to the nature, scale, production limits or project duration including changes to rail infrastructure or rail traffic generated.
Singleton Council	Singleton Council confirmed that they had no specific requirements in regard to the proposed modification.
NSW Environment Protection Authority	The EPA confirmed that the proposed modification was unlikely to increase the potential impacts from mining operations and accordingly the EPA had no comments or recommended conditions.
Health – Hunter New England Local Health District	Hunter New England Health had no comments on the proposal.
Office of Environment and Heritage	The Office of Environment and Heritage (OEH) confirmed that it saw no major issues for the proposed modification. OEH also confirmed the ecological assessment approach was suitable and that no further offsets were required as a result of the proposed modification.
Roads and Maritime Services	Roads and Maritime Services confirmed that the proposed modification would not result in any modifications to the public road network and therefore had no objections to the proposed modification.
Transport for NSW	Transport for NSW offered no comment on the proposed modification.

The four responses that were received where further information or clarification was sought from NSW Government agencies included

- Department of Planning and Environment (DPE)
- Department of Primary Industries (DPI)
- Department of Industry, Resources and Energy (DRE)
- Heritage Council of NSW (Heritage Council).

The specific requests from the relevant agencies can be found below in bold, with detailed responses following those requests.

2.2 NSW Government – Planning and Environment

1. The Department asks for additional information on potential surface and groundwater impacts, with particular consideration of in-ground migration of water entrained in the tailings.

The approved tailings strategy for the Bulga Surface Operations includes emplacement of tailings into the underground workings. As outlined in the SEE, as a result of the decision to suspend mining operations at the Bulga Underground, it has also become necessary to develop a revised tailings management strategy.

The emplacement of tailings within the approved Main Pit is not dissimilar to the currently approved tailings emplacement strategy which involves emplacement of tailings both within open cut mining areas and the underground workings. As outlined in the SEE, the proposed modification will not increase the currently approved production limits or the total volume of tailings requiring disposal. It is considered that the proposed modification will not increase the overall impact or risk associated with tailings emplacement as the modification would simply allow for tailings to be emplaced in a different location within the mining area and in an area that will be well below the final rehabilitated surface level.

In response to the request from DPE for further information, BCM engaged specialist groundwater consultants AGE to undertake a review of the potential impacts with the outcomes summarised below. A copy of the full report is provided in **Appendix 1**.

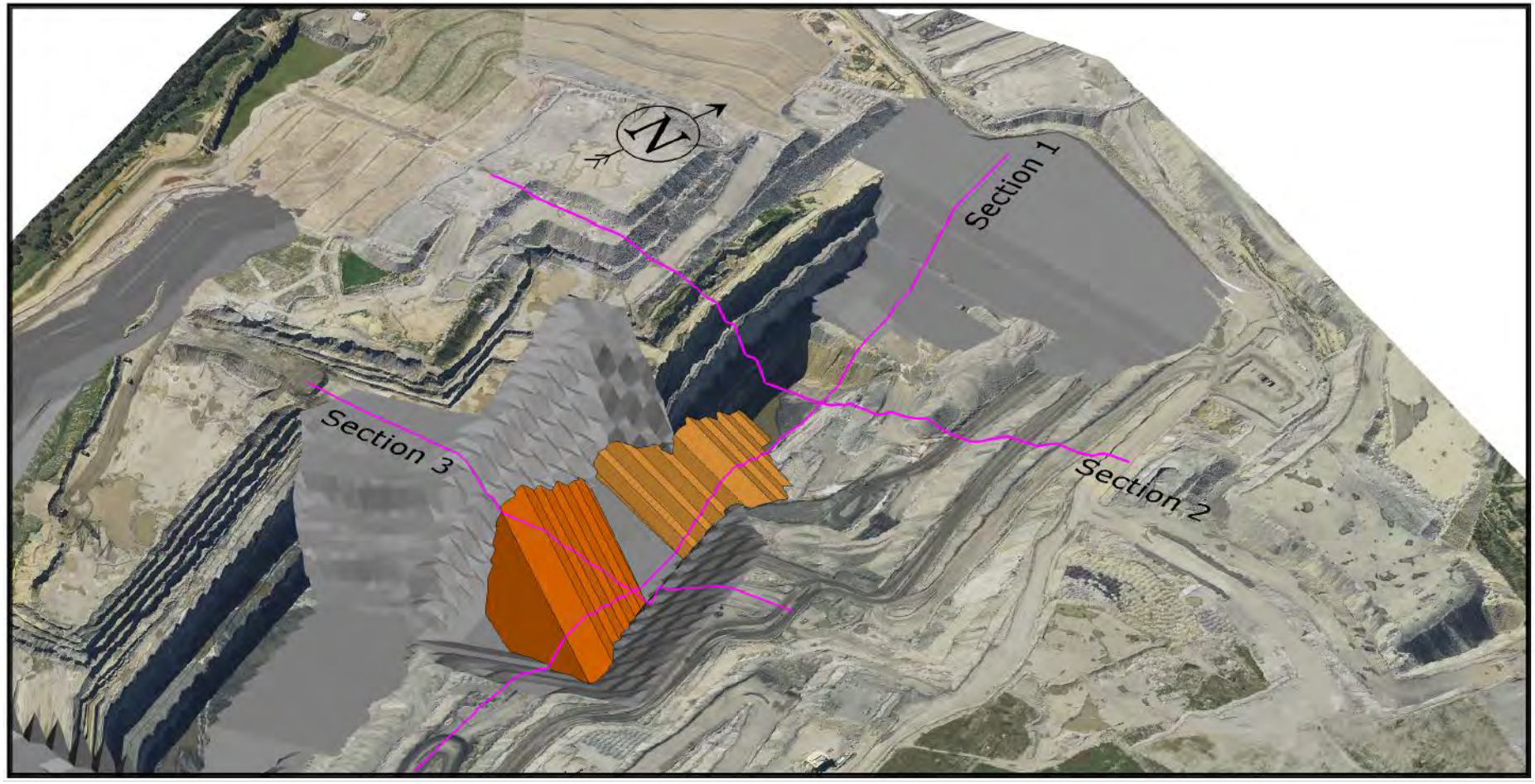
The proposed revised tailings emplacement location is shown on **Figures 2.1** and **2.2**. Tailings are planned to be deposited into a series of cells at the base of the Main Pit, from approximately -60 mRL up to an approximate elevation of 0 mRL. The total volume of tailings to be emplaced is estimated as 7.5 GL. The tailings emplaced will be in conjunction with other mining waste materials such as overburden / interburden and coarse reject or thickened tailings which are currently co-disposed during backfilling operations.

Groundwater level responses

The fine tailings material will be pumped to the proposed tailings emplacement area. Once the solids have settled out the tailings water will be removed from the pit and re-used within the mine water management system. During the settling process it is possible that some of the associated water will migrate through fractures or higher permeability zones within the pit walls where these areas have been dewatered during mining. Any loss of water into the surrounding pit walls is expected to be very limited as an inward hydraulic gradient remains adjacent to the mined areas promoting groundwater flow from the surrounding groundwater system towards the deeper areas in the approved pit. Moreover, the generally low permeability of the *in situ* strata will also limit the volume that may seep into the bedrock and any changes in groundwater level are expected to be localised around the tailings emplacement area.

There are no proposed changes to the mined area, depths of the pits, or the final post mining landform as a result of the proposed modification. The Main Pit, which includes the proposed tailings emplacement area, is approved to be mined and as noted the steep hydraulic gradients expected during mining will draw water towards the Main Pit and prevent significant seepage from within the active mining area. Any groundwater inflows will be collected in sumps and managed in the mine water circuit.

The area of the Main Pit containing the proposed tailings emplacement will be rehabilitated to form an elevated platform above the pre-mining landscape. On completion the tailings material would be encapsulated under at least approximately 100 m of backfill and overburden. The overburden material is



Orange areas indicate proposed tailings dams

Figure 2.1 Revised Tailings Emplacement Location

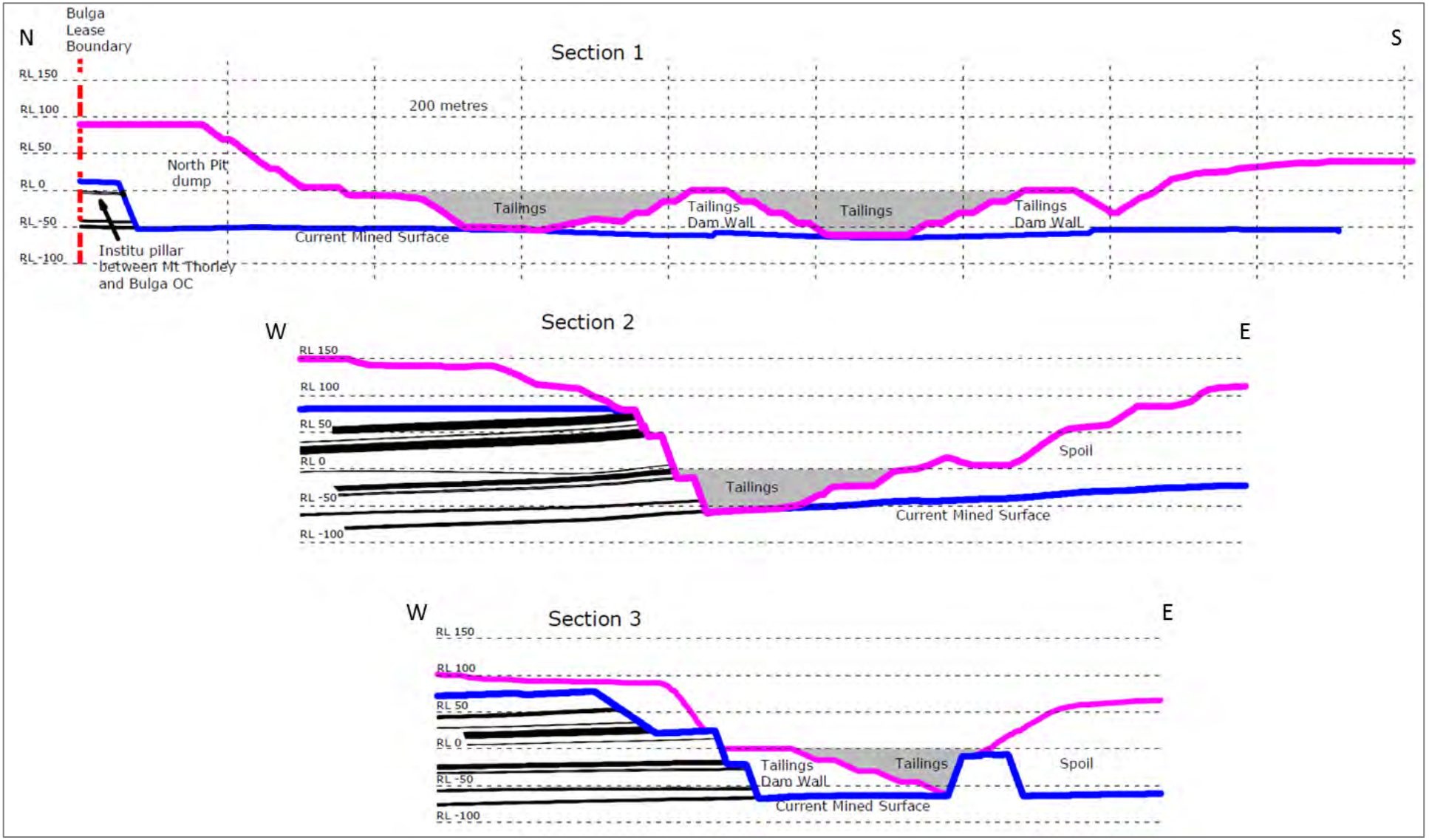


Figure 2.2 Revised Tailings Emplacement Location

expected to physically and chemically weather over time to form a relatively low permeability cap. This significant thickness of capping material will also serve to consolidate the tailings material reducing the hydraulic conductivity and the potential for movement of groundwater through the emplacement.

Groundwater Quality Response

Emplacement of tailings in the Main Pit to an elevation of approximately 0 mAHD will result in minimal chance of the material working its way to the surface over time. However, salts within the tailings materials have the potential to dissolve into the groundwater and then migrate away from the emplacement area. As discussed above, the hydraulic gradients developed during mining will draw water towards the active pits and there will be no off site movement of the dissolved materials during this period. Previous assessment of tailings leachate water quality has concluded that there is a low acid forming potential at the site, with the possible exception of two units which may be extracted from the East Pit, and that the natural carbonate at the site would buffer any potential acid generation (AGE 2016). As outlined previously, the approved tailings strategy for the Bulga Surface Operations includes emplacement of tailings into the underground workings. As the proposed modification will not increase the currently approved production limits or the total volume of tailings requiring disposal it is considered that the proposed modification will not increase the overall impact or risk associated with tailings emplacement as the modification will simply allow for tailings to be emplaced in a different location.

Numerical modelling of the site (Mackie, 2012) found that the Southern Pit void will remain a local groundwater sink for over 500 years post closure. Any migration of tailings influenced water will therefore continue to be towards the pit for a considerable period of time post mining. The tailings are planned to be deposited up to approximately 0 mAHD, with the post closure pit lake predicted to reach approximately 17 mAHD approximately 500 years post mining. Therefore, in the long term groundwater levels will rise above the elevation of the tailings and limit any potential acid formation. During the intervening period encapsulation of the tailings materials deep within the pit will also reduce oxidation and any potential acid formation.

The emplacement of tailings within the approved Main Pit is not dissimilar to the currently approved tailings emplacement strategy which involves emplacement of tailings both within open cut mining areas and the underground workings. As outlined in the SEE, the proposed modification will not increase the currently approved production limits or the total volume of tailings requiring disposal. It is considered that the proposed modification will not increase the overall impact or risk associated with tailings emplacement as the modification would simply allow for tailings to be emplaced in a different location within the mining area and in an area that will be well below the final rehabilitated surface level.

In theory it is possible that the emplacement of fine tailings in the base of the Main Pit could contribute to changes in pit lake water chemistry. However, given that coarse and thickened tailings are already being co-disposed with overburden and that tailings emplacement within other voids and in the underground workings are currently approved, the risk of void water quality changes is considered similar to that of the currently approved operations. A significant capping of overburden material will be provided over the proposed emplacements and will serve to isolate and consolidate the tailings material limiting the permeability and movement of groundwater through the tailings material. As noted above, previous assessment of tailings leachate water quality has concluded that there is a low acid forming potential at the site, with the possible exception of two units which may be extracted from the East Pit, and that the natural carbonate at the site would buffer any potential acid generation (AGE 2016). If the tailings are shown to include potentially acid forming materials then the backfill surrounding the tailings would include carbonate rich overburden to prevent or mitigate any acid formation.

Summary

AGE concluded the risks to the groundwater regime associated with the proposed amendments to the tailings emplacement strategy are minor as:

- Previous assessment of tailings leachate water quality concluded that there was a low acid forming potential at the site, with the possible exception of two units which may be extracted from the East pit, and the natural carbonate at the site would buffer any potential acid generation.

- Under the expected conditions the open pits will act as groundwater sinks during mining and for a considerable period afterwards. This will minimise the potential for any potentially mine affected water to migrate away from the site.

- Coarse reject and thickened tailings are already co-disposed with overburden and backfill materials. There is not expected to be any significant difference in mineral composition between the thickened tailings and fine tailings.

A significant capping of overburden material will be provided over the proposed emplacements and will serve to isolate and consolidate the tailings material limiting the permeability and movement of groundwater through the tailings material.

Surface Water Considerations

As is standard practice, water will be recovered from emplaced tailings as the solids settle out. This recovered water will be removed from the pit and re-used within the mine water management system. This is the existing practice at the site and would continue with or without the proposed modification, it would only be the location of tailings emplacement that would change. The change in location will not have any effect on the nature of water recovered from the tailings and reused in the mine water management system.

In regards to interactions with surface flows following completion of emplacement, as discussed above the proposed tailing emplacement area is located within the existing mine area and will be encapsulated under at least approximately 100 m of backfill and overburden. Therefore, the completed tailings emplacement area will have no interaction with surface water and there will no changes to impacts to surface water resources as a result of the tailings emplacement.

2. The Department requests that Glencore provide a realistic photographic montage to demonstrate that the potential views of the revised EEA would continue to be shielded by these intervening features.

DPE noted that the radial analysis provided in the SEE, which was taken from the top of the proposed emplacement area, identified the potential for the emplacement area to be visible from a resident located off Mitchell Line of Road to the north west of the proposed emplacement area. As noted in Section 6.7 of the SEE, whilst the radial analysis (which is developed from a digital terrain model of the land and does not take into account vegetation on the land) would indicate that parts of the revised EEA may be visible at one privately owned residence to the northwest, consistent with the findings of the BOP EIS, the line-of-sight to the revised EEA is obscured by roadside vegetation and trees on a ridgeline between Mitchell Line of Road and the revised EEA, screening the potential views.

Notwithstanding the above Umwelt has prepared a photomontage from the residence that was identified as theoretically being able to see the EEA. The visual montage, refer to **Figure 2.3** confirms that direct views of the proposed EEA are expected to be obscured by roadside vegetation, exiting vegetation on the ridge in the foreground and also the ridge itself. This confirms the assessment findings outlined in the SEE and no further mitigation measures are considered to be required.

2.3 NSW Government - Department of Primary Industries

The proponent has stated that it will license all water take as required by the provisions of the *Water Management Act 2000*. Further information is required that outlines specifically how reductions in catchment and any other water take will be accounted for with reference to the licensing provisions of the *Water Management Act 2000*.

The *Water Sharing Plan for the Hunter Unregulated and Alluvial Water Sources* 2009 applies to the proposed EEA modification. BCM proposes to operate within the rules of the Water Sharing Plan and by using the existing water access licences held for the unregulated and alluvial water sources. This is supported by the use of harvestable rights.

Approved Project

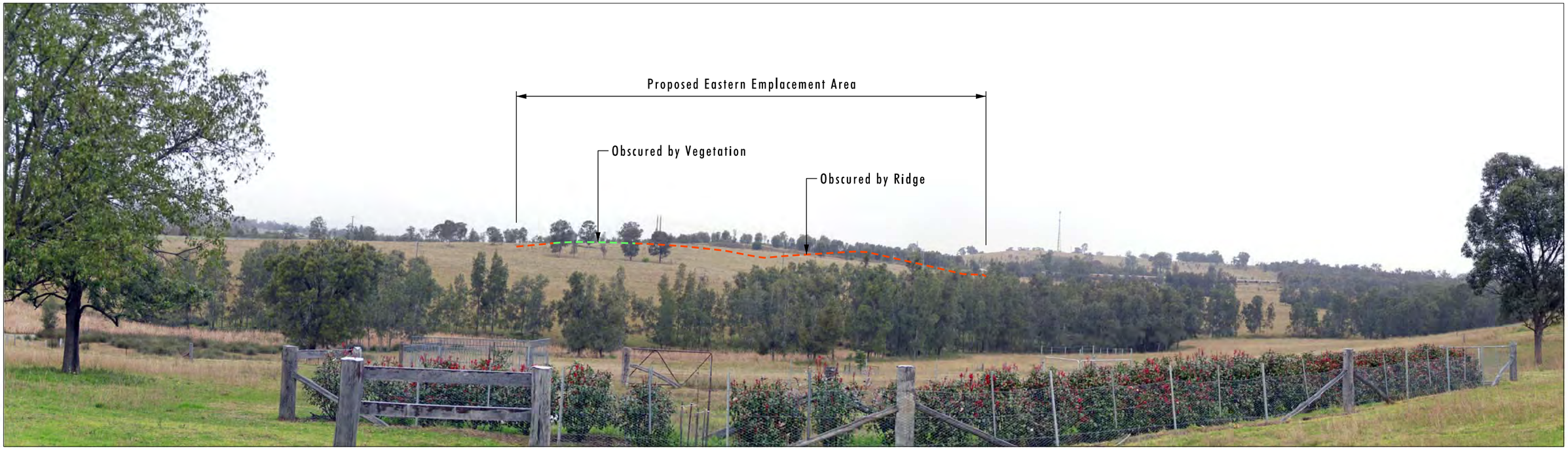
As addressed in the EIS Appendix 10 – Surface Water Assessment (Umwelt, 2013), the current contiguous land holdings of BCM are approximately 6300 hectares. This equates to a harvestable right of approximately 440 ML per year.

There are numerous minor farm dams located on the landholdings of BCM with an estimated total volume of approximately 100 ML. These farm dams are located on 1st order and 2nd order watercourses. This volume equates to approximately 23 per cent of the harvestable rights for BCM. As such, the remaining harvestable rights for the Project, based on the current contiguous landholding, are approximately 340 ML per year. This is equivalent to capturing 10 per cent of runoff from approximately 4850 hectares, or 100 per cent of runoff from approximately 485 hectares.

As detailed in the BOP EIS Appendix 10 – Surface Water Assessment (Umwelt, 2013), the natural/undisturbed catchment areas upslope of the open cut pits and infrastructure areas from which runoff would be captured in the water management system (WMS) are at their largest in Year 6 at 347 hectares.

The clean water weir upstream of the Northern Dam was also estimated to reduce flows to the downstream catchment areas by approximately 77 ML per year via water lost through evaporation from the pond upstream of the weir (Umwelt, 2013). The clean water weir and associated drainage channels were designed to assist in diverting clean water flows around the Northern Dam and as such reduce the capture of clean water within the WMS.

The Approved Project has sufficient harvestable rights provisions to allow for capture of clean water runoff and evaporative losses from the clean water weir pond (refer to **Table 2.2**).



Legend

- – – Obscured by Ridge
- – – Obscured by Vegetation

FIGURE 2.3

Visual Montage Hedly Residence
Final Landform - Eastern Emplacement Area

With the proposed modification

The proposed modification will result in a net reduction in capture of clean water runoff. The revised layout for the Eastern Emplacement Area allows provision for additional clean water drainage systems between the EEA and the Northern Dam reducing the capture of clean runoff, whilst there is a small increase in captured clean water runoff in areas to the east of the EEA. The net change in clean water catchment area captured by the existing Water Management System is a reduction of approximately 224 hectares to capture of runoff from an area of approximately 123 hectares. The proposed modification reduces the take of clean water runoff and as such the total estimated clean water take remains within the Harvestable Rights Provisions.

Table 2.2 Summary of Licensing

Aspect	Approved Project		Proposed Modification	
	Area (ha)	Volume (ML)	Area (ha)	Volume (ML)
Harvestable Rights Provision (based on BCM land holdings)	6,300	440	6,300	440
Farm dams		-100		-100
Clean water catchment take	-347	-243	-123	-86
Evaporative losses from clean water weir		-77		-77
Sub-Total of Estimated Take		-420		-263
Total		+20		+177

Further information is also required on the direct and indirect disturbance of watercourses and riparian areas, and associated impacts, with reference to the DPI Water Guidelines for Controlled Activities on Waterfront Land. DPI notes that the existing consent requires that the design, installation and maintenance of infrastructure within 40 m of watercourses be generally in accordance with the Guidelines.

The proposed EEA impact area was assessed under the original EIS. The EIS Appendix 10 – Surface Water Assessment (Umwelt, 2013) provides details on the areas of the Loders Creek catchment which will be impacted by the proposed modification.

The impact area associated with the proposed EEA lies within the area of waterfront land of a 2nd order watercourse. The 2nd order watercourse primarily lies within the area of the footprint of the EEA. There are some infrastructure works located outside of the EEA footprint, including drainage controls that will lie within waterfront land. The design and construction methods for all infrastructure works that lie within this area of waterfront land will consider the DPI Water Guidelines for Controlled Activities on Waterfront Land as required by the consent.

It is also requested that the proponent provides a map to demonstrate that the emplacement area doesn't overlie highly productive alluvial aquifers. Should this indicate that emplacement is proposed over highly productive aquifers, further information and review will be required consistent with the NSW Aquifer Interference Policy.

As can be seen in **Figure 2.4** the proposed eastern emplacement area does not overlie highly productive alluvial aquifers. Further, as stated as outlined in Mackie 2013, *the alluvial aquifer systems associated with Wollombi Brook and Monkey Place Creek are considered to fall within the less productive aquifer definition by virtue of the variable and sometimes poor groundwater qualities. These alluvial materials are unlikely to support a water supply structure capable of a sustained yield greater than 5 L/sec within an acceptable salinity range (deeper parts of the alluvium tend to host more saline groundwater).*

2.4 NSW **Government - Department of Industry (Resources and Energy)**

Further information is required from the Proponent in order for the Division to determine that sustainable rehabilitation outcomes may be achievable on mine closure.

The additional information will need to provide:

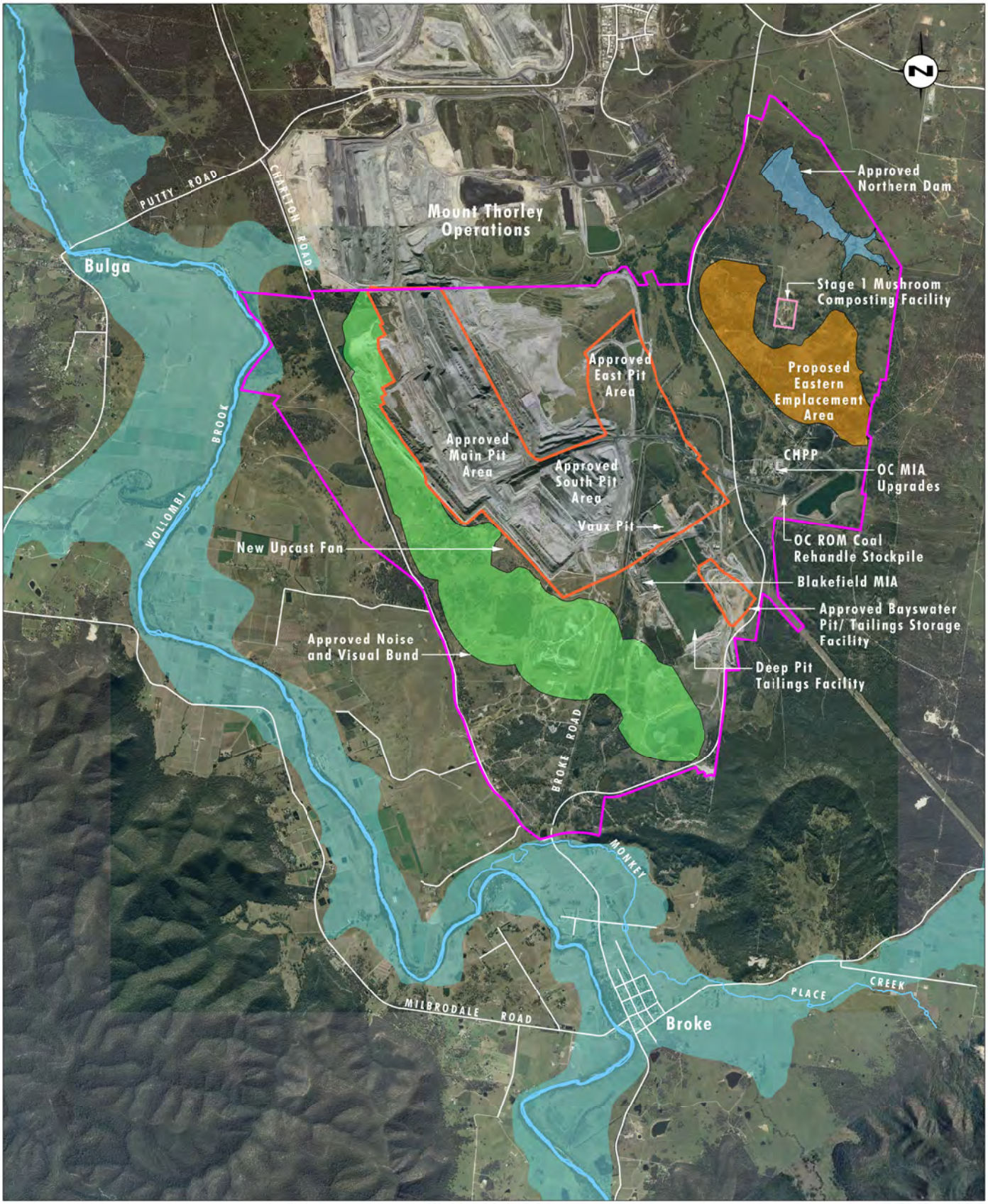
1. **Increased Detail and/or modelling of the final landform incorporating:**

    - The integration of a natural landform, with macro and micro-relief integrated into the final landform
    - Maximum opportunities for external water drainage away from final voids.
    - Minimise reliance on linear drop structures
    - Identification of association risks with the achievement of final landform in regards to its ability of sustaining the intended final land use; and
    - Plans and relevant cross- sections to an appropriate scale.

The BOP EIS provided substantial detail on the indicative post mining land use for the BCC following completion of the Bulga Optimisation Project. The post mining land use primarily involves the establishment of native vegetation communities impacted by the Project. The BOP EIS included a detailed assessment of the conceptual final landform and land use that included the Eastern Emplacement area subject to the proposed modification. The proposed land use was developed in consideration of a number of factors including existing strategic land use objectives as well as site opportunities as discussed in detail in the BOP EIS.

The proposed final landform and land use for the proposed EEA is consistent with that of the approved project with no changes proposed to final land use or the key principles used to establish the final landform. While there are some changes to the landform itself due to the revised design of the EEA, the key design principles are consistent. The revised EEA overall will be emplaced to a height of approximately RL 150 mAHD however selected areas may be emplaced to approximately RL 165 mAHD to introduce micro relief features into the landform consistent with surrounding terrain and BCM's rehabilitation strategy commitments. Additionally overburden emplacement areas will include variation in vertical relief in order to prevent ponding of surface water as well as create a profile that is commensurate with the natural local topography.

It is also noted that no changes are proposed to the approved conceptual final landform or land use of the remainder of the Bulga Surface Operations, including the final void areas, with the only landform change being associated with the EEA.



Source: AAM Pty Limited (March 2012), Xstrata Coal (NSW) Pty Ltd, MER (2012)

0 1.0 2.0 3km

1:75 000

Legend

- Revised Project Area
- Coal Extraction Area
- Approved Noise and Visual Bund
- Proposed Revised EEA
- Approved Northern Dam
- Alluvium

FIGURE 2.4

Alluvial Aquifers

File Name (A4): R22/2869_1032.dgn
20160915 10.05

Rehabilitation and closure activities will be implemented progressively throughout the life of mine to maximise any opportunities for the development of other potentially viable land use options. Further, the details of the landform, land use and associated rehabilitation from the BOP EIS have been included into the currently approved Mining Operations Plan (MOP). It is proposed that should the modification be approved, the MOP would be updated to include the modified EEA including more detailed landform plans in accordance with DREs guidelines for MOPs. **Figures 2.5** and **2.6** provide further detail on the proposed final land form and land use for the EEA including cross sections.

A summary of the details of the landform, land use and associated rehabilitation is provided below.

Indicative Post Mining Land Use

The proposed conceptual final land use of a return to native ecosystem underpins the closure objectives and criteria (refer to Sections 5.14.1 and 5.14.1 of the BOP EIS respectively), which were developed to guide rehabilitation and decommissioning activities. It is proposed that these closure objectives and criteria, which are currently applicable to BCC will be applied to the EEA. These criteria have been further refined in the MOP developed for the Bulga Surface Operations. As noted above, this MOP will be updated to include the revised EEA should the modification application be approved.

The approach for on-going management of the post mining land use will be determined as part of the detailed mine closure planning process. This will involve investigations into a range of mechanisms that will allow for the land to be managed sustainably into the future as well as to allow BCM to dispose of the land asset when the appropriate closure and rehabilitation criteria have been met.

Rehabilitation and Closure Objectives

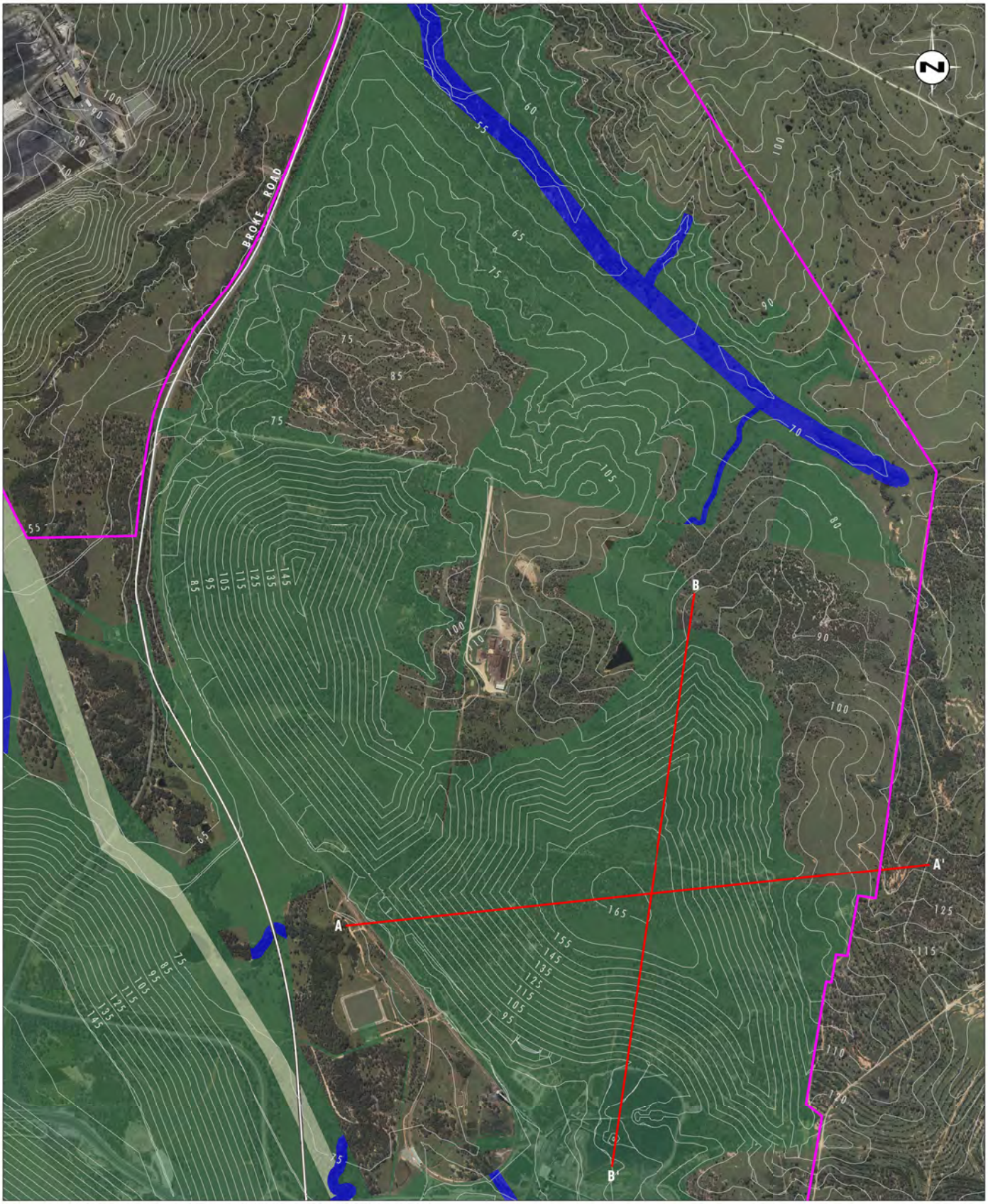
BCM's rehabilitation objectives for BCC which will also be applied to the EEA include the following:

- provide for the safety of employees and the public during and following the closure of the mining operations
- provide a sustainable final landform and use that can co-exist with surrounding land uses
- establish similar native vegetation communities to those that will be impacted
- develop native vegetation corridors linking surrounding remnant vegetation areas to the south and east of the BCC area and to the north through the proposed native rehabilitation areas of Mount Thorley and Warkworth mines
- not to preclude other potential post mining land use options should they be determined to be viable and preferable as part of the detailed mine closure planning process that commences at least five years prior to the planned cessation of mining.

Closure and Rehabilitation Completion Criteria

Completion criteria are objective target levels or values assigned to a variety of indicators (i.e. slope, species diversity, groundcover etc.), which can be measured against to demonstrate progress and the ultimate success of rehabilitation. As such, they provide a defined end point, at which point in time rehabilitation can be deemed successful and the mining lease relinquishment process can proceed.

The preliminary closure and rehabilitation completion criteria for the Bulga Surface Operations are outlined in Table 5.26 of the EIS. The criteria have been developed considering site specific issues and objectives, Glencore's (managing owner of BCM) standards and the outcomes of the 2005 ACARP study entitled



Source: AAM Pty Limited (March 2012), BCM (2013), EMGA

0 0.25 0.5 1.0km
1:20 000

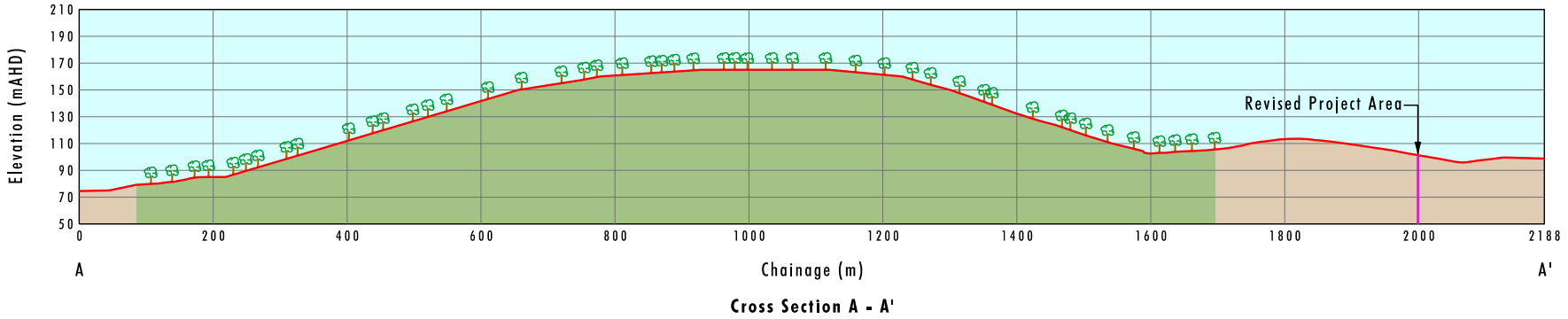
Legend

- Revised Project Area
- Woodland
- Riparian Revegetation
- Cross Section Location

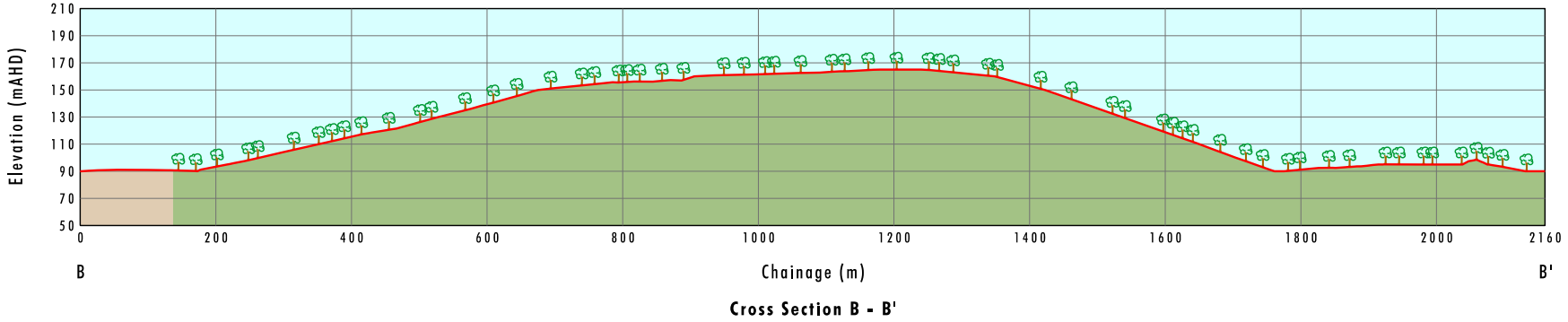
FIGURE 2.5

Conceptual Final Landform and Rehabilitation Areas

20161122 13.27
20161122 13.27



Cross Section A - A'



Cross Section B - B'

0 50 125 250m
Vertical Scale 1:5000

0 100 250 500m
Horizontal Scale 1:10 000

Legend

- Conceptual Final Landform
- Woodland

FIGURE 2.6

Eastern Emplacement Area Cross Sections

'Development of Rehabilitation Completion Criteria for Native Ecosystem Establishment on the Coal Mines in the Hunter Valley'.

These completion criteria, which may be subject to refinement, including through consultation with the relevant stakeholders, will be utilised to demonstrate achievement of rehabilitation objectives. The achievement of the completion criteria will be monitored and reported within the annual reports to be submitted to relevant government agencies.

The preliminary closure completion criteria will be reviewed and revised throughout the life of the Bulga Surface Operations in consideration of the results of rehabilitation monitoring programs; any relevant research trials; and consideration of stakeholder feedback. This process will occur on an on-going basis as part of the development of the MOPs for the mining operations and reported against through annual reviews that are submitted to relevant government agencies and made available to the community.

The gradual achievement (or otherwise) of these completion criteria will be assessed and discussed in the annual reviews, which will include the identification of any failures to achieve the criteria, and measures taken to address any such issues.

Overburden Emplacement Area – Design Considerations

Key design considerations associated with the overburden emplacement areas, including the EEA are outlined below:

- all final landform slopes will be battered to an average of 10 degrees to minimise erosion risk. Concave profiles may be implemented to further enhance stability and provide consistency with surrounding natural landforms

- overburden emplacement areas will include variation in vertical relief in order to prevent ponding of surface water as well as create a profile that is commensurate with the natural local topography

- the footprint of the overburden emplacement areas, has been designed to be irregular in shape in order to provide a more natural profile.

Drainage structures will be designed to minimise scouring associated with anticipated runoff. Where practicable, drainage lines will be designed to be commensurate with natural landforms.

Tailings Dam Decommissioning

The tailings emplacement areas on site will be filled and shaped to the conceptual final landform plan and subsequently capped. The primary objective of the capping design will be to minimise the potential for exposure of potentially environmentally sensitive tailings material in the rehabilitated landform and prevent the occurrence of spontaneous combustion.

Revegetation

After surface soil amelioration and tillage is completed for any given area, revegetation will commence as soon as practicable.

The rehabilitation strategy involves the establishment of a native ecosystem, through the creation of large patches of rehabilitated woodland which will link to remnant stands of native vegetation within the existing BCC and to remnants adjoining the BCC. Rehabilitated woodland areas will be created to contain flora species assemblages characteristic of the dominant vegetation communities impacted.

Revegetation will primarily involve direct seeding of native species along with a suitable cover crop or other organic material (e.g. mulch, brush matting or biosolids etc.) as required to prevent soil loss and add biomass to the profile. A range of other techniques including the planting of tubestock may also be utilised where appropriate.

Proposed Rehabilitation Monitoring

BCM will continue to undertake a rehabilitation monitoring program in accordance with Glencore standards. The objectives of the program will be to:

- assess the long term stability and functioning of re-established ecosystems on mine affected land
- assess rehabilitation performance against the closure criteria
- facilitate continuous improvement in rehabilitation practices.

The monitoring program will be continued within rehabilitated as well as non-mined areas until it can be demonstrated that rehabilitation has satisfied the closure criteria. Information from this monitoring program will also be used to refine closure criteria as required.

Revegetation Care and Maintenance

Based on the outcomes of the rehabilitation monitoring program as outlined above, a care and maintenance program will be implemented so that rehabilitation is sustainable for the long term. The scope of the care and maintenance program may include weed and feral animal control, fertilising, re-seeding or planting (where required) and erosion and sediment control works.

2. Provide further detail on the proposed tailings disposal, life-of-mine tailings strategy and tailings rehabilitation strategy, consistent with the objectives of the final landform.

BCM currently operate a number of approved tailings emplacement facilities in accordance with a tailings management plan. The only change to this strategy is the addition of a series of tailings emplacement cells within Main Pit as an alternative to the previously planned disposal of tailings in underground mining areas. The overall approach to management of tailings remains consistent with the current, approved strategy.

DRE has requested further information about the proposed approach to tailings disposal. To address this request, further information about the deposition strategy is provide below.

The deposition strategy for the proposed tailings emplacement area in Main Pit will be in consistent with the existing tailings management strategy at BCC. The objectives of tailings deposition strategy are to:

- optimise the discharge point locations taking into consideration the pit geometry, surrounding topography and location of existing infrastructure
- provide a deposition strategy to maximise tailings storage and decant recovery
- incorporate a decant recovery strategy suitable for the life of the proposed tailings emplacement area to maximise water recovery. In order to achieve the above objectives, the following principles would apply:
- utilise the topography of the pit to:
    - ensure the decant collection location is as far away from the discharge points as possible

    - optimise the storage capacity by establishing the final locations of the discharge points at as high an elevation as possible

- utilise the relatively low permeability characteristics of the tailings to create a seal over the impoundment area, effectively sealing the base to minimise seepage into the surrounding environment

- locate decant return water pump and deposition points near existing infrastructure to maximise water recovery

- provide multiple deposition points to maximise deposition areas allowing for drying time, increasing tailings beach angle

    - secondary flocculation of tailings to improve beach angle and dewatering.

As outlined in **Section 2.2** a significant capping of overburden material will be provided over the proposed emplacements and will serve to isolate and consolidate the tailings material. Moreover the final land form proposed for the main pit will not change from the currently approved final land form.

Further detail is provided in BCC tailings management strategy provided in **Appendix 2**.

3. **Further development of objectives and completion criteria to achieve the final land use and landform must be developed in the Mining Operation Plan (MOP), including but not limited to, specific outcomes relating to vegetation communities and integration of macro and micro-relief. Based on constraints/opportunities in the final landform design, an evaluation of the proposed final land use and whether they can be sustained by the final landform.**

BCM will include this detail in the MOP that will be prepared in consultation with DRE.

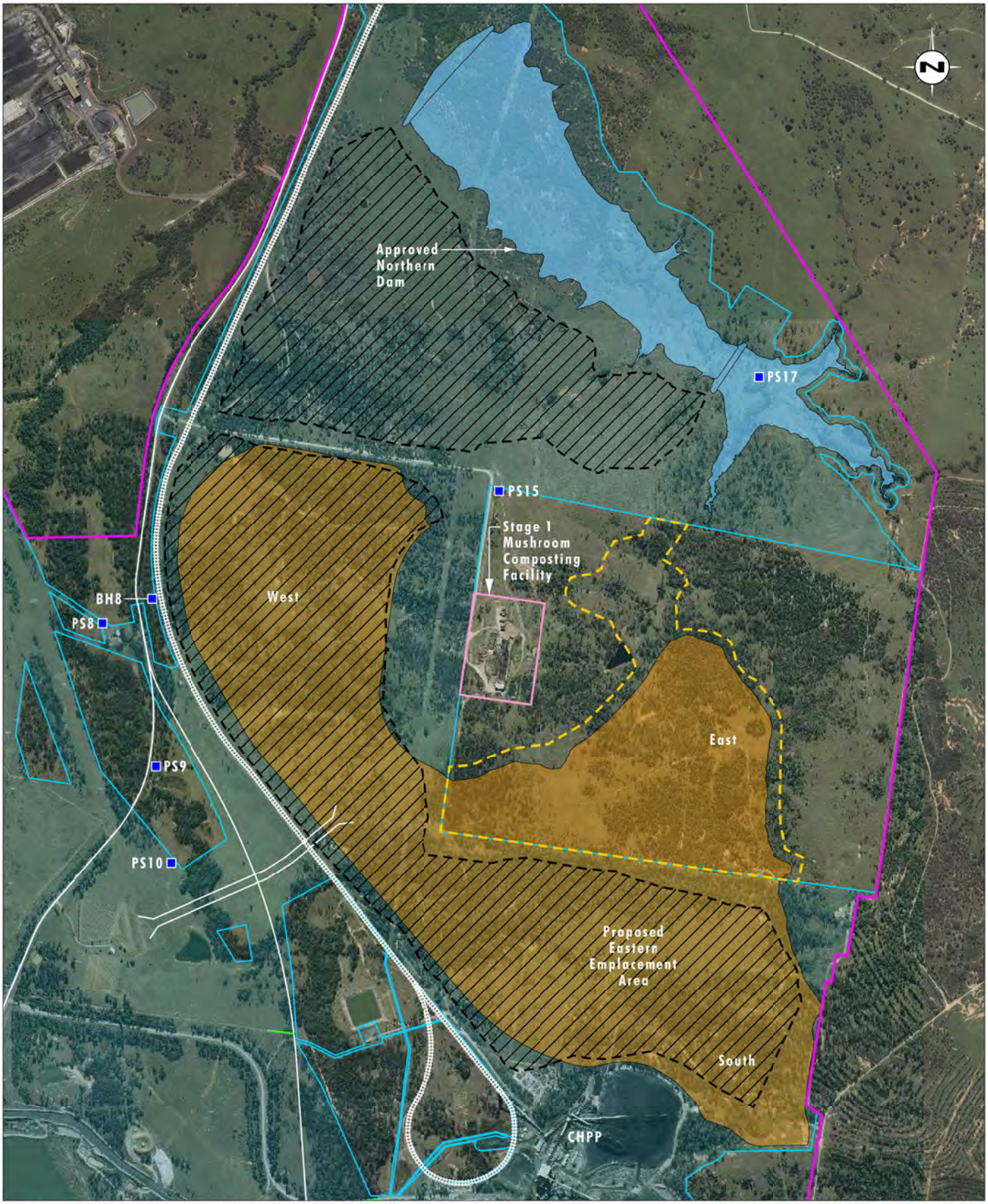
2.5 NSW Government – Heritage Council of New South Wales

The Heritage Council recommends the SEE be amended to reflect the location of known heritage items in relation to the proposed modification works. This could then be used to demonstrate whether these items and values would or would not be affected by the proposal.

As outlined in the SEE, the proposed modification will not impact any known heritage items and no heritage items have been identified within the proposed modification area as shown on **Figure 2.7**. **Figure 2.7** also shows the location of heritage sites within the surrounding area.

A comprehensive assessment of the potential impacts of the Bulga Optimisation Project on historic heritage values was completed and included as Appendix 14 of the Environmental EIS (Umwelt 2013). As outlined in Section 5.11.3 of the EIS, there are 29 potential heritage sites located within the Project Area (refer to **Figure 2.7**). Four of these, BH11 (a former farmstead site including dairy and yards), PS17 (former hut site), Charlton Road (part of the former Great North Road) and the former Broke RAAF Landing Ground were identified as having local heritage significance. No sites of regional or State significance were identified within the Project Area.

None of the heritage sites occurring within the surrounding area will be affected by the proposed modification.



Source: AAM Hatch Pty Limited (March 2012), BCM (2013)

0 0.25 0.5 1.0km

1:20 000

Legend

- Revised Project Area
- Approved Project Disturbance Footprint
- Revised Disturbance Area
- Proposed Revised EEA
- Approved EEA
- Approved Northern Dam
- Approved BCC Access Roads
- Existing Rail Line
- Non-listed Potential and Known Heritage Sites

FIGURE 2.7

Historic Heritage Items

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20160708 15.00

3.0 Conclusion

The proposed modification does not result in the Bulga Surface Operations being substantially different from the currently approved operations. The amendments to the EEA have generally resulted in environmental impacts that are the same or reduced when compared to those impacts currently approved.

It is considered that the minor nature of the potential impacts was reflected in the submissions received. Notably no submissions were received from the community and of the 11 submissions received from the State Government agencies; seven had no comments and no further requirements or clarifications. This report addresses all of the remaining requirements and clarifications from the remaining four agencies.

The proposed modification will provide BCM with significant operational benefits including the removal of the need for BCM to construct a haul road bridge across the Stage 1 Mushroom Composting Facility access road resulting in reduced costs and reduced potential for interaction with traffic from the Stage 1 Mushroom Composting Facility. The proposed modified tailings emplacement will avoid sterilising part of the coal resource as underground mining operations will not be sufficiently advanced to implement the previously planned underground placement of tailings at the time it will be required.

Further, as outlined in this assessment, the impacts of the Bulga Surface Operations with the proposed modification are very similar to the currently approved operations and all potential impacts can be managed within the current approval limits. Accordingly the proposed modification will allow these benefits to be realised without resulting in any substantive change in impacts to the environment and community.

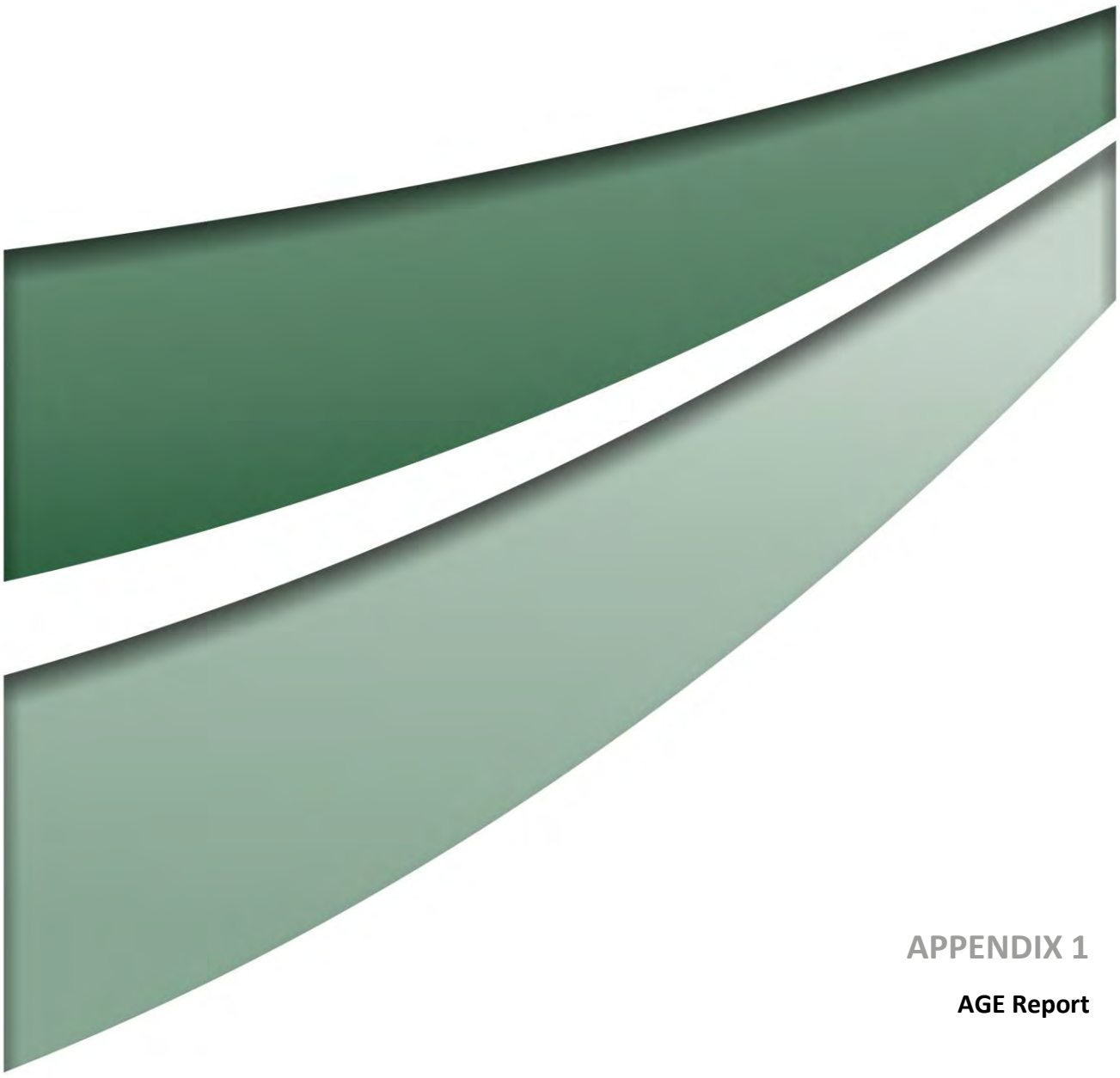
4.0 References

Umwelt (Australia) Pty Limited, 2016 *Bulga Surface Operations Eastern Emplacement Area Modification, Statement of Environmental Effects*

Umwelt (Australia) Pty Limited, 2013 *Bulga Optimisation Project Environmental Impact Statement.*

Mackie Environmental Research 2012 *Assessment of Groundwater Related Impacts Arising from the Proposed Bulga Optimisation Project*.

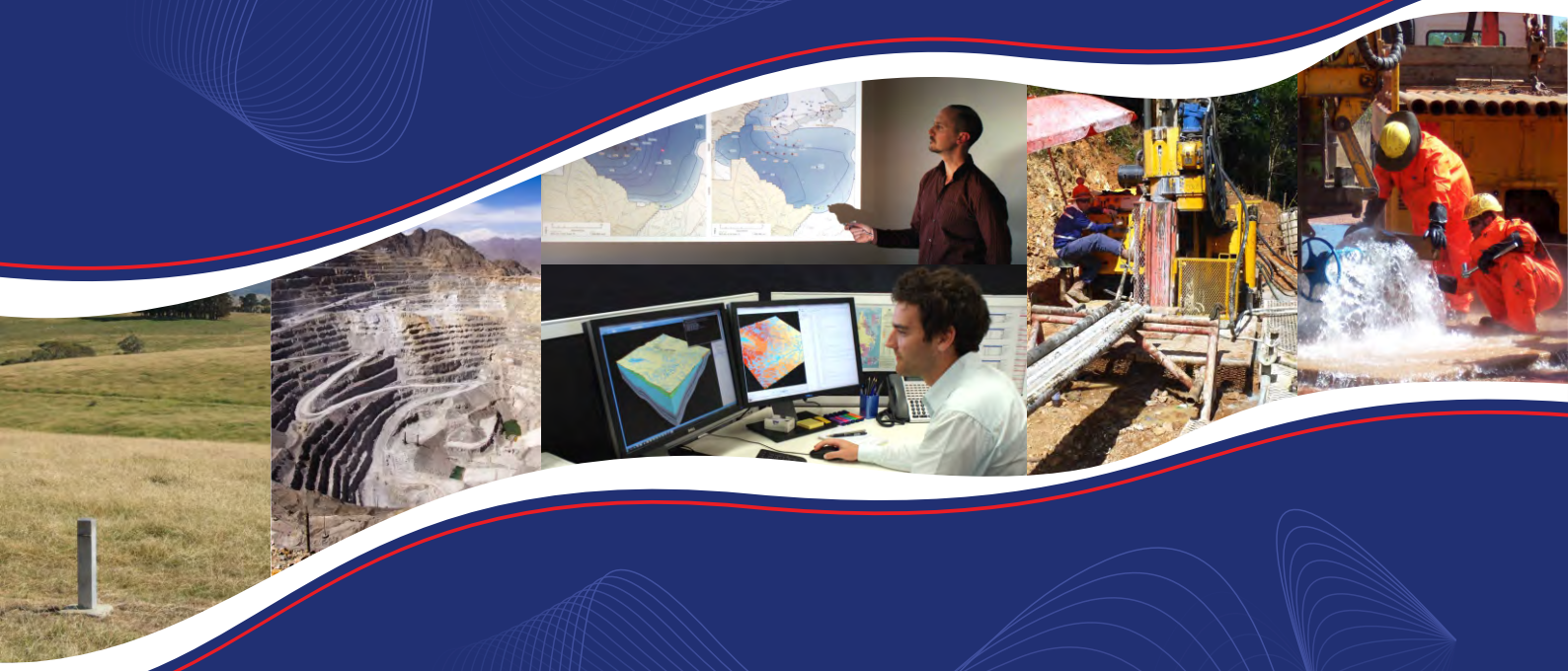
Australian Groundwater and Environmental Consultants (AGE), 2016 *Bulga Tailings Amendment Groundwater Review*



APPENDIX 1

AGE Report

Australasian
Groundwater
and Environmental
Consultants Pty Ltd
(AGE)



Report on

Bulga Tailings Amendment Groundwater Review

Prepared for

Bulga Coal Management

Project No. G1832 November 2016
www.ageconsultants.com.au ABN 64 080 238 642

Document details and history

Document details

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Report on

Bulga Tailings Amendment
Groundwater Review

1 Introduction

The Bulga Coal Complex (BCC) is located in the Upper Hunter Valley, NSW, approximately 12 km southwest of Singleton, and 2 km from the townships of Broke and Bulga. The site is approved to process up to 20 Mtpa semi soft coking coal and thermal coal using open cut and underground mining methods. Bulga Coal Management (BCM) operates the BCC on behalf of Bulga Joint Venture.

BCM are seeking to modify the approved tailings emplacement strategy for the BCC. The currently approved tailings emplacement strategy allows for disposal of fine tailings in underground workings. BCM are considering suspension of underground mining activities towards the end of 2017. Placement of tailings in the available underground voids would inhibit the future underground mining of underlying seams and sterilise coal resources. BCM has therefore developed a revised tailings management strategy for the BCC. This involves emplacement of tailings within the open cut mining area in the Main Pit rather than into the underground workings.

This document reviews the potential risk to groundwater and possible changes to the hydrogeological regime as a result of the proposed modification to tailings emplacement.

2 Objectives and scope of work

The objective of this study was to identify any risks to groundwater and the hydrogeological regime associated with the revised tailings emplacement strategy. To achieve this objective the scope of work included:

- reviewing available information on the hydrogeological regime at the site, and the predicted future impacts under currently approved mining conditions;
- determining the potential changes to the groundwater regime that may result from the proposed modification;
- reporting the potential risks to groundwater associated with the proposed modification; and
- if required, providing recommendations on further work to clarify any significant uncertainties that remain.

3 Background

3.1 Mining history and environmental setting

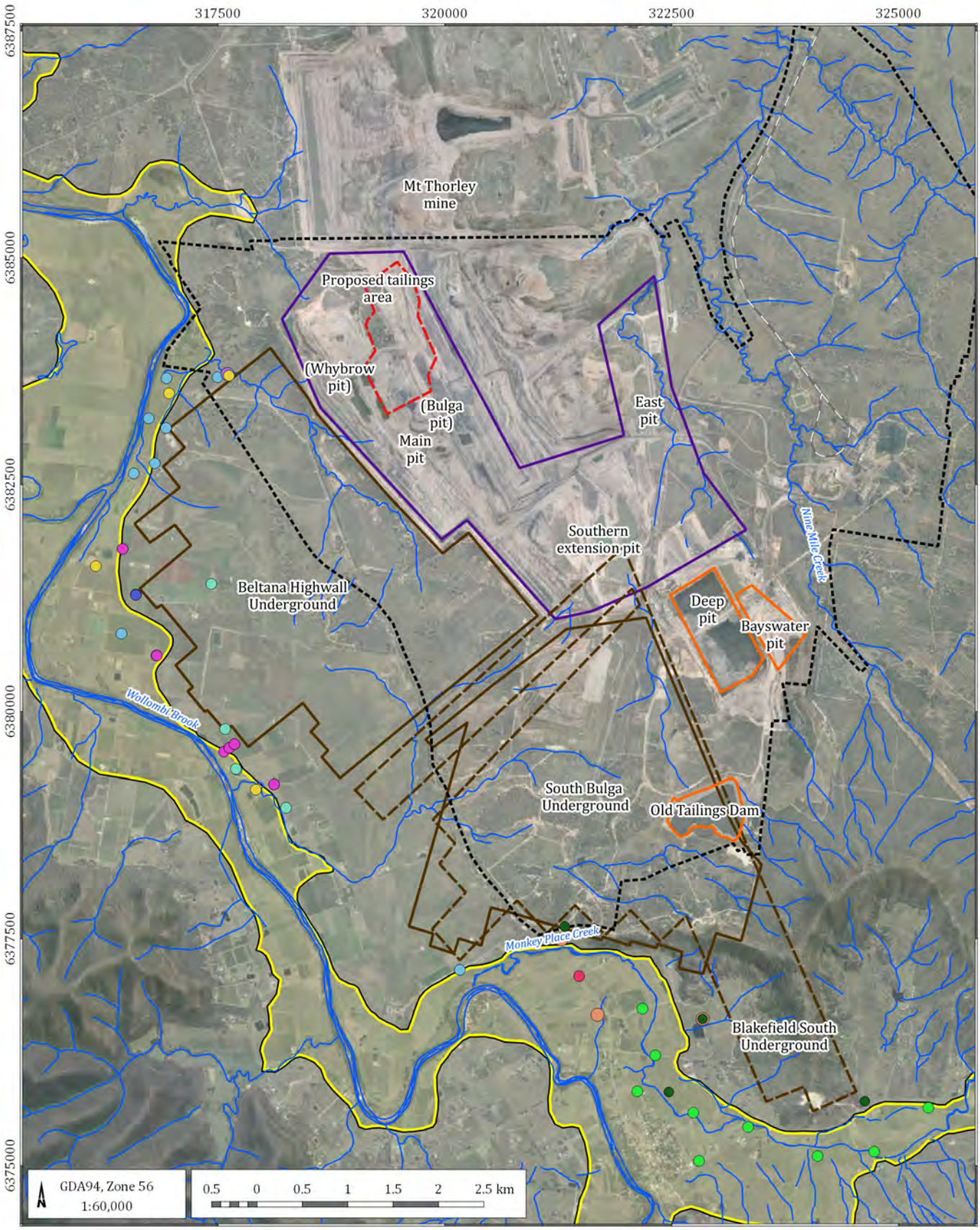
Open cut mining has been carried out at the BCC since 1982. Mining has occurred from several different open pits using either truck and shovel, or dragline extraction methods. The current mine approval allows for open cut mining to continue until 2035.

Underground mining commenced at the site in 1994. BCC has approval to mine four seams using underground mining methods. The uppermost seam (Whybrow seam) was extracted from the now completed Beltana Highwall and South Bulga mining areas, and the Blakefield South mine is currently extracting from the Blakefield seam. The deeper Glen Munro and Woodlands Hill seams have yet to be mined. The underground mines are located to the south and west of the open cut pits. The surface footprints of the underground mines overlap, with longwall extraction starting in the shallower seams and moving deeper over time.

The BCC is bordered by the Mt Thorley mine immediately to the north of the site and Warkworth mine is located a short distance north of Mt Thorley mine.

The Monkey Place Creek and Wollombi Brook flow around the southern and western borders of the BCC respectively. Surface flows to the east of the BCC are captured by the Nine Mile Creek.

The key features of the site are shown in Figure 3.1.



LEGEND

- Project area
- Proposed tailings emplacement area
- Optimised pit shell
- Tailings storage facility
- Underground mine Whybrow seam
- Underground mine Blakefield seam
- Alluvium
- Rail
- Drainage

Active groundwater monitoring network

- Beltana Area Miscellaneous Bores and Wells
- Beltana Area NPZ
- Broke Area Alluvials
- Broke Area Wollombi Seam
- Northern Alcheringa Seam
- Northern Area Lower Whybrow Seam
- Northern Area Shallow Alluvials
- SBC/Broke Area Lower Whybrow Seam
- Wollombi Alluvials and Shallow Coal Measures
- Not classified

Bulga Tailings Review (G1832)

Key features of BCC site

DATE 17/11/2016

FIGURE No: **3.1**

G:/Projects/G1832.Bulga Tailings Review/3_GIS/Workspaces/001_Deliverable1/03-01_G1832_Layout of BCC site.qgs

3.2 Approved tailings disposal plan

Coarse and fine rejects are produced during coal preparation at the site. Approximately two-thirds of the reject material is coarse, with the remaining third being fine reject or tailings. Coarse rejects and paste thickened tailings are co-disposed with overburden in the Bulga pit. Prior to 2014, fine tailings at the site were disposed of in the Old Tailings Dam at the southern edge of the BCC and the Deep Pit mine void. The Old Tailings Dam is now being rehabilitated, with fine tailings still being disposed of into the mined out Deep Pit.

Future tailings disposal has also been approved into the Bayswater Pit, which lies adjacent to the Deep Pit, and the underground workings once they are completed.

A change in underground operations means that underground tailings disposal is no longer a viable option. Therefore BCM is seeking approval for tailings emplacement in the Main pit.

Although underground disposal of tailings has been approved the exact locations for disposal have yet to be finalised. Post-extraction collapse of the longwall panels will result in the only large void spaces available for underground tailings disposal being the network of access roads, although the decant could seep into the goaf areas. The coal seams extracted in the underground mines dip to the west-southwest. Close to the open cut pit the shallowest seams extracted using underground mining lie at elevations of approximately 50 mAHD, but then dip to as low as -150 mAHD at the end of several of the longwall panels. These are the shallowest depths that the tailings could be placed in the underground workings. The deeper seams within the underground mine plan are located between approximately -100 mAHD and -350 mAHD.

4 Groundwater regime

4.1 Geology / hydrogeology

BCC is located within the coal-producing region of the Hunter Valley. The coal bearing seams are Permian in age and generally dip to the west-southwest. A series of folds, superimposed on the regional dip, form large north-south trending anticlines, synclines, and monocline structures.

The coal seams extracted at BCC are part of the Wittingham Coal Measures. The coal seams outcrop in the east of the site before dipping steeply and levelling out across the area of active mining. The existing BCC operations have extracted coal from the Whybrow, Redbank Creek, Wambo, Whynot, Blakefield, Glen Munro and Woodlands Hill seams. Approved future mining will also extract from the Broonie series and the Bayswater and Foybrook seams.

There are three recognised types of aquifer occurring within the region:

- Alluvial sediments, primarily associated with the Wollombi Brook;
- Weathered shallow coal measures; and
- Coal seams.

The alluvial sediments typically comprise shallow sands overlying silty and clayey sands with occasional cleaner sand zones. The alluvium can reach thicknesses of 10 m to 15 m, and its porosity and permeability can be high enough to support stock-domestic and irrigation water supplies for bores and wells. Groundwater quality is variable from fresh to brackish.

The weathered shallow coal measures may locally support isolated springs following periods of high rainfall. Seepages from these areas generally cease during extended dry periods. Water quality is not directly measured but likely to vary from slightly brackish to saline (refer to water quality in Section 4.3).

The non-coal interburden sediments within the coal measures are generally regarded as low permeability aquitards with minor aquifers developed within the cleat networks in the coal seams. Isolated secondary storage may also be developed along structural fractures at shallow depths.

4.2 Groundwater levels

4.2.1 Current

Groundwater levels have been monitored at the site since 1998, with the network expanding as the mine has grown. The current network comprises approximately 46 monitoring locations (Figure 3.1). The network is designed to monitor the alluvial groundwater resources of the Wollombi Brook and Monkey Creek Place, and the bedrock units associated with the Whittingham and Wollombi Coal Measures.

Measured groundwater levels at the active monitoring sites are reported quarterly, and reviewed annually and at the completion of each longwall panel. An independent audit of groundwater impacts resulting from the mine was completed in June 2016 (Dundon, 2016). The audit concluded that groundwater impacts were currently within the predicted range in all aspects reviewed.

No groundwater level contour maps are provided in the annual reports or more frequent monitoring reports. Mackie (2013) prepared groundwater level contour maps for 2012 using the site numerical groundwater model. The groundwater levels for four model layers are reproduced in Figure 4.1. These maps show dewatering and depressurisation of the strata associated with both open cut and underground mining. The open cut mines depressurise the strata down to the base of the open cut and a broad area surrounding the pit, whereas the longwall panels have more localised drawdown focussed on the areas overlying the panels due to propagation of connective / subsidence cracking. There is little impact predicted in the alluvial aquifers close to the mines from open cut or underground mining. This has been explained (Mackie, 2013) as a combination of the low permeability of the strata underlying the alluvium and the high storage and recharge within the alluvium itself.

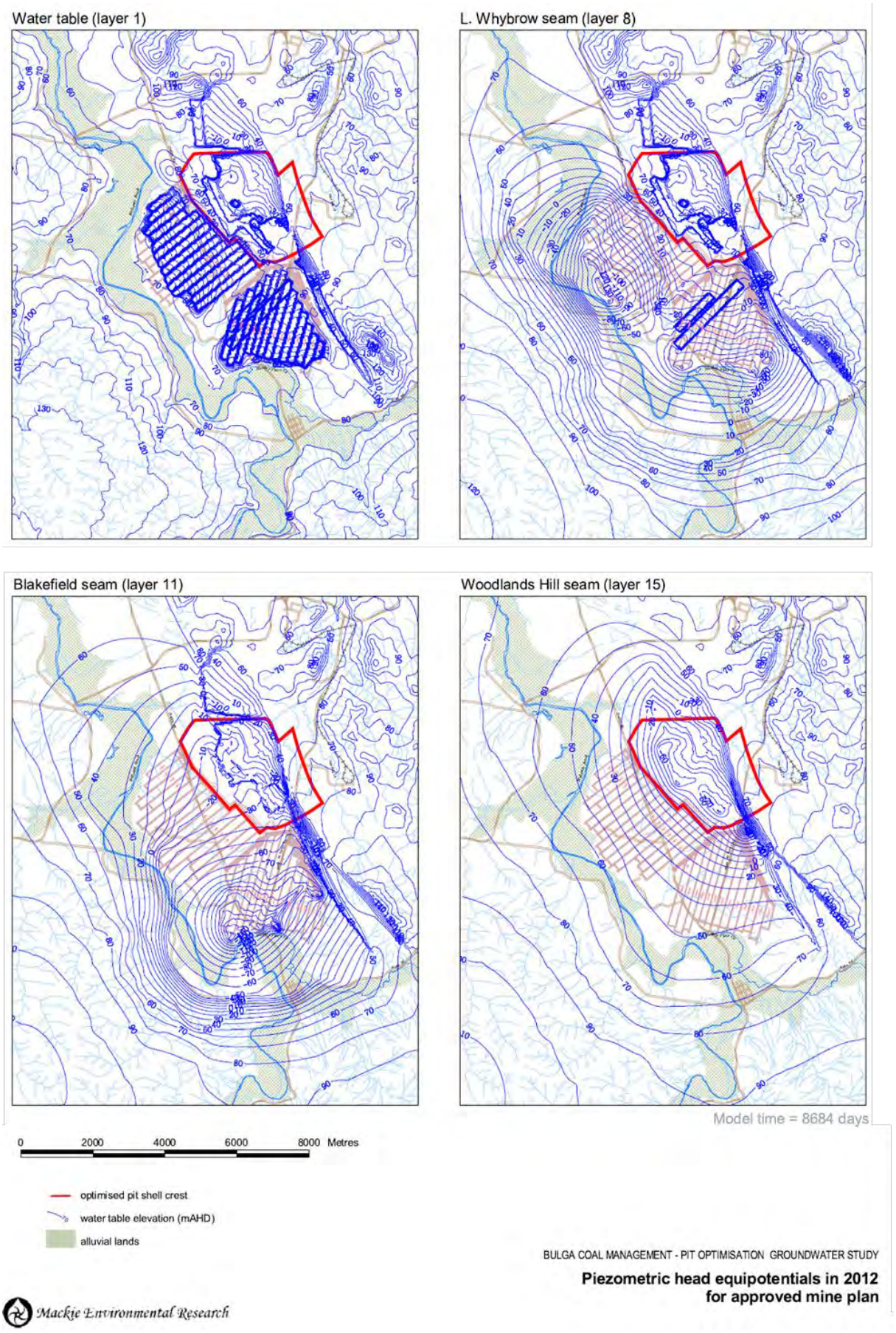


Figure 4.1 Modelled groundwater head contours in 2012 (Mackie, 2013)

4.2.2 Predicted

The modelled mine plan has the Main Pit, comprising the Whybrow and Bulga pits, being worked to a depth of ~200 metres below the original topographic surface. The Main pit will be backfilled and rehabilitated to form an elevated platform above the pre-mining landscape. The Southern Extension pit is planned to be significantly deeper than the Main pit, extracting down to 350 metres below original topography or -270 mAHD. At the end of mining in 2035 the Southern Extension pit will remain a void and will be rehabilitated to eventually form a pit lake. The modelled underground mining will also be completed by 2035, having extracted down to the Woodlands Hill seam.

Predicted heads for four model layers at the end of mining in 2035 (Mackie, 2013) are shown in Figure 4.2. The modelling indicates that adjacent to the mined area there will continue to be little impact on water levels within the alluvial aquifers. There is complex dewatering and depressurisation effects within the deeper layers, associated with both the open cut and underground mines. Contour lines show that the mined areas will form low points in the groundwater system, creating a gradient towards those mined areas.

The predicted heads are an indication of the most likely response of the groundwater system to approved mining activities. Emplacement of the tailings within the open cut pit will require modification of the pit backfilling schedule, however the conceptual final landform remains unchanged, and it is only the timing of the backfilling that will be altered. In this case the modelled groundwater levels predicted for mine closure would not be substantially different from previous predictions.

Groundwater modelling to predict the post closure impact of the mine on groundwater resources (Mackie, 2013) indicated a pit lake would form within the Southern Extension pit which is not fully backfilled. Inflows to the void would occur through groundwater seepage, infiltration through spoil, direct rainfall, and runoff. The only outflow during this time is predicted to be evaporation. The water levels within the void would rise to an elevation of ~ 17 mAHD, or 60 metres below the natural ground surface after 500 years. As this level is well below the regional groundwater levels the void would therefore act as a groundwater sink during this period. The ultimate level of the pit lake under equilibrium conditions has been estimated by Mackie (2013) as 88 mAHD. If the pit lake reaches this level water from the lake could migrate slowly outwards through the rehabilitated overburden. This long term scenario is highly dependent on long term climatic conditions and many other factors such as the final landform adopted at the Mt Thorley mine.

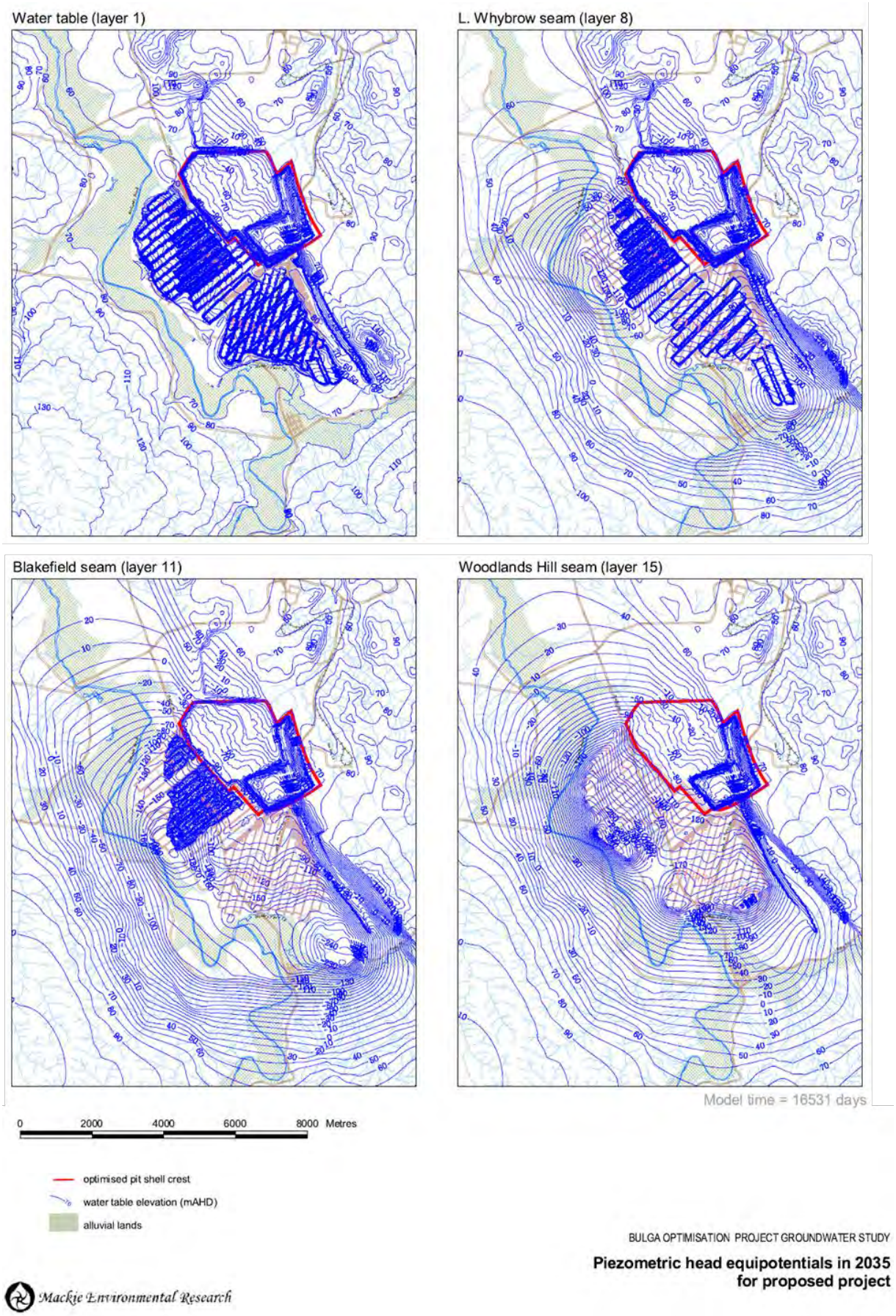


Figure 4.2 Predicted groundwater heads for 2035 (Mackie, 2013)

4.3 Water quality

SLR (2016) provide a summary of groundwater quality at the site within the 2015 Annual Review which is reproduced within Table 4.1. Figure 3.1 shows the locations of bores within each water quality group. The annual review concluded recent results were found within the historically observed ranges for each bore. The pH of groundwater within most bores is neutral to slightly alkaline. Average electrical conductivity (EC) readings show a fresh to brackish salinity. Groups including coal measures or coal seams have slightly higher maximum salinity as indicated by EC measurements.

Table 4.1 Summary of groundwater quality monitoring, 2015 annual average range

Group	Average pH	Average EC (µS/cm)	Number of bores
Broke Area Alluvials	6.62 – 8.6	519 – 6,249	11
Broke Area Wollombi Seam	7.57 – 8.43	5,443 – 10,017	3
Northern Area Shallow Alluvials	6.32 – 7.53	242 – 1,339	5
SBC / Broke Area Lower Whybrow Seam	7.09 – 7.41	1,297 – 8,360	2
Northern Area Lower Whybrow Seam	6.77	1,488	1
Northern Alcheringa Seam	7.05	761	1
Beltana Area Miscellaneous Bores and Wells	7.07 – 7.82	278 - 846	5
Beltana Area NPZ	6.41 – 7.76	144 – 2,648	10
Wollombi Alluvials and Shallow Coal Measures	6.95 – 7.52	767 – 20,312	7

Previous tests on the waste rock and tailings materials indicated a low acid forming potential, with the possible exception of some areas of the basal Archerfield Sandstone and Foybrook seam which may be extracted from the East pit. It was recommended that any materials with higher acid forming potential be placed at depth, below any long term recovered water table, and co-disposed with overburden having a high carbonate presence to buffer any acid generation.

Factors that will determine the long term hydrochemistry of any pit lake will include the composition of the exposed strata on the final pit walls, and the relative proportions of groundwater and runoff that enter the pit lake. Evaporation from the pit lake will concentrate salt within the pit lake.

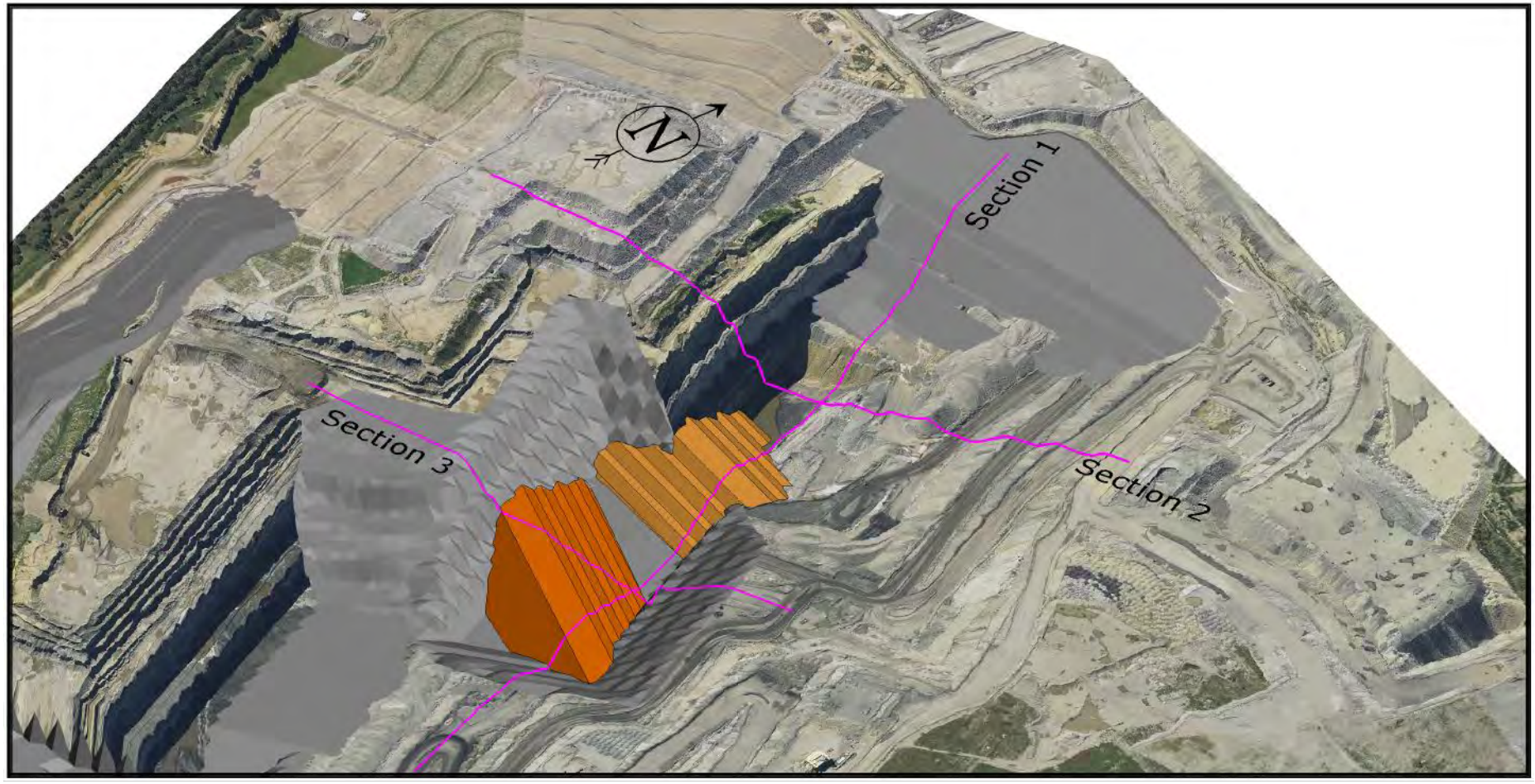
Mackie (2013) concluded that based on the widespread presence of carbonate materials at the site the long term leachate quality of the final void is likely to trend towards a pH range from 7 to 9 and TDS below 4,000 mg/L (equivalent EC ~ 6,000 µS/cm – 7,000 µS/cm).

5 Discussion of revised tailings disposal plan and impacts

5.1 Proposed tailings emplacement plan

The approved tailings disposal plan includes emplacement of tailings into the underground workings. If underground mining is suspended from late 2018 underground disposal of tailings is not currently an option. The proposed revised tailings emplacement location is shown on Figure 3.1, with more detailed sections provided as Figure 5.1 and Figure 5.2. Tailings would be deposited into cells at the base of the Bulga pit within the Main pit, from approximately -60 mRL up to a maximum elevation of 0 mRL. The total volume of tailings to be emplaced is estimated as 7.5 GL.

The tailings will take the place of waste materials such as interburden and coarse reject or thickened tailings which are currently co-disposed during backfilling operations.



Orange areas indicate proposed tailings dams

Figure 5.1 Proposed open pit tailings disposal area (provided by BCM)

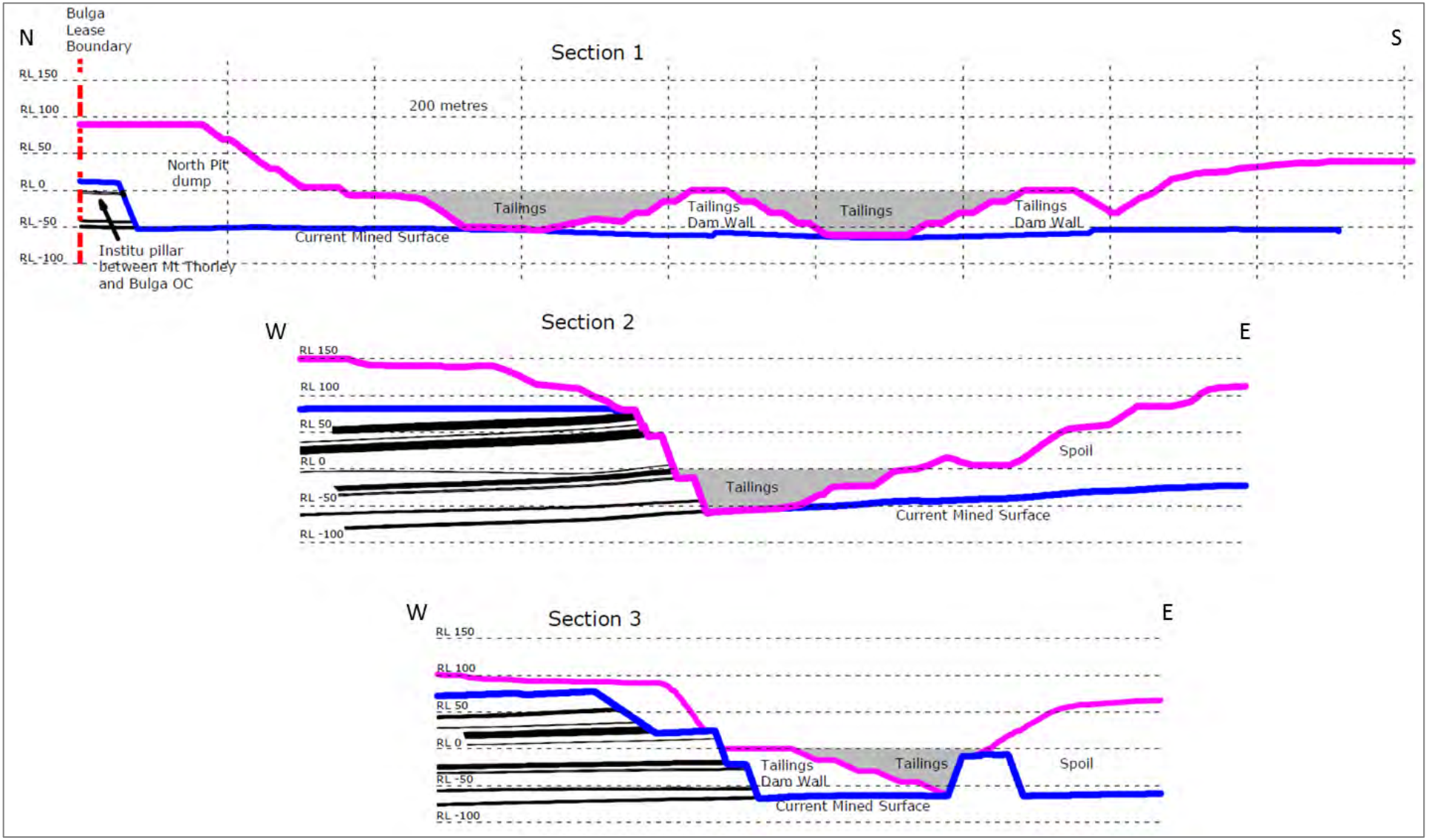


Figure 5.2 Sections through open cut mine showing proposed tailings emplacement (provided by BCM)

5.2 Groundwater level responses

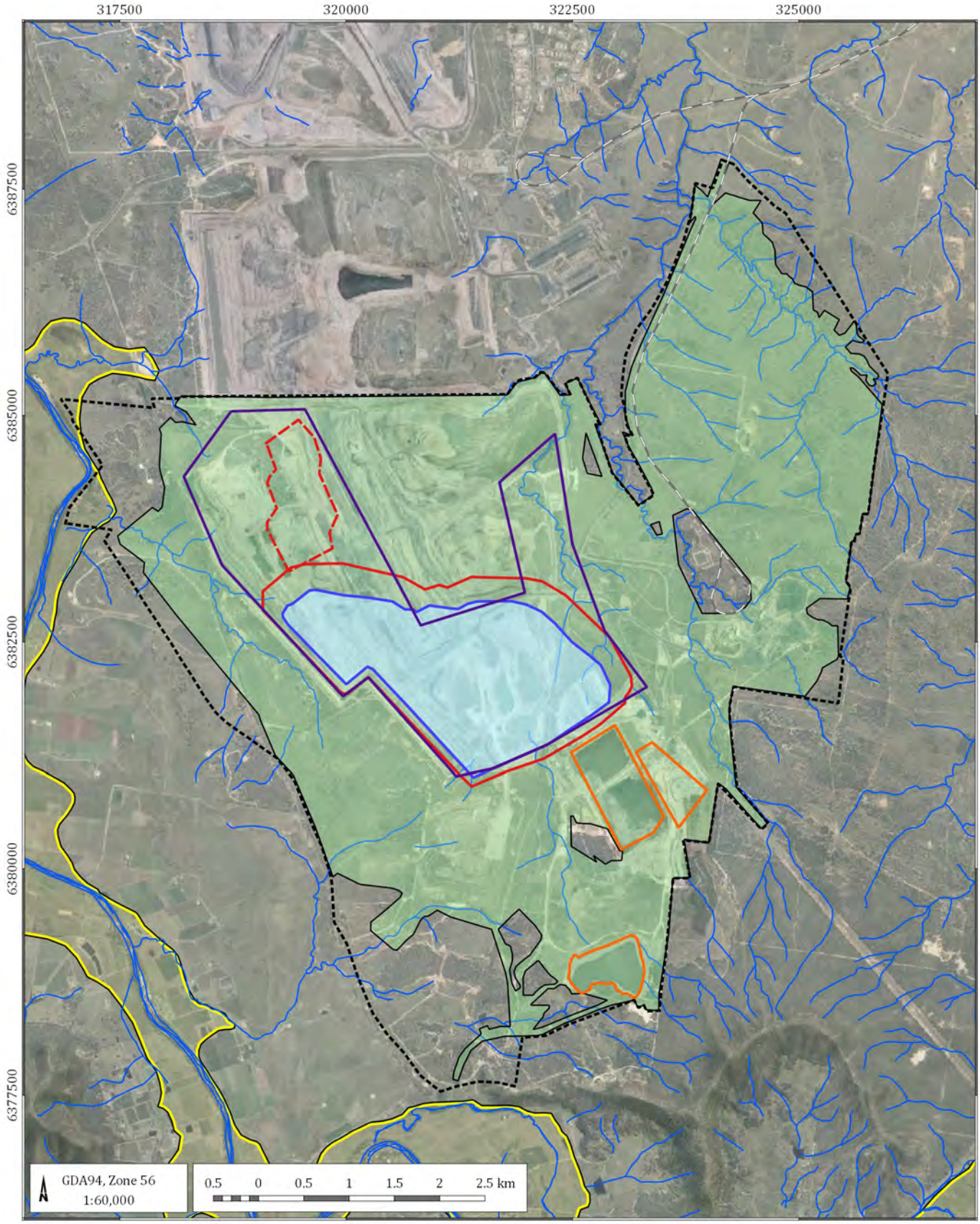
The fine tailings material will be pumped as a slurry to the proposed emplacement area. Once the solids have settled out the tailings water will be removed from the tailings emplacement cell and re-used within the mine water system. During the settling process it is possible that some of the associated water will migrate through fractures or higher permeability zones within the pit walls where these areas have been dewatered during to mining. Any loss of water into the surrounding pit walls is expected to be very limited as an inwards hydraulic gradient remains adjacent to the mined areas promoting groundwater flow from the surrounding groundwater system towards the deeper Southern Extension area. The generally low permeability of the materials will also limit the volume that may seep into the bedrock and any changes in groundwater level are expected to be localised around the tailings emplacement area.

There are no proposed changes to the mined area, depths of the pits, or the final post mining landform. The Main pit, which includes the proposed emplacement area, will be worked to a depth of ~200 metres below the original surface topography. The Southern Extension pit is planned to be significantly deeper, extracting down to 350 metres below original topography or -270 mAHD. As noted the steep hydraulic gradients expected during mining will draw water towards the Southern Extension pit and prevent significant seepage from within the active mining area. Any groundwater inflows to the Southern Extension pit will be collected in sumps and managed in the mine water circuit.

The area of the Main pit containing the proposed tailings emplacement will be rehabilitated to form an elevated landform above the pre-mining landscape. On completion the dry or dewatered tailings material would be encapsulated under at least 100 m of backfill and overburden. The overburden material is expected to physically and chemically weather over time to form a relatively low permeability cap. This significant thickness of capping material will also serve to consolidate the tailings material reducing the hydraulic conductivity and the potential for movement of groundwater through the emplacement.

To the south of the proposed tailings emplacement the Southern Extension pit will remain a void and rehabilitated to eventually form a pit lake (Figure 5.3). The tailings material would be emplaced close to, but not directly exposed within, the pit lake.

As tailings are proposed to be emplaced to a maximum height of 0 mAHD and the Southern void pit lake is expected to only reach 17 mAHD after 500 years it is probable that the tailings would be only partially saturated for a large period of this time.



LEGEND

- Project area
- Optimised pit shell
- Tailings storage facility
- Proposed tailings emplacement area
- Final void
- Final void lake
- Rehabilitation area
- Alluvium
- Rail
- Drainage

Bulga Tailings Review (G1832)

Final landform and tailings location

DATE 17/11/2016

FIGURE No: **5.3**

G:/Projects/G1832.Bulga Tailings Review/3_GIS/Workspaces/001_Deliverable1/05-03_G1832_Final landform and tailings location.qgs

5.3 Groundwater quality responses

Emplacement of tailings at the base of the main pit to a maximum elevation of 0 mAHD will result in minimal chance of the material working its way to the surface over time. However, salts within the tailings materials have the potential to dissolve into the groundwater and then migrate away from the emplacement area.

As discussed in Section 5.2 the hydraulic gradients developed during mining will draw water towards the active pits and there will be no off site movement of the dissolved materials during this period.

Numerical modelling of the site (Mackie, 2013) has suggested that the Southern pit void will remain a local groundwater sink for over 500 years post closure. Any migration of tailings influenced water will therefore continue to be towards the pit for a considerable period of time post mining. The tailings are planned to be deposited up to 0 mAHD, with the post closure pit lake predicted to reach 17 mAHD approximately 500 years post mining. Therefore, in the long term groundwater levels will rise above the elevation of the tailings and limit any potential acid formation. During the intervening period encapsulation of the tailings materials deep within the pit will also reduce oxidation and any potential acid formation.

In theory it is possible that the emplacement of fine tailings in the base of the Main pit will cause a change in pit lake water chemistry. However, given that coarse and thickened tailings are already being co-disposed with overburden the water quality differences will most likely be indistinguishable from currently approved operations. If the tailings are shown to include potentially acid forming materials then the backfill surrounding the tailings should include carbonate rich overburden to prevent or mitigate any acid formation.

A final evaluation of the post closure pit lake hydrochemistry will be undertaken as part of the detailed site closure studies developed towards the end of active mining.

5.4 Potential risks and outcomes from the revised tailings emplacement

The potential risks to groundwater from moving the tailings emplacement from the underground mine to the open cut are summarised in Table 5.1. The table does not summarise the risks to groundwater from mining at the site, only the difference in risks and outcomes that may result from the revised tailings emplacement.

Table 5.1 Summary of potential risks and outcomes from the revised tailings emplacement

Description	Discussion	Likelihood	Consequence	Risk to site surroundings
Tailings emplacement alters groundwater levels during mining	• The open cut pit shells remain unchanged from the approved mine plan which was numerically modelled • The open cut pits, especially the Southern Extension pit, will act as strong groundwater sinks during mining • Tailings are deposited as a slurry and the inward hydraulic gradient along with the low permeability of the bedrock will reduce any migration away from the emplacement area • Settled tailings water will be removed from the tailings emplacement area and re-used within the mine, minimising the volume that could seep into the groundwater	Low	Low	Low
Tailings emplacement alters groundwater levels post mining	• The Southern Extension pit will remain the dominant groundwater sink for over 500 years post mining • Tailings will not contribute any additional water to the system once deposition stops and the area above them is backfilled • Tailings materials are of a lower conductivity than the backfill materials but constitute a small volume of the total area to be rehabilitated. Any changes in level will be localised	Low	Low	Low
Tailings material reaches ground surface after mine closure	• Tailings will be emplaced at depth over 100 m below final ground surface, and the capping material will enhance the consolidation of the tailings over time reducing the permeability and limiting the movement of groundwater through the tailings material	Very low	Medium	Low - Medium

Description	Discussion	Likelihood	Consequence	Risk to site surroundings
Dissolution of tailings materials generates a change in groundwater quality which then migrates away from the emplacement area during active mining	• Open cut pits, especially the Southern Extension pit, will act as groundwater sinks during operations and capture any tailings influenced groundwater • Coarse reject and thickened tailings are already co-disposed with the backfill and overburden • Tailings emplacement in the Underground outside the confines of the Open Cut voids is already approved • Carbonate materials within the waste rock are predicted to buffer any adverse changes in water quality	Low	Low	Low
Dissolution of tailings materials generates a change in groundwater quality which then migrates away from the emplacement area post mining	• The Southern Extension pit will remain a groundwater sink for over 500 years post mining and capture any tailings influenced groundwater • Coarse reject and thickened tailings are already co-disposed with the backfill and overburden • Tailings emplacement in the Underground outside the confines of the Open Cut voids is already approved • Carbonate materials within the waste rock are predicted to buffer any changes in water quality	Low - Medium	Low	Low - Medium

6 Conclusions

Based on the information available for this review it is concluded the risks to the groundwater regime associated with the proposed amendments to the tailings emplacement strategy are minor as:

- Previous assessment of tailings leachate water quality concluded that there was a low acid forming potential at the site, with the possible exception of two units which may be extracted from the East pit, and the natural carbonate at the site would buffer any potential acid generation.
- Under the expected conditions the open pits will act as groundwater sinks during mining and for a considerable period afterwards. This will minimise the potential for any potentially mine affected water to migrate away from the site.
- Coarse reject and thickened tailings are already co-disposed with overburden and backfill materials. There is not expected to be any significant difference in mineral composition between the thickened tailings and fine tailings.
- A significant capping of overburden material over the proposed emplacements will serve to isolate and consolidate the tailings material limiting the permeability and movement of groundwater through the tailings material.

7 References

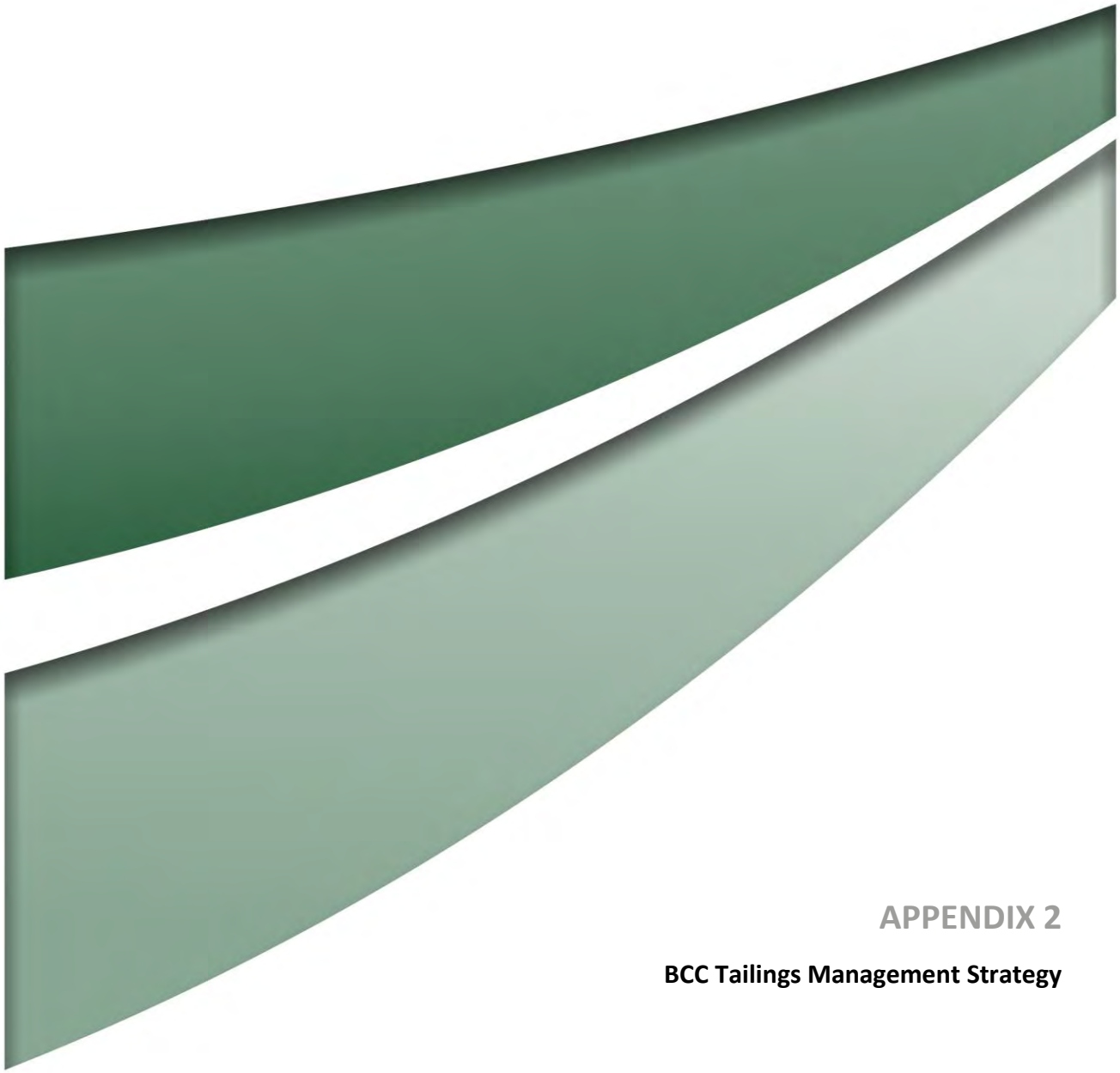
Dundon Consulting Pty Ltd (2016), "*Bulga Underground Operations, Independent Audit of Groundwater Impacts",* June 2016.

Mackie Environmental Research (2013), "*Assessment of groundwater related impacts arising from the proposed Bulga optimisation project"*. Forming Appendix 11 of "*Environmental Impact Statement, Bulga Optimisation Project".*

SLR Consulting Australia Pty Ltd (2015), "*2014 Annual Environmental Management Report – 1 January to 31 December 2014"*.

SLR Consulting Australia Pty Ltd (2016), "*2015 Annual Review – 1 January to 31 December 2015"*.

Umwelt (Australia) Pty Limited (2013), "*Environmental Impact Statement, Bulga Optimisation Project*", April 2013. Volume 1 – Main text.



APPENDIX 2

BCC Tailings Management Strategy

BULGA
OPEN CUT

GLENCORE

Plan for

Tailings Management Plan

Document Number:	BUL CHP PLN 0012
Status:	Approved
Version:	1.0
Effective:	12/09/2016
Review:	15/09/2019
Owner:	[Enter document owner position title]

Table of Contents

1 Purpose

Bulga Surface Operations operates a number tailings emplacement facilities in various stages throughout their lifecycles. This document outlines the various emplacement facilities and details the management of the new Bayswater Pit Emplacement facility.

2 Scope

This document applies to all active Tailings Emplacement Facilities at Bulga Surface Operations. While referenced in this document specific information related to the closure of the Old Tailings Facility can be found in the Old Tailings Facility Capping Management Plan.

3 Bulga Complex Tailings

The Bulga Complex manages a number of reject streams from the onsite CHPP.

Course reject material from the CHPP is collected in the course reject bin.

A paste thickener is utilised to treat approximately 50% of the tailings generated by one of the two modules within the Bulga CHPP. The discharge from the paste thickening process is also collected in the course reject surge bin. The contents of the surge bin are transport for co-disposal in the Bulga Open cut overburden emplacement by rear dump trucks.

The remaining tailings produced within the Bulga CHPP is currently emplaced in Deep

Pit as fine tailings.

In 2017 Bulga Complex will commission a flotation plant which is expected to recover 2.5% increased yield from the existing fine tailings stream. At this point it is expected that the tailing production will decrease by approximately 25-30% and while the volume of paste will remain constant the proportion of paste will increase.

3.2 Tailings Characteristics

The characteristics of the fine tailings produced by the Bulga CHPP were previously described in the

2009 ATC Life of Mine Tailings Disposal Strategy and other relevant documents.

The un-flocculated tailings were described as having the following characteristics:

- pH of 8.46;
- EC of 3,200 mS/cm;
- solid content of 25.5%;
- tailings particle density of2.21 t/m3;
- tailings are very fine grained, with around 95% of the particles passing the 75 micron sieve;
- the tailings fines are highly plastic, and in terms of the Unified Classification System (UCS);
- the material would classify as a high plasticity Clay (CH); and
- Net Acid Producing Potential of the tailings was negligible due to their low pyrite content.

A copy of the particle size distribution report for a typical un-flocculated (pre-flotation) tailings sample from the Bulga CHPP is attached as Appendix A.

The results of drained and undrained tray settlement tests illustrate the effectiveness of flocculent addition in separating the water and solids. The original tailings sample had a final solids content of approximately 33% following settlement, whereas the flocculated tailings sample had a final solids content of approximately 62%. Copies of reports of relevant tray settlement tests are also attached in Appendix A.

3.2.1 Tailings In-Situ Density

Based on ATC Williams report (108028.21-L001)

- Tailings Particle Density – 1.78;
- Initial settled density – 0.63 t/m3; and
- Shrinkage limit density – 1.19 t/m3.

Deposited Bulga coal tailings densities can therefore be generally expected to range between 0.63 t/m3 to 1.19 t/m3 under normally consolidated conditions.

4 Tailings Facilities

4.1 Old Tailings Dam Emplacement Facility

In accordance with Section 100 of the CMH&S Act 2002, Bulga Coal applied to recommence emplacement of tailings in the Old Tailings Dam Emplacement Facility in 2010. Refer to Application to Establish an Emplacement Area Old Tailings Dam for details of application and Old Tailings Dam Approved Tailings Emplacement Plan for location of the facility. Bulga Completed Emplacement in 2015 & is currently decommissioning the Old Tailings Dam Emplacement Facility. This closure is being managed in accordance with the Old Tailings Facility Capping Management Plan

4.2 Deep Pit Emplacement Facility

The Deep Pit TSF is located approximately 2 km South West of the mine site offices and process plant. Tailings deposition has taken place by filling the previously mined Deep Pit. Originally this TSF comprised two cells, namely the North and South Cells, and was separated by a dividing embankment constructed to separate the Deep Pit into approximately two equally sized cells.

The Deep Emplacement facility was commissioned in 1996 as a single southern cell and continued into the northern cell in 2005. The TSF is currently being operated as a single cell facility and the dividing embankment has been covered with deposited tailings.

The TSF is bounded by the Small Bayswater Void (Dam) and new Bayswater Pit along the North Eastern side, waste rock dump (over in situ Permian formations) along the Southern side and a Permian formation high wall on the western.

The Blakefield South / Bulga Underground Operations Administration offices, workshop and car park are located at the north western corner of the facility.

Tailings deposition into the facility is currently taking place from multiple discharge points located around the northern, eastern and southern sides together with a central discharge tower locater in the South East corner.

Decant water is currently being pumped from the Eastern embankment (Eastern end of the old Deep Pit dividing embankment) back to the CHPP Surge Dam (main site water storage facility).

The Facility is scheduled to be completed between December 2016 and March 2017. Since development in 2009, this facility has been managed in accordance with the Life of Mine Tailings Management Strategy developed by ATC Williams.

4.3 Bayswater Pit Emplacement Facility (proposed)

The Bayswater Pit Emplacement facility is proposed to be operated from October 2016. To maximise tailings dewatering and beaching, this facility is to be operated in conjunction with the Deep Pit Emplacement Facility until completion and in conjunction with the Northern Pit Tailings facility when available in 2018.

4.3.1 Deposition Strategy

A deposition strategy has been developed by ATC Williams to optimise tailings emplacement.

The objective of Bayswater Pit deposition strategy is to:

- Optimise the discharge point locations taking into consideration the pit geometry, surrounding topography and location of existing infrastructure;
- Provide a deposition strategy to maximise tailings storage and decant recovery from the TSF;
- Incorporate a decant recovery strategy suitable for the life of the TSF.

In order to achieve the above objectives, the following principles with respect to TSF management apply:

- Utilise the topography of the pit to:
    - Ensure the decant collection location is as far away from the discharge points as possible;
    - Optimise the storage capacity of the TSF by establishing the final locations of the discharge points at as high an elevation as possible.
- Utilise the relatively low permeability characteristics of the tailings to create a seal over the impoundment area, effectively sealing the base to minimise seepage into the surrounding environment;
- Locate decant return water pump and deposition points near existing infrastructure utilised for Deep Pit TSF.
- Multiple deposition points will be located around the TSF to maximise deposition areas allowing for drying time increasing beach angle.
- Secondary flocculation of tailings to improve beach angle and dewatering.
- Utilise the remaining space in the Deep Pit TSF to alternate deposition of tailings between the Bayswater and Deep Pit TSF's to improve drying and beach angle.

4.3.2 Bayswater Pit Emplacement Facility Consequence Category

The design approach adopted for Bayswater TSF is that no tailings or water (decant or flood storage allowance) be retained by waste rock dump materials. The adopted maximum containment (tailings and/or water) elevation of the facility is RL 69 m (based on the level of the original landform between the Bayswater Pit Emplacement Facility and deep Pit emplacement Facility).

A Consequence Category assessment in accordance with Table 2 of the New South Wales Dams Safety Committee "Tailings Dams", Information Sheet has been carried out and can be summarised as follows:

- Population at Risk (PAR) = < 1
- Receiving Environment = Remote / Degraded
- Severity of damage and loss = Medium (saline liquid/unsightly solid)

A Consequence Category of "LOW" is hence proposed for the Bayswater Void TSF. However should a future increase to Tailings level be required, this assessment would need to be re-assessed.

The resulting design criteria, based on the DSC guidelines are as follows:

- Flood Storage Capacity:

  No allowance has been made for a spillway as all tailings and flood water will be contained within the pit area. The required flood storage capacity has been based on a Total Freeboard (vertical distance between the operational decant pond and the minimum pit wall level) required to store the 72 hour duration, 1 in 1,000 AEP (annual exceedance probability) rainfall event.

- Seismic Design: MDE (maximum design earthquake) = AEP 1 in 500

(Criteria adopted for “Significant” consequence category, as no specific criteria apply to “Low” category dams).

Flood Capacity

The estimated flood capacities for a Low Consequence Category facility, as identified above, and assuming no catchment losses is summarised in the Table below.

Flood Capacity Summary

Consequence Category	Flood Storage Requirement	Catchment Area (ha)	Flood Depth (mm)	Required Flood Storage Capacity (m^3)
Low	1:1,000yr, 72hr	40	344	137,600

The catchment area has been determined based on the available ground survey data provided in June 2014 with the inclusion of the final Bayswater Void pit model.

The flood depth of 344 mm has been estimated for the Bulga site using the preliminary procedures outlined in Australian Rainfall and Runoff Guidelines. Estimation of the rainfall depths for storm event AEPs beyond 1: 100 years involves the establishment of the Probable Maximum Precipitation (PMP).

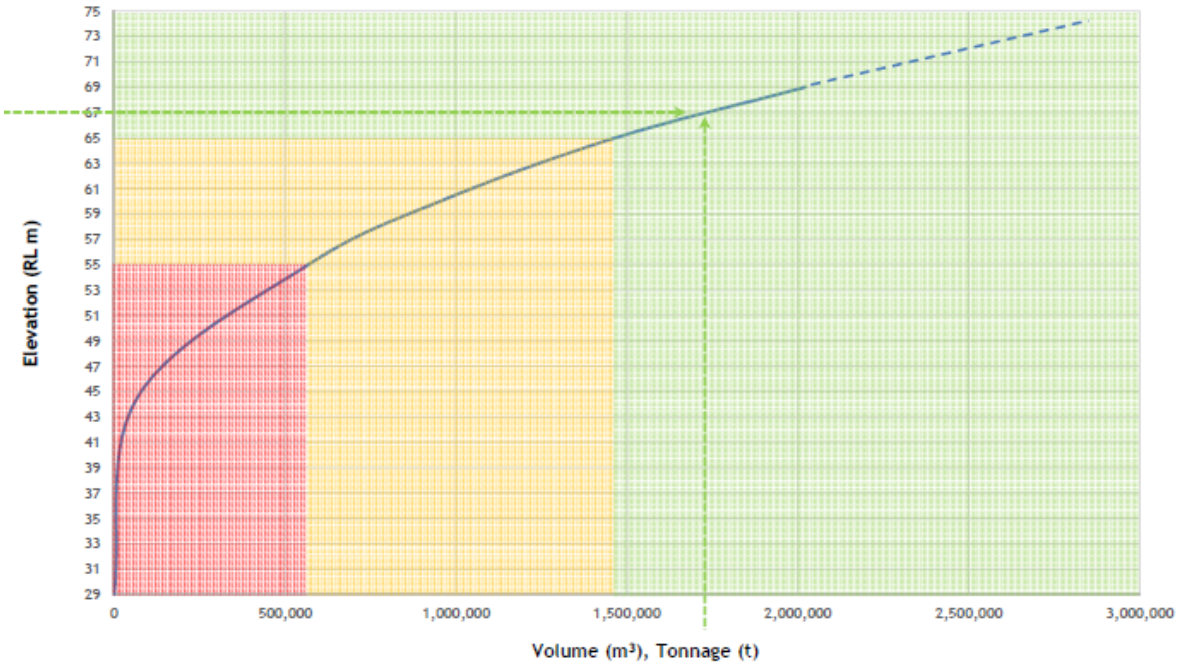
As the TSF is considered an in-pit TSF, the design does not include an emergency spillway and has been designed to contain the deposited tailings and the flood event inflows for a long duration (72 hour) event without overtopping.

4.3.3 Facility Life

Estimated Run of Mine (ROM) feed data has been utilised to calculate the tailings production values based on the following assumptions:

- Until Flotation is introduced:
    - Total tailings estimated to be approximately 9.0% of the total ROM feed;
    - 80% of the produced tailings will be deposited within the Bayswater Void TSF;
    - The remaining 20% will be used as paste backfill;
- In April 2017, a floatation module will be introduced to Bulga CHPP and:
    - the tailings production will reduce by 2.5% to 6.5%; and
    - Paste backfill tonnage proportion will remain constant at 28% (20% of 6.5% tailings production) for the life of the facility (i.e. tailings material reporting to the Bayswater Void TSF will reduce).

Based on September 2016 production estimates, the Bayswater Pit Tailings Emplacement facility will near capacity in Q3 2018. (This estimate does not include concurrent emplacement in the Deep Pit facility.)



4.3.4 Secondary Flocculation

Bulga Coal currently operates a Secondary Flocculation Plant located adjacent to the Deep Pit and Bayswater Pit. This plant will continue to be used to secondary floc tailings deposited into the Bayswater TSF. During the initial stages of the Bayswater Pit Emplacement facility, a strategy of alternating between multiple discharge points and the two active facilities will be used to reduce the rise rate & increase the effectiveness of secondary flocculation.

4.3.5 Deposition Arrangements

Currently two tailings streams (Module1 and Module2) report to the Deep Pit TSF and the Bayswater deposition strategy has been configured accordingly. Splitting the tailings flow will allow the discharged tailings to cover a greater area potentially achieving the following:

- Steeper beach slopes;
- Thinner deposited layers increasing the potential for desiccation and consolidation; and
- Generation of a uniform beach which will assist in optimising the storage capacity of the TSF.

Tailings will be deposited using an arrangement of deposition points around the Bayswater TSF to maximise beach angle and water recovery at the decant point.

Multiple discharge points will be set up along the North East and South West sides of the Bayswater TSF with the ability to operate individual or multiple outlets at any one time.

Valving and pipe arrangements on the main delivery lines will also allow the switching of tailings deposition between the Bayswater and Deep Pit TSF's to improve drying during the overlapping period of operation.

4.3.6 Water Recovery

Skid-mounted diesel decant pump / pumps will be arranged on a gravel pad structure to facilitate the pumping of decant water from the TSF to a main water storage facility. Rock wall filters will be established at the decant area to assist in the segregation of tailings from water.

4.3.7 Risk Assessment

The following risk assessment for the emplacement of tailings in, and the lifecycle of for the Bayswater Pit Emplacement facility has been conducted in line with the Glencore Tailings Storage Management Standard. Actions have been captured and tracked within CMO.

Schedule 1, clause 2 of the Work Health and Safety (mines and petroleum) Regulations 2014 require that all tailings emplacements require the risk of ground or strata failure be considered. This has been addressed within the ATCW Bayswater Void TSF Conceptual Filling Strategy report section 6 and will be Monitored & Controlled in accordance with BSO's Ground and Strata Control Plan. The Inrush & inundation risks are specifically addressed within the ATCW Bayswater Void TSF Conceptual Filling Strategy report sections 6 & 7.

Bayswater Pit TSF Risk Assessment

4.3.8 Mine Operating Plan

The emplacement of tailings within the Bayswater Pit Tailings facility is in accordance with the Bulga Open Cut Mining Operating Plan. Refer to section 2.2.5.

4.3.9 Access & Site Security

The Bayswater Pit emplacement facility perimeter will be excluded from vehicle traffic via windrows and berms with gated access to the ramp leading into the dam.

Access from Broke Road will be prevented via fencing installed along the road easement.

Access to the site will be in accordance with Bulga Coal CHPP's Controlled work Area procedure.

4.3.10 Closure

Upon completion, the Bayswater Pit Tailings Facility will be capped with a stable free drainage landform and rehabilitated in such a way as to prevent long term legacies in regard to safety, stability and environment.

4.4 Northern Pit Emplacement Facility (proposed)

Bulga Coals current Life of Mine Plan contains a Norther Pit Emplacement Facility designed for tailings to be emplaced from 2018 to the current Life of Mine. A development consent modification application for inclusion of the Northern Pit Emplacement Facility was lodged with the Department of Planning and Environment in June 2016.

5 Management of active Tailings Storage Facilities

The Bulga CHPP Water Management Coordinator position includes the responsibility to manage, inspect and report on the status of water dams, Tailings Storage Facilities, Pipelines and Pumps. The Bayswater TSF will be managed by the Bulga Water Management Coordinator, who reports and escalates performance reports or exceptions to the CHPP Production Superintendent and CHPP Manager

6 Transport of Tailings

Tailings is pumped from the CHPP thickeners to the emplacement facility via 2 tailings pipelines and treated with secondary flocculation at the emplacement facility. The tailings lines are marked and double skinned where they travel through environmentally sensitive areas, with real time flow monitoring on tailings lines & level monitoring on spill dams. The pipelines are maintained in accordance with the Failure Modes and Effects Analysis completed in 2010 and reviewed in 2014.

CHPP Tailing System Failure Modes and Effects Analysis

7 Risk Assessment

A number of Risk Assessments associated with Tailings Emplacement and Facility closure have been conducted and are referenced in the plans for each facility above.

An overall Rejects and Tailings Treatments risk assessment has been conducted and is contained within the site Risk Database (CURA).

8 Training and Implementation

All personnel are trained in the risks associated with active and inactive Tailings facilities via the site Induction.

9 Review and Improvement

Active & Inactive Tailings Emplacement facilities are monitored periodically as required by the Ground and Strata Failure Management Plan.

Active & Inactive Tailings Emplacement Facilities are inspected at risk based intervals in accordance with the Bulga Inspection Procedure. This inspection will occur at least daily while tailings is being emplaced.

Active Tailings Emplacement Facilities are reviewed on bi-annual basis to assess emplacement performance against design.

10 Inspections

Inspections of the Bayswater TSF will be conducted in line with site and Glencore requirements, this consists of daily workplace inspections & periodic Geotechnical Inspections as determined by the Bulga Ground and Strata Failure Management Plan.

11 Accountabilities

Role	Accountabilities for this document
Coal Preparation Plant Manager	Provide resources for implementation of Plan. Provide Resources for periodic audits to verify implementation & effectiveness of the Plan.
CPP Superintendent	Monitor effectiveness of Tailing Storage facility inspections, audits and performance. Escalate to CHPP Manager by exception.
All Supervisors	Conduct Daily inspections of Tailing Facilities in accordance with Workplace Inspection Plan. Escalate to CHPP Production Superintendent by exception.
All personnel	CHPP Water Management Coordinator Manage, inspect and report on the status of Tailings Storage Facilities, Pipelines and Pumps. Conduct Periodic inspections of Tailing Facilities in accordance with Tailings Management Plan. Conduct Periodic Performance Assessments of Tailing Facilities in accordance with Tailings Management Plan. Escalate to CHPP Production Superintendent by exception.

12 Document Information

12.1 Related Documents

Related documents, listed in ***Table 12-1*** below, are internal documents directly related to or referenced from this document.

Number	Title
108028.21 – L001	ATC Williams – Bayswater Void TSF Conceptual Filling Strategy (September 2016)
DSC3F	NSW Dams Safety Committee (DSC) "Tailings Dams" Information Sheet
BUL CHP EXT 7836	Deep Pit TSF Operation and Maintenance Manual
CA HSEC STD 0006	Glencore Tailings Storage Management Standard

Table 12-1 – Related documents

12.2 Reference Information

Reference information, listed in ***Table 12-2*** below, is information that is directly related to the development of this document or referenced from within this document.

Reference	Title
External	Work Health and Safety Act 2011
External	Work Health and Safety Regulations 2011
External	Work Health and Safety (Mines and Petroleum) Act 2013
External	Work Health and Safety (Mines and Petroleum) Regulation 2014

Table 12-2 – Reference information

12.3 Change Information

Full details of the document history are recorded in the document control register, by version. A summary of the current change is provided in ***Table 12-3*** below. Example detail shown below.

Version	Date	Review team (consultation)	Change Summary
1.0	13 March 2014		New document

Table 12-3 – Change information

Appendix A - Bulga Fine Tailings Particle Size Distribution report

CLASSIFICATION TEST RESULTS	NATA REPORT No.
	JOB No. 108028.01
CLIENT : Bulga Coal	
CLIENT ADDRESS :	
PROJECT : Bulga Coal Tailings Strategy	LOCATION :

REGISTER NUMBER	SAMPLE DESCRIPTION	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	LINEAR SHRINKAGE (%)	SAMPLE CURLED (CU) / CRUMBLED (CR)
27408	Tailings Un-Flocculated	67	20	47	-	-

☐ Sampled by MPA Williams & Associates Pty, Ltd, in accordance with AS 1289,1,2,1
☒ Sample provided by the client.
Note: The test result relate only to the items tested.

TEST METHODS :

LIQUID LIMIT	☐	AS 1289, 3.1.1	(Standard method)
	☒	AS 1289, 3.1.2	(Subsidiary method)
PLASTIC LIMIT	☒	AS 1289, 3.2.1	
PLASTICITY INDEX	☒	AS 1289, 3.3.1	
LINEAR SHRINKAGE	☐	AS 1289, 3.4.1	
MOISTURE CONTENT	☐	AS 1289, 2.1.1	

SAMPLE PREPARATION :

☐	Natural Moisture	☒	Air Dried	☐	Oven Dried	☐	Unknown
☐	Wet Sieved	☒	Dry Sieved	☐	Unsieved		

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NATA ACCREDITED LABORATORY NUMBER: **3372**
This document is issued in accordance with NATA's accreditation requirements,
Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Approved Signatory ..... Date .....

Name Of Signatory .....

Form No, RSN 002,4 (Tails)
Date of Issue : December, 2007

PARTICLE SIZE DISTRIBUTION

NATA

☐ AS 1289.3.6.1 ☑ AS 1289.2.1.1

☑ AS 1289.3.6.2

☑ AS 1289.3.6.3

REPORT No. :

JOB No. : 108028.01

CLIENT: Bulga Coal

REGISTER No. : 27408

CLIENT ADDRESS:

PROJECT: Bulga Coal Tailings Strategy **LOCATION:**

SAMPLE DESCRIPTION : Un-Flocculated Tailings

BOREHOLE ☐ TEST PIT ☐

No. : DEPTH :

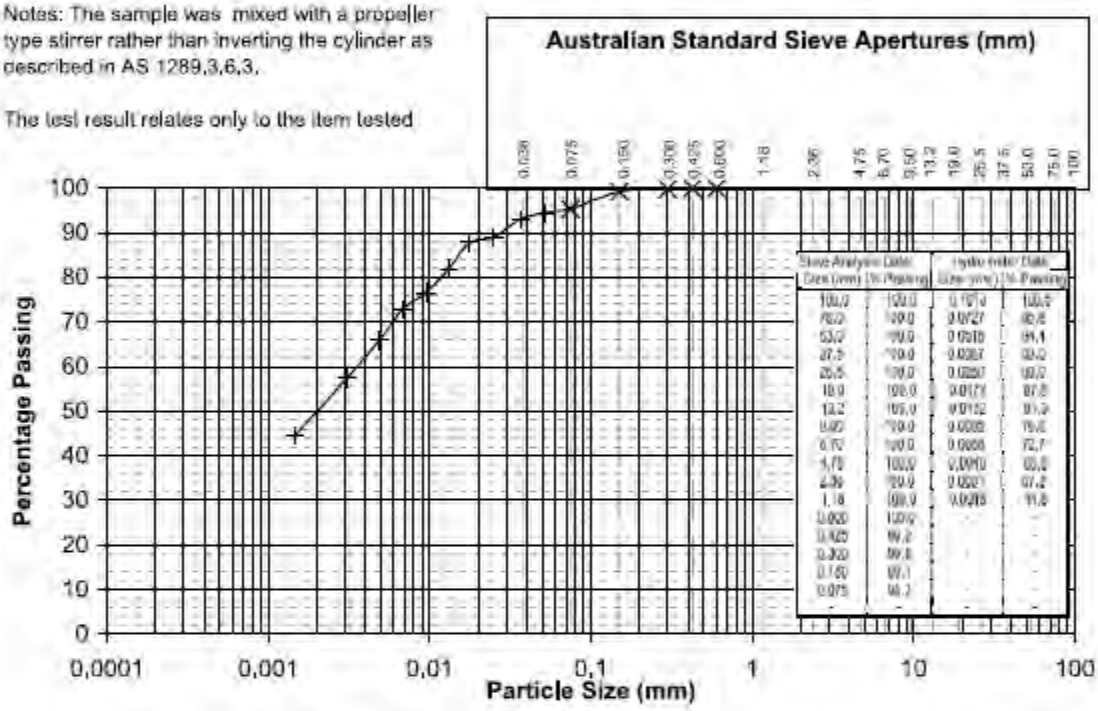
Dispersion Method Used: Mechanical Stirrer. Hydrometer Type Used: ASTM 152H

☐ Sampled by MPA Williams & Associates Pty. Ltd. using a piston sampler (not covered in AS 1289.1.2.1.)

☑ Sample provided by the client.

Notes: The sample was mixed with a propeller type stirrer rather than inverting the cylinder as described in AS 1289.3.6.3.

The test result relates only to the item tested



CLAY	SILT			SAND			GRAVEL			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	0.002	0.006	0.02	0.06	0.2	0.6	2	6	20	60

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Approved Signatory ..... Date .....

Name Of Signatory .....

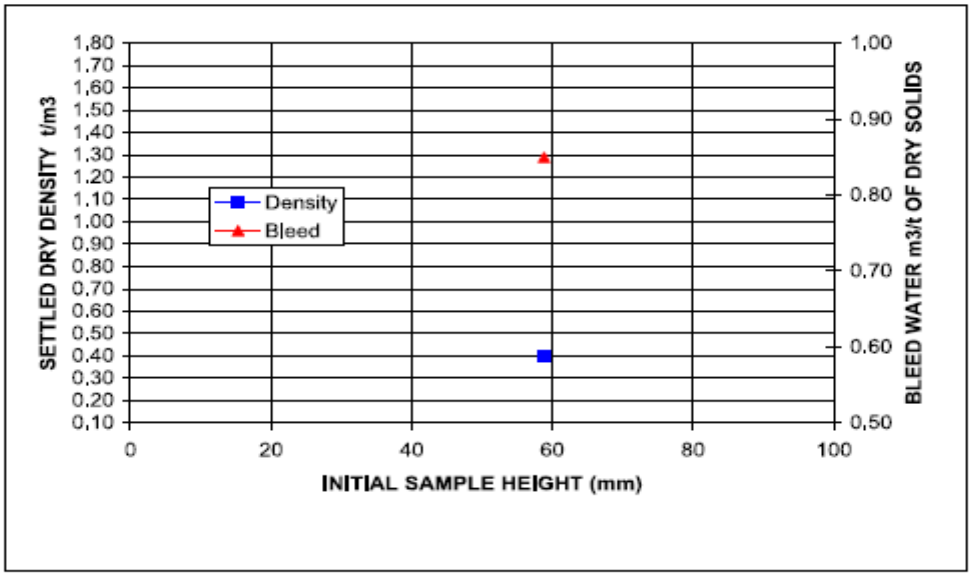
Form No. : RSN 004.11 (PSD)
Date of Issue : December, 2007

108028.01
Bulga Coal Tailings Strategy

SUMMARY OF RESULTS
Tray Settlement Tests

Sample No. **27408** **Tailings**

SOLIDS CONTENT %		SAMPLE DEPTH mm			$(H_F/H_0)x100$	SETTLED	BLEED WATER	
INITIAL	FINAL	INITIAL H_0	FINAL H_F	DH		DRY DENSITY t/m^3	% OF INITIAL WATER	m^3/t OF DRY SOLIDS
25,49	32,53	58,8	44,0	14,8	74,83	0,396	29,06	0,849

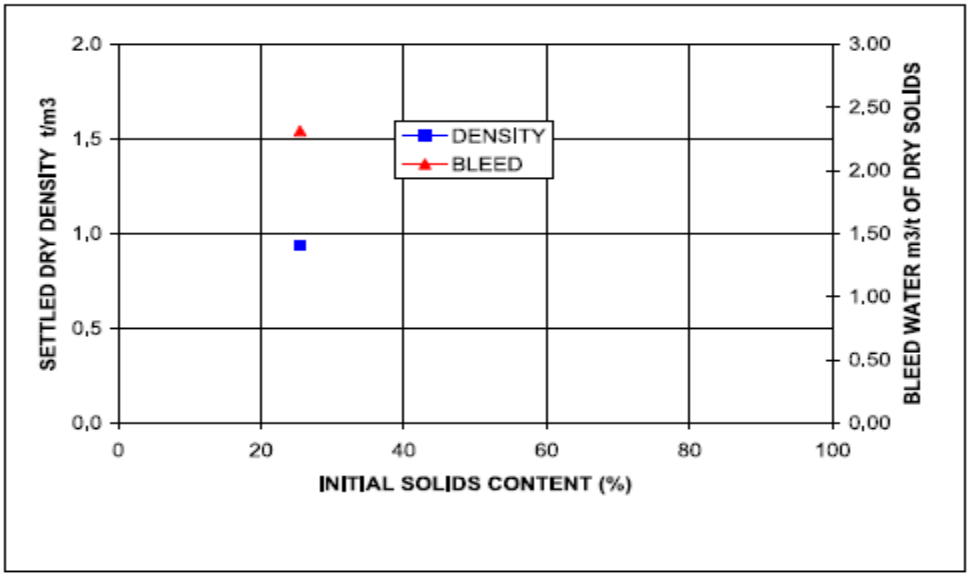


108028.01
Bulga Coal

SUMMARY OF RESULTS
Drained Tray Settlement Tests
(10 kPa Vaccuum)

Sample No. **27808 Flocculated Tailings Sample**

SOLIDS CONTENT %		SAMPLE DEPTH mm			$(H_F/H_0)x100$	SETTLED	BLEED WATER	
INITIAL*	FINAL	INITIAL H_0	FINAL H_F	DH		DRY DENSITY t/m^3	% OF INITIAL WATER	m^3/t OF DRY SOLIDS
25,46	62,03	59,40	18,70	40,70	31,48	0,940	79,09	2,316



Newcastle	Perth	Canberra	Sydney	Brisbane
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