THE WALLERAWANG COLLERIES PTY LIMITED

Environmental Assessment: Ben Bullen Creek Rehabilitation

FINAL

August 2015

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
The Wallerawang Collieries Pty Limited

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Project Manager: David Holmes
Report No. 3451/R01/Final
Date: August 2015
Executive Summary

Baal Bone Colliery is operated by Wallerawang Collieries Pty Limited (Wallerawang), a wholly owned subsidiary of Glencore. Wallerawang is seeking a modification to the approved conceptual final landform plan and associated Project Approval conditions for the Baal Bone Coal Project under Project Approval 09_0178. The modification is being sought under Section 75W of the Environmental Planning and Assessment Act 1979 (EP&A Act) and relates to the final alignment and rehabilitation of Ben Bullen Creek.

Longwall mining at Baal Bone Colliery was completed in 2011. Washing and transport of coal from Baal Bone Colliery continued until Mid 2012 when the site was placed on care and maintenance. Further extraction of remnant coal areas is approved until 30 December 2019. With the completion of longwall mining, plans for the final rehabilitation and eventual closure of the mine are progressing. Rehabilitation of some sections of the mine, including the areas to the north and south of the current mine infrastructure area and Reaches 1 and 3 of Ben Bullen Creek are well progressed. Rehabilitation of the areas around the existing mine infrastructure area are being rehabilitated where there is no further surface disturbance proposed.

A key element of the final rehabilitation of the site is the rehabilitation of Ben Bullen Creek which passes through the mine infrastructure area. The original rehabilitation plan for Baal Bone Colliery contemplated the reinstatement of Reach 2 of Ben Bullen Creek in its pre-mining alignment through the mine infrastructure area. However, an options analysis and concept design study for Ben Bullen Creek by URS on behalf of Baal Bone Colliery in 2014 (Phase 1 Report), identified significant environmental and logistical benefits in retaining and enhancing the existing alignment of Ben Bullen Creek rather than re-establishing the pre-mining creek line. The proposed modification seeks to amend the final landform plan for the mine to allow the creek line to remain in its current alignment, with appropriate rehabilitation works to be undertaken.

The re-establishment of the former alignment of Ben Bullen Creek would require extensive reconstruction works which have the potential to result in downstream environmental impacts with little or no environmental benefit. The location of the former alignment is highly modified having been back-filled and is currently occupied by mining infrastructure used for the ongoing underground operations. Therefore rehabilitation works in this area could not be commenced until after mining is complete and this infrastructure is removed and would therefore extend the mine site rehabilitation period. In contrast, rehabilitation of the existing alignment could commence as soon as the required approvals have been granted.

The proposed modification to the conceptual final landform plan to retain Ben Bullen Creek in its current alignment provides numerous environmental benefits and would result in a more effective and efficient rehabilitation program relative to the existing approved final landform. These benefits include:

- creek line rehabilitation activities can progress while Baal Bone Colliery is still in operation or in care-and-maintenance mode, allowing the final rehabilitation of the area to be completed much earlier
- the existing creek line is known to be geomorphologically stable, having been used as the current stream bed for approximately 30 years, with lower risk of long-term instability and associated downstream impacts compared to constructing a new section of creek along the former alignment
- only minor works are required to improve the geotechnical stability of the existing creek and bank areas, reducing the long-term stability risk and risk of downstream impacts
the existing alignment has existing biodiversity values which will assist in the rehabilitation process, meaning that the timeframe required to achieve appropriate biodiversity values of the restored creek is reduced

the earthworks required to reinstate the creek to its pre-mining alignment are substantial and would result in environmental impacts which, whilst manageable, can be avoided if the existing alignment is retained

reinstating the former alignment requires earthworks in the infrastructure area in locations where soil contamination may have occurred and this matter is best investigated and resolved separately following the completion of operations, rather than during the process of re-establishing the water course

final rehabilitation of the site can be achieved earlier with reduced risk to the downstream environment.

In addition to achieving the above environmental benefits, the rehabilitation of the existing creek alignment can be achieved with lower upfront costs and reduced ongoing maintenance costs compared to re-establishing the former alignment. The proposed modification is being sought to enable these benefits to be realised.
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APPENDICES

1 Letter from Department of Planning and Environment – Dated 27/08/2014
2 Phase 1 - Options Analysis and Concept Design. Baal Bone – Ben Bullen Creek Rehabilitation – URS, 2014
3 Agency Comments (DRE, NOW, OEH, EPA)
1.0 Introduction

Baal Bone Colliery is operated by Wallerawang Collieries Pty Limited (Wallerawang), a wholly owned subsidiary of Glencore. Wallerawang is seeking a modification of the approved final landform plan and associated Project Approval conditions for the Baal Bone Coal Project under Project Approval 09_0178 (the Project Approval). The modification is being sought under Section 75W of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and relates to the final alignment and rehabilitation of Reach 2 of Ben Bullen Creek.

Baal Bone Colliery is currently managed under care and maintenance status with longwall mining being completed in 2011. Further underground mining operations are approved to extract areas of remnant coal until 30 December 2019.

With the completion of longwall mining, plans for the final rehabilitation and eventual closure of the mine are progressing. Rehabilitation of areas to the north and south of the current mine infrastructure area are well progressed with the areas around the existing mine infrastructure area being rehabilitated where there is no further surface disturbance proposed. Condition 22 of the Project Approval requires rehabilitation of the site in a manner generally consistent with the proposed rehabilitation strategy set out in the Environmental Assessment for Baal Bone Colliery (AECOM 2010) (2010 EA) and depicted conceptually in the Final Landform figure in Appendix 4 of the Project Approval (refer to Figure 1.1). The Final Landform figure in the Project Approval and 2010 EA identify Ben Bullen Creek being reinstated to its pre-mining alignment through the mine infrastructure area. However, recent studies associated with developing the design of the rehabilitation of this area have identified that there are considerable environmental benefits in retaining and enhancing the existing alignment of Ben Bullen Creek rather than re-establishing the pre-mining alignment.

The proposed modification seeks to amend the final landform plan for the mine site and associated Project Approval conditions to enable the retention of Ben Bullen Creek in its current alignment through Reach 2.

This Environmental Assessment has been prepared by Umwelt (Australia) Pty Ltd (Umwelt) on behalf of Wallerawang to assess the environmental impacts of the proposed change to the alignment of Reach 2 of Ben Bullen Creek. It has been prepared in accordance with requirements set out in the letter from the DP&E dated 27 August 2014 (*Appendix 1*) and will accompany Wallerawang’s modification application.
FIGURE 1.1
Approved Final Landform Plan
2.0 Baal Bone Colliery and Existing Environment

2.1 Baal Bone Colliery

Baal Bone Colliery is an underground coal mine located approximately 5 kilometres north east of Cullen Bullen and 25 kilometres north west of Lithgow (refer to Figure 2.1). Baal Bone Colliery is located within the Lithgow Local Government Area (LGA). The Colliery is bordered to the north and east by the Capertee and Wolgan Valleys respectively with the Invincible Colliery located to the south and private property to the west. A number of other coal mines are located within the region, including Airly, Angus Place, Pinedale, Lamberts Gully and Springvale Collieries.

Baal Bone Colliery has a long history of coal mining. The mine surface infrastructure is located on the site of the former Ben Bullen open cut mine which commenced production in the 1940s. Underground mining operations having been undertaken at the mine since 1983. Baal Bone Colliery currently operates under a project approval (PA09_0178) granted in 2011 under Part 3A of the EP&A Act (the Project Approval). The Project Approval provided for the continuation of operations at Baal Bone Colliery and the rehabilitation of the site following cessation of mining activities. Baal Bone Colliery is currently managed under care and maintenance status with longwall mining being completed in 2011. Further underground mining operations are approved to extract areas of remnant coal until 30 December 2019.

The development approved by the Project Approval is described in the 2010 EA. The general layout of the colliery is shown in Figure 2.2.

Operations at Baal Bone Colliery which were approved in 1982 resulted in the diversion of Ben Bullen Creek to the west of its original alignment to accommodate part of the mine infrastructure areas associated with underground workings. The present alignment of Ben Bullen Creek has been in place for approximately 30 years.

2.2 Approved Rehabilitation Plan for Ben Bullen Creek

The 2010 EA identified the rehabilitation of Ben Bullen Creek as a key component of developing a suitable post mining landscape. For management purposes, the rehabilitation of Ben Bullen Creek has been divided into three reaches. The reaches of Ben Bullen Creek are shown on Figure 2.3. The rehabilitation of Reaches 1 and 3 has been largely completed in accordance with the Project Approval. The changes to the final alignment of Ben Bullen Creek proposed in this application for modification do not apply to Reaches 1 and 3 of Ben Bullen Creek.

The objectives for the rehabilitation of Ben Bullen Creek were set out in a document prepared in consultation with Department of Water and Environment (now known as NSW Office of Water (NOW)) and the Department of Industry and Investment (now known as NSW Department of Industry, Division of Resources and Energy (DRE)) referred to as the Natural Channel Design and Restoration Plan (Revegetation Contractors Pty Ltd, 2007). These objectives included the reinstatement of Ben Bullen Creek to its pre-mining alignment.
The 2010 EA adopted the recommendations of the *Natural Channel Design and Restoration Plan* and identified that the rehabilitation of Reach 2 would include the re-creation of the original alignment of Ben Bullen Creek. The approved final landform (refer to Figure 1.1) shows the primary channel for Ben Bullen Creek as being the pre-mining alignment with the existing alignment forming a secondary drainage channel for run-off from the south east rehabilitation area. This drainage line would intersect with Ben Bullen Creek at the Southern end of Reach 2. The re-creation of the pre-mining alignment of Ben Bullen Creek through Reach 2 was proposed to be completed following mine closure as the original alignment ran through an area that is currently part of the mine infrastructure area supporting the underground operation. The location of the pre-mining flow path has been difficult to identify with any certainty from pre-mining aerial photography or topographic mapping and there are few remnants of the former creek line remaining. Notwithstanding, the alignment identified in the 2010 EA was considered generally representative of the likely path (URS, 2014).

To undertake the approved works, the following activities would need to take place:

- decommissioning of all infrastructure facilities
- investigation of, and if necessary remediation of, any soil contamination in the infrastructure area
- excavation of channel for proposed creek line, channel and bank stabilisation works
- revegetation of recreated riparian areas (starting from bare earth)
- the existing (realigned) creek line would need to be realigned as an overflow channel in the event of floods.

The rehabilitation of Ben Bullen Creek to its pre-mining flow path would not be able to commence until mining operations have ceased and the decommissioning and demolition of all the infrastructure currently built across the pre-mining alignment has been completed. This is not likely to occur until at least 2020.

Condition 16 of Schedule 3 of the Project Approval requires the preparation of a management plan known as the Ben Bullen Creek Natural Channel Design and Restoration Plan which will detail the final rehabilitation plan for Ben Bullen Creek and address geotechnical issues associated with the re-instatement of the creek and the remediation of the current alignment. While the name of the plan is similar to the 2007 plan developed in consultation with NOW and DRE and the approved Final Landform Plan (refer to Figure 1.1) reflects the recommendations in that plan, the Ben Bullen Creek Natural Channel Design and Restoration Plan required by the Project Approval is a standalone plan which must address a number of additional matters set out in Condition 16.

Condition 14 of Schedule 3 of the Project Approval requires implementation of the Ben Bullen Creek Natural Channel Design and Restoration Plan.
2.3 Environmental Context

2.3.1 Site context

The Baal Bone Colliery lease area is located on the watershed of the Great Dividing Range, which separates the eastern fall Hawkesbury-Nepean Catchment from the western fall Central West Catchment near the town of Cullen Bullen. The lease area is divided between the two catchments.

The catchment area for Ben Bullen Creek includes undisturbed natural catchment immediately east of the mine, and also includes most of the mine infrastructure area. Both Ben Bullen Creek and Baal Bone Creek flow into Jews Creek which forms part of the Central West Catchment, and flows westward to the Turon River which reports to the Macquarie River.

Land further to the east and south of the mine site forms part of the Colo River sub catchment within the Hawkesbury Nepean Catchment. The south eastern portion of the site includes the headwater streams of the Coxs River which also forms part of the Hawkesbury Nepean Catchment and supplies Warragamba Dam.

The topography, hydrology and catchment areas of Baal Bone Colliery are shown on Figure 2.3.

The full length of Ben Bullen Creek within the mine site area is approximately 4 kilometres. The upper reaches of the catchment consist of rugged hills with steep sided ridgelines rising to over 1050 metres in elevation and are covered in largely undisturbed forest and woodland vegetation. In this area, the creek is undefined and consists of many gullies that converge into one creek depression just south of the Colliery Holding boundary (refer to Figure 2.3). The lower reaches of the creek flow through areas previously disturbed by operations at Baal Bone Colliery. Ben Bullen Creek flows in to Jews Creek just outside the Baal Bone Colliery Holding. Downstream of the confluence, Jews Creek flows through open farmland as a small creek depression (URS, 2014).

2.3.2 Existing Rehabilitation of Reaches 1 and 3

Rehabilitation of the Ben Bullen Creek in Reaches 1 and 3 (refer to Figure 2.3) has been substantially undertaken consistent with the approved final landform plan and rehabilitation requirements of the Project Approval. No changes are proposed to the alignment of Reaches 1 and 3 of Ben Bullen Creek.

2.3.3 Existing Rehabilitation of Reach 2

Rehabilitation of some areas of Baal Bone Colliery, predominately those areas impacted by open cut operations, is already well advanced. Areas currently required for the underground operations will be rehabilitated following cessation of underground mining activities, currently approved until 30 December 2019.
**Figure 2.4** shows 2014 satellite imagery of the areas of Baal Bone Colliery adjacent to Reach 2. As can be seen from **Figure 2.4**, mining activities have disturbed a large portion of the area shown in the figure. Some areas will continue to be required for surface operations associated with the mining of the approved remnant areas of coal remaining in the underground workings. These areas include the mine infrastructure area and the coal stockpile area shown on **Figure 2.4**. The coal conveyor crossing the current alignment of Ben Bullen Creek is used to transfer coal from the underground workings to the coal stockpile area. This conveyor is constructed on an earthen embankment across Ben Bullen Creek. The haul road located on the lower (northern) end of Reach 2 will also remain in place for some time to facilitate access to rehabilitation areas to the north (refer to **Figure 1.1**). Ben Bullen Creek currently passes through large culverts under both the coal conveyor and haul road.

Rehabilitation of most areas in and around Reach 2 to achieve the outcomes identified in the Final Landform Plan (refer to **Figure 1.1**) can only occur following cessation of mining activities and, as such, have not yet commenced. Notwithstanding, some revegetation of areas adjacent to the current alignment of Ben Bullen Creek through Reach 2 has occurred and provides some existing habitat and biodiversity benefits.

**Plates 1** to **3** show the current state (November 2014) of the northern sections of Reach 2 with **Plates 4** to **6** (taken in 2013), showing the Southern sections of Reach 2 in 2013. As can be seen from these Plates and **Figure 2.4**, vegetation can be seen growing adjacent to Reach 2 of Ben Bullen Creek. The predominate tree species in the northern area (refer to **Plate 1** is Radiata Pine however native shrubs and small trees are also present (refer to **Plates 1** and **2**). Mature eucalypt trees (predominately Ribbon Gum) are also present in some areas adjacent to Reach 2 (refer to **Plate 6**).

Vegetation on slopes and riparian areas adjacent to Reach 2 is patchy however sections contain vegetation with groundcover, understorey and canopy species present (refer to **Plate 6**). Weed species will be required as part of the final rehabilitation of the site however, as can be seen in **Plates 1** to **6**, Radiata Pine and native species are establishing themselves along the creek bank and adjacent areas. Significant additional revegetation work is required and the establishment of vegetation in these areas will be assisted by the existence of shrubs and trees already in place.

As can also be seen from **Plates 1** to **5**, there is little evidence of stream bank erosion and the stream bed is well established. As can be seen from **Plate 4**, sections of the creek currently run on bedrock material with other sections running through areas of Common Reed (refer to **Plates 3** and **5**).
FIGURE 2.4
Reach 2 Rehabilitation

Legend
- Current Ben Batten Creek Alignment
- Pro Mining Alignment
- Water Storage Dam (retained)
Plate 1 – View of northern section of Reach 2.

Plate 2 – Vegetation adjacent to Northern section of Reach 2
Plate 3 - Reeds in bed of stream in northern section of Reach 2 (looking south)

Plate 4 – Stream bed in Reach 2 on bedrock
Plate 5 - Remnant highwall adjacent to Reach 2 with conveyor bridge over Reach 2 in background.

Plate 6 - Vegetation on the western side of the Reach 2 creek line (existing alignment), dominated by a canopy of Ribbon Gum
3.0 Proposed Modification

Wallerawang commissioned an options analysis and concept design study for Ben Bullen Creek to facilitate the development of the Ben Bullen Creek Channel Design and Restoration Plan as required by Condition 16 of the Project Approval. A copy of this Phase 1 Options Analysis and Concept Design Report (Phase 1 Report) (URS, 2014) is included in Appendix 2. The Phase 1 Report identified significant environmental benefits in retaining the existing alignment of Ben Bullen Creek (i.e. the realigned alignment), rather than reinstating the creek to its pre mining alignment.

As a result of the findings from the Phase 1 Report Wallerawang is seeking to modify the Project Approval to retain Ben Bullen Creek in its current alignment through Reach 2 to realise these environmental benefits.

The proposed modification will include the following works:

- some stabilisation works required on the banks, but overall minimal additional surface disturbance along the existing Ben Bullen Creek alignment
- continued enhancement of vegetation along the established Ben Bullen Creek alignment focussing on native riparian vegetation
- removal of the haul road crossing Northern end of Reach 2 and the coal conveyor bridge and embankment following cessation of mining
- rehabilitation of the mine infrastructure area following completion of mining activities. This will include works associated with drainage of this area and development of an overflow channel for high flow events in Ben Bullen Creek.

The physical bank stabilisation works and revegetation along the existing Ben Bullen Creek alignment are not additional work that is required as a result of the amendment as these works would have been required irrespective of the final creek alignment through Reach 2 to ensure a stable landform. With the exception of the removal of the haul road and coal conveyor bridge, these rehabilitation works along the existing creek line alignment can commence immediately, with no delay pending the eventual closure of the colliery. The removal of the haul road at the northern end of Reach 2 will occur following cessation of mining activities.

The detailed design of the rehabilitation works for Ben Bullen Creek will be identified in the Ben Bullen Creek Rehabilitation Plan which will require approval from the DP&E prior to implementation.
3.1 Proposed Modifications to Project Approval

The following modifications to the conditions of Schedule 3 of the Project Approval are being sought by Wallerawang to accommodate the proposed modification.

**Ben Bullen Creek**

13. The Proponent shall restore Ben Bullen Creek to the satisfaction of the Secretary, in general accordance with the Ben Bullen Creek Rehabilitation Natural Channel Design and Restoration Plan.

**Water Management Plan**

14. The Proponent shall prepare and implement a Water Management Plan for the project to the satisfaction of the Secretary. This plan must:

   (a) be prepared in consultation with the EPA, DPI, DRE and NOW by suitably qualified expert/s whose appointment/s have been approved by the Secretary;  
   (b) be submitted to the Secretary for approval prior to carrying out any construction on site; and  
   (c) include:

      • a detailed Site Water Balance;  
      • the Ben Bullen Creek Natural Channel Design and Restoration Rehabilitation Plan;  
      • an Erosion and Sediment Control Plan;  
      • a Surface Water Monitoring Program;  
      • a Groundwater Monitoring Plan; and  
      • a Surface and Ground Water Response Plan.

16. The Ben Bullen Creek Natural Channel Design and Restoration Rehabilitation Plan must include:

   (a) geomorphic and geotechnical assessment of the existing alignment of Ben Bullen Creek diversion;  
   (b) assessment of flood hydraulics of the existing alignment of Ben Bullen Creek diversion;  
   (c) staging and timing of remediation works;  
   (d) detailed design of bed and bank remediation works;  
   (e) revegetation and rehabilitation methods;  
   (f) a program to monitor surface water flows, quality, stream health and channel stability; and  
   (g) an implementation program.

**Rehabilitation Objectives**

22. The Proponent shall rehabilitate the site to the satisfaction of the Deputy Secretary of DRE. This rehabilitation must be generally consistent with the proposed rehabilitation strategy described in the EA (and depicted conceptually in Figure 1 in Appendix 4), and achieve the objectives in Table 6.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ben Bullen Creek</td>
<td>Hydraulically and geomorphically stable with established riparian vegetation.</td>
</tr>
<tr>
<td></td>
<td>To be restored generally to its pre-disturbance flowpath, with established riparian vegetation.</td>
</tr>
</tbody>
</table>

As a consequence of modifying the above project approval conditions, Wallerawang is also seeking to amend the approved Final Landform Plan included as Figure 1, Appendix 4 of the Project Approval to reflect the retention of the current Ben Bullen Creek Alignment as the primary creek line channel in the final landform.

The revised indicative Final Landform Plan is provided as Figure 3.1.
4.0 Planning Context

4.1 EP&A Act Assessment and Approval Requirements

Wallerawang is seeking a modification to the Project Approval under Section 75W of the EP&A Act. Although Part 3A has been repealed, clause 3(1) of Schedule 6A of the Environmental Planning and Assessment Regulation 2000 provides transitional arrangements for the continued use of section 75W to modify project approvals granted under Part 3A.

DP&E provided requirements for the environmental assessment for the modification in the letter dated 27 August 2014 (refer to Appendix 1). These requirements and where they are addressed in this Environmental Assessment are outlined in Table 4.1.

Table 4.1 – DP&E Assessment Requirements

<table>
<thead>
<tr>
<th>Assessment Requirement</th>
<th>Section Reference</th>
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<tbody>
<tr>
<td>Confirm the proposed approval pathway and describe the proposed modification to the conditions of approval.</td>
<td>Refer to Sections 3.0 and 4.0</td>
</tr>
<tr>
<td>Compare in detail the short, medium and long-term merits of retaining the creek in its current alignment with restoring the creek to its pre-mining flow path.</td>
<td>Refer to Section 6.5</td>
</tr>
<tr>
<td>Include an assessment of the following:</td>
<td></td>
</tr>
<tr>
<td>Short-term and long-term geomorphic and geotechnical integrity of the proposed alignment of Ben Bullen Creek.</td>
<td>Refer to Section 6.2.</td>
</tr>
<tr>
<td>Baseline data and/or hydrologic modelling of surface water flows and quality in Ben Bullen Creek, including sections downstream of the current diversion that could be impacted by the proposed modification.</td>
<td>Refer to Appendix 2. Further detail to be provided in Ben Bullen Creek Rehabilitation Plan.</td>
</tr>
<tr>
<td>Flood hydraulics and velocities associated with, or which may be affected by, the current diversion.</td>
<td>Refer to Appendix 2. Further detail to be provided in Ben Bullen Creek Rehabilitation Plan.</td>
</tr>
<tr>
<td>Appropriate design of any proposed creek bed and bank remediation works, and the staging and timing of these works.</td>
<td>Refer to Section 6.5 and 7.0 Further detail to be provided in Ben Bullen Creek Rehabilitation Plan.</td>
</tr>
<tr>
<td>Biodiversity impacts, including • current aquatic and riparian ecosystems and their functionalities;</td>
<td>Refer to Section 6.4.</td>
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<tr>
<td>• potential impacts and/or benefits of remediation works on ecosystem functionality;</td>
<td></td>
</tr>
<tr>
<td>• how aquatic and riparian ecosystems would be further enhanced, established and monitored over time;</td>
<td></td>
</tr>
<tr>
<td>• impediments to fish passage, and the proposed removal of these impediments;</td>
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</table>
As discussed in Section 3.0, the proposed modification seeks to retain the current alignment of Ben Bullen Creek. The proposed modification will not affect the nature of other approvals already required under other State legislation for Baal Bone Colliery, however, it will require a variation of Mining Operations Plan (MOP)/Rehabilitation Management Plan approved by NSW Department of Industry, Division of Resources and Energy (DRE). The changes to the MOP and a general discussion of approvals related to works on and adjacent to waterways are discussed below.

### 4.2 Mining Operation Plan

Under the Mining Leases held for Baal Bone Colliery, all rehabilitation works are to be undertaken in accordance with an approved MOP. The currently approved MOP reflects the existing approved final landform plan in the Project Approval (refer to Figure 2.2). The MOP will require amendment to reflect changes associated with the retention of the existing Ben Bullen Creek alignment in the final landform and the proposed change to the Rehabilitation Objectives in Table 6 and Condition 22 of Schedule 3 of the Project Approval (refer to Section 3.1). These changes will also be detailed in the Ben Bullen Creek Rehabilitation Plan which will form part of the MOP. Further details regarding the requirements for the MOP are provided in Section 7.0.

### 4.3 Water Approvals

As the current alignment of Ben Bullen Creek will be retained, no additional approvals will be required under the Water Management Act 2000 or Water Act 1912. A controlled activity approval under Part 3 of the Water Management Act 2000 will not be required as the works will be carried out in accordance with the terms of mining leases granted under the Mining Act 1992.

The geotechnical works associated with rehabilitation of the existing alignment and works associated with the remediation of the mine infrastructure area will not involve the take of any ground or surface water and accordingly, no additional water supply licence requirements are triggered.
5.0 Stakeholder Consultation

Consultation for the proposed modification has been undertaken as part of the preparation of the Ben Bullen Natural Channel Design and Restoration Plan required under the Project Approval.

An initial meeting to discuss the restoration of the existing alignment of Ben Bullen Creek was held with DP&E on 30 May 2013. Following that meeting Wallerawang commissioned URS to prepare the Phase 1 Report. Following the completion of the Phase 1 Report a further meeting was held with DP&E on 5 June 2014 to discuss the findings of the Phase 1 Report, including the proposed change to the final alignment of Ben Bullen Creek.

In response to the meeting on 5 June 2014, correspondence from DP&E was received on 28 August 2014 confirming that a modification to the Project Approval was required and detailing the assessment requirements for the proposed modification.

On 5 February 2015, an interagency meeting was held onsite at Baal Bone Colliery to discuss the proposed modification works. Representatives of the following agencies attended the site meeting:

- NSW DP&E
- NSW Office of Environment and Heritage (OEH)
- NSW Environment Protection Authority (EPA)
- DRE
- NOW.

Following the agency site meeting each agency provided comments on the proposed Ben Bullen Creek Rehabilitation Modification Project. Copies of the correspondence received from each agency are provided as Appendix 3. A table showing each agency comment and the section of this assessment that addresses the comments is provided in Table 5.1 below.

Table 5.1 – Agency Comments

<table>
<thead>
<tr>
<th>Agency Comment</th>
<th>Section Addressed</th>
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<tbody>
<tr>
<td>OEH</td>
<td></td>
</tr>
<tr>
<td>Weed Management – OEH officers observed that there is a high number of Radiata Pine (Pinus radiata) throughout the site. The Environmental Assessment should include specific management actions regarding this species.</td>
<td>Sections 6.1 and 6.4.1</td>
</tr>
<tr>
<td>Rehabilitation – The rehabilitation plan should include species from the entire range of strata that match the target vegetation community.</td>
<td>Section 6.4.1</td>
</tr>
<tr>
<td>EPA</td>
<td></td>
</tr>
<tr>
<td>General comment regarding potential water pollution as a result of rehabilitation works where the current creek alignment passes through former waste rock emplacements.</td>
<td>Section 6.3.2</td>
</tr>
<tr>
<td>DRE</td>
<td></td>
</tr>
<tr>
<td>Final Land Use Goal – statement outlining the intended final land use of the modification area and any other options considered.</td>
<td>Section 7.0</td>
</tr>
<tr>
<td>Agency Comment</td>
<td>Section Addressed</td>
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</tr>
<tr>
<td>Rehabilitation Objectives – identify strategic rehabilitation objectives that support the achievement of the final land use.</td>
<td>Section 7.0 - see also Table 6 from development Consent (refer to Section 3.1)</td>
</tr>
<tr>
<td>Strategic Completion Criteria – identify strategic biophysical indicators and completion criteria that can be used to measure the performance of the rehabilitation in achieving the objectives. Completion criteria can be broad (i.e. ranges) at this stage and crystallised further in the MOP as required.</td>
<td>Section 7.0</td>
</tr>
<tr>
<td>Rehabilitation Methodology – identify and briefly describe the likely rehabilitation methods likely to be used</td>
<td>Section 7.0</td>
</tr>
<tr>
<td>Rehabilitation Monitoring – describe the rehabilitation monitoring methods to be used to measure progress against objectives and completion criteria</td>
<td>Sections 7.0 and 8.0</td>
</tr>
<tr>
<td>Conceptual Final Landform Plan – a plan at a suitable scale and level of detail to describe the final landform outcome</td>
<td>Section 7.0</td>
</tr>
</tbody>
</table>

**NOW**

<table>
<thead>
<tr>
<th>Agency Comment</th>
<th>Section Addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of potential groundwater / surface water connectivity within the proposed alignment and consideration of mitigating and monitoring measures to address significant gains or losses in water volume.</td>
<td>Section 6.3.1</td>
</tr>
<tr>
<td>Detail of proposed final landform and water management for the previously approved creek alignment. This is to include an assessment of water take from both surface water and groundwater, and the interaction of any retained water storages with the groundwater and surface water system.</td>
<td>Figure 3.1, Section 6.3.1</td>
</tr>
<tr>
<td>Design of proposed creek restoration works to be consistent with the Office of Water guidelines for Controlled Activities on Waterfront Land (July 2012). The introduction of geomorphic complexity more characteristic to a river style for this locational setting is recommended to increase geomorphic functioning and habitat diversity.</td>
<td>Section 6.3.1</td>
</tr>
</tbody>
</table>
6.0 Environmental Assessment

6.1 Summary of Impacts

Table 6.1 summarises the key environmental impacts associated with the proposed modification.

Table 6.1 – Summary of Environmental Impacts of Retaining Current Ben Bullen Creek Alignment

<table>
<thead>
<tr>
<th>Impact</th>
<th>Existing Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>No additional impact. Some earthworks required for geotechnical works but less than for re-establishment of pre-mining creek alignment. These works would be required under current approval to ensure stable final landform. Potentially minor decrease in impacts relative to existing approved project.</td>
</tr>
<tr>
<td>Vibration</td>
<td>No additional impact. Blasting not likely to be required and would only require small charges if needed. Any works requiring blasting would also be required under current approval to ensure stable final landform.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>No additional impact. Earthworks associated with geotechnical works would be required under current approval to ensure stable final landform. Potentially minor decrease in impacts relative to existing approved project as creekline establishment works not also required.</td>
</tr>
<tr>
<td>Surface Water Quality</td>
<td>No additional impact. Earthworks for geotechnical works and removal of haul road between Reach 2 and 3 will include installation of sedimentation controls as per Blue Book. These works would be required under current approval to ensure stable final landform. Impacts will be less than existing approved project as stream bed is already stable; re-establishment of the stream bed in its original alignment would result in increased turbidity and sedimentation downstream following high flow events until the new stream bed stabilised.</td>
</tr>
<tr>
<td>Surface Water Quantity</td>
<td>No Impact.</td>
</tr>
<tr>
<td>Groundwater</td>
<td>No Impact. Works will largely retain existing landform and stream bed gradient, therefore the current groundwater environment will be unaffected by the proposed modification.</td>
</tr>
<tr>
<td>Geotechnical Stability</td>
<td>Creek line has been established for over 30 years. Minor works required to improve long term stability in some areas (refer to Section 6.2). These works would be required under current approval to ensure stable final landform.</td>
</tr>
<tr>
<td>Geomorphological Stability</td>
<td>Creek bed is stable. No additional works required (refer to Section 6.2)</td>
</tr>
<tr>
<td>Riparian Biodiversity</td>
<td>Already partly established along the proposed final alignment. Areas disturbed as a result of geotechnical works will need to be revegetated. These works would be required under current approval to ensure stable final landform. Ongoing weed management required. Non-native species will be the focus of weed management works undertaken in accordance with the Biodiversity Management Plan and weed management procedures for the operation. Enhancement of existing vegetation in riparian areas along Ben Bullen Creek will occur earlier than if required to be established ‘from scratch’ as would be the case under current approved development.</td>
</tr>
<tr>
<td>Impact</td>
<td>Existing Alignment</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Stream Health</td>
<td>Existing stream health is unlikely to be significantly impacted by geotechnical works. Will continue to improve as biodiversity in riparian areas increases and trees become more established over entire reach.</td>
</tr>
<tr>
<td>Aboriginal Cultural Heritage</td>
<td>No impact. Area already significantly disturbed and no known sites present in areas required to be disturbed by rehabilitation activities. These rehabilitation works would be required under current approval to ensure stable final landform.</td>
</tr>
<tr>
<td>Historic Heritage</td>
<td>No impact. No known items of historical heritage present.</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>Retention of current alignment will reduce the time period until mine site is complete. Geotechnical works can occur while underground mining operations continue. Revegetation of riparian areas along proposed alignment already commenced in some areas.</td>
</tr>
<tr>
<td>Greenhouse and Energy</td>
<td>No additional impact. Minor level of emissions associated with diesel use required for geotechnical works. These rehabilitation works would be required under the current approval.</td>
</tr>
<tr>
<td>Social</td>
<td>No additional impact. Benefits provided include completion of final rehabilitation of the site more quickly and avoidance of impacts associated with creek re-establishment works.</td>
</tr>
<tr>
<td>Economic</td>
<td>Lower cost than alternative of establishing a new creek line along the former alignment. No additional costs associated with the modification as geotechnical works and revegetation will be required regardless of creek alignment chosen. Reduced ongoing management costs than currently approved project due to existing established rehabilitation.</td>
</tr>
</tbody>
</table>

These impacts and the comparative advantages/disadvantages of the proposed modification relative to the existing approved requirement to reinstate the pre-mining alignment are considered further below.

### 6.2 Geomorphic and Geotechnical Assessment

A preliminary geomorphic and geotechnical assessment of Ben Bullen Creek was undertaken as part of the Phase 1 Report (refer to Appendix 2). The following section provides an assessment of the short term and long term geomorphic and geotechnical integrity of the proposed alignment of Ben Bullen Creek.

#### 6.2.1 Preliminary Geomorphic Assessment

The preliminary geomorphic assessment contained in the Phase 1 Report identified that the existing creek line was largely stable and the Report did not identify any fluvial geomorphological benefits to restoring Reach 2 to its assumed pre-mining flow path in preference to rehabilitation in its current location.

Under the currently approved final landform plan, the creek bed will need to be re-established and, as with any recently constructed drainage line, would inevitably change within the confines of the banks following higher flow periods over the short to medium term. This would have associated turbidity and sedimentation impacts downstream until a naturally stable stream bed is established. This would require monitoring over the short to medium term and may require the installation of gabions or other structures to maintain geomorphic stability. The proposed modification does not pose the same risk of instability and downstream impact as the creek bed is already well established as it has been in place for approximately 30 years.
6.2.2 Preliminary Geotechnical Assessment

The Phase 1 Report includes a preliminary geotechnical assessment. Whilst the preliminary geotechnical assessment considered all reaches of Ben Bullen Creek, only the geotechnical assessment of Reach 2 is relevant to the proposed modification. A summary of the preliminary geotechnical assessment of Reach 2 is provided below.

Both banks of Reach 2 are formed from unconsolidated mine spoil for the first 500 metres (refer to Plates 1 to 6). The batters in some areas are approaching angle of repose (steeper than 2H:1V) and have heights ranging from 5 metres to 15 metres. While not currently showing any significant levels of erosion or instability, the preliminary geotechnical assessment identified that most would currently be at the borderline of acceptable long term geotechnical stability. Re-grading of some slopes to a shallower angle, along with suitable capping, will improve long term geotechnical stability and these works will be carried out as part of the proposed rehabilitation of the existing alignment.

The existing alignment runs along the toe of a highwall formed by previous open cut mining up to approximately 15 metres high (refer to Plates 1 and 5). The top stratum of the highwall is relatively sound sandstone. The sandstone has the potential to be undercut which does not pose a risk to the hydraulic stability of the creek, but is a potential long term public safety issue. Similar geotechnical issues exist in relation to the existing approved rehabilitation plan as the re-establishment of the pre-mining alignment would also include a section passing through an existing open cut void with associated highwall (refer to Plate 7).

Plate 7 – Remnant highwall and water storage located pre-mining creek alignment

The proposed rehabilitation works will include stabilisation of the highwall to manage the potential future safety risk. The works required to achieve this outcome will be determined in the detailed design phase, with the planned works outlined in the Ben Bullen Creek Rehabilitation Plan. Further investigation regarding geotechnical works on slopes that may require regrading will be also be undertaken as part of the preparation of the Ben Bullen Creek Rehabilitation Plan.
6.3 Water

6.3.1 Hydrology

The Phase 1 Report includes preliminary hydraulic modelling for Ben Bullen Creek (refer to Appendix 2).

Modelling indicated that results for bed shear stress, stream power and velocity within the existing alignment of Reach 2 are all within the limits suggested as being appropriate by the Australian Coal Association Research Program, Bowen Basin Diversion – Design and Rehabilitation Criteria (ACARP, 2002). The results for bed shear stress, stream power and velocity for a modelled pre-mining alignment are significantly higher, suggesting that the pre-mining alignment is likely to be less stable during a flooding event. On this basis, the existing alignment will represent more favourable conditions for successful rehabilitation.

Further hydrological modelling will be undertaken as part of the preparation of the Ben Bullen Creek Rehabilitation Plan to develop the final landform where the haul road crosses the creek line and inform the design of the landform to manage high flow events (including the use of an overflow channel through the rehabilitated mine infrastructure area for high flow events). The modelling will:

- include additional baseline data on surface water flows and water quality within Ben Bullen Creek
- identify necessary management measures to reduce the potential impacts of the flows in Reach 2 on Reach 3 of Ben Bullen Creek
- include modelling of overflow conditions through the former mine infrastructure area (potentially along a similar alignment to the pre-mining alignment of Ben Bullen Creek).

The existing water storage to the east of the northern end of Reach 2 (refer to Figure 3.1 and Plate 7) is a former void area and is located on the original creek realignment. It is likely that there are some minor groundwater inflows into this void from the former highwall. As a result of the retention of the creek in its existing alignment, the existing water storage will be retained at closure and over time will recharge and discharge depending on rainfall, surface water flows (refer to Figure 3.1), groundwater inflows and evaporative conditions. This dam would have been retained in the final landform under the current Project Approval conditions; accordingly, the flux of water to and from this existing water storage will be largely the same under the proposed Ben Bullen Creek alignment as the currently approved rehabilitation alignment. The only change will be that under the proposed final landform design, there will be less inflows to the storage from overland flows than would have been the case if Ben Bullen Creek had directly fed into the storage. In the proposed final landform, the haul road at the north of the existing water storage will be removed and the storage dam will flow to Ben Bullen Creek via an existing channel (as is the case under the current water management system at the site). Any loss of water as a result of evaporation from this water storage will occur under either approval scenario.

No significant water gains or losses to the Ben Bullen Creek system are anticipated as a result of the creek remaining in its current alignment. The proposed modification will not result in any ‘take’ of water or the diversion of water from one catchment to another. Under either development scenario, the banks of the final creek alignment will be formed by unconsolidated material. The impact on groundwater will be similar under either rehabilitation approach.
The proposed modifications to the Project Approval condition for the Ben Bullen Creek Rehabilitation Plan (refer to Section 3.1), would require Wallerawang to detail the proposed rehabilitation process for Ben Bullen Creek, including the requirement to complete an additional geomorphic and geotechnical assessment for the rehabilitation of Ben Bullen Creek. The creek rehabilitation works outlined in the Ben Bullen Creek Rehabilitation Plan and MOP (refer to Section 7.0) will have regard to the NOW Guidelines for Controlled Activities on Waterfront Land (NOW, 2012). Further specifics of water management with regard to the rehabilitation works will be included in an updated version of the Water Management Plan for the site. The Water Management Plan will be prepared in consultation with NOW, DRE and EPA to the satisfaction of DP&E.

6.3.2 Surface Water Quality

Run-off from disturbed areas associated with earthworks adjacent to waterways, such as the geotechnical works required to ensure long term geotechnical stability along Reach 2, have the potential to affect stream water quality. Such risks can be managed by implementing appropriate sedimentation controls, such as those required by the ‘Blue Book’. The presences of the large Common Reed bed in the downstream sections of Reach 2 will help operate as a filter and settling area should any turbid run-off enter the stream in the event of a failure of sedimentation controls. This will minimise any impacts to downstream environments. Existing controls to manage risks presented by run-off from disturbed areas entering Ben Bullen Creek will be maintained.

The risks to downstream water quality from the retention of the current alignment of Ben Bullen Creek are considered to be significantly lower than would be the case under the currently approved landform and proposed re-instatement of the pre-mining alignment through the mine infrastructure area. In the early stages following construction and commissioning, stream health along any re-established section of creek line is typically poor due to the extent of earthworks required and lack of both riparian and in-stream vegetation. Significant geotechnical and revegetation works will also be required to incorporate the existing void dam into the creek alignment (refer to Plate 7) and these works would inevitably result in some level of turbid run-off entering the waterway and flowing downstream. Significantly, the realigned section of Ben Bullen Creek would not have the benefit of the reed bed currently present in the Northern section of the existing alignment which provides a natural buffer between turbid run-off in upstream areas and the lower catchment.

The scouring that would almost certainly occur during high flow events as the stream bed becomes established would also impact on the health of Ben Bullen Creek in Reach 3 through increased turbidity and sedimentation. Such impacts would be less likely if the existing alignment through Reach 2 is retained as the creek bed is already well established and the existing reed bed operates a natural sediment trap and buffer between Reach 2 and Reach 3 should any turbid run-off enter the waterway as a result of the geotechnical and other rehabilitation works.

It is noted that the reestablishment of Ben Bullen Creek to its pre mining alignment would involve the disturbance of fill and waste rock material. These works would pose a higher degree of risk to water quality than the minor works associated with the retention of the existing alignment of Ben Bullen Creek.

6.3.3 Surface Water Monitoring

As outlined above, Wallerawang will prepare a Ben Bullen Creek Rehabilitation Plan which will include the implementation of a program to monitor surface water flows, quality, stream health and channel stability.
Condition 16 and 18 of Schedule 3 of the Project Approval require Wallerawang to prepare an extensive surface water monitoring program as part of the Water Management Plan for Ben Bullen Creek as well as the other creeks located within the site. This monitoring Program will be modified to reflect the proposed changes in final landform design, as required.

The monitoring program will be reviewed at least every two years and, as rehabilitation progresses, the frequency and type of monitoring and/or number and location of monitoring points will be revised to reflect any changes in environmental risk profile.

6.4 Biodiversity Assessment

6.4.1 Existing Ecological Environment

An assessment of the existing ecological environment along Reach 2 of Ben Bullen Creek was undertaken as part of the Phase 1 Report. The existing site context and state of rehabilitation in Reach 2 is discussed in Section 2.3. The following additional information has been obtained from the Phase 1 Report.

The existing creek alignment contains areas subject to past rehabilitation works which display varying levels of success (refer to Appendix 2). The rehabilitation works along this reach of the creek line generally occur along both banks, with the western side having greater success (refer to Plate 6). As can be seen in Plates 1, 3 and 5, in-stream vegetation along this reach, particularly the northern section, is dominated by Common Reed and less frequently Juncus spp.

The vegetation along this reach of the creek consists of scattered canopy and understorey species, with scarce groundcover on the slopes adjacent to the creek line. Beyond the immediate slopes along the creek line, a structured woodland community containing a good diversity of Acacia spp, Eucalyptus spp. and other native herbs and grasses is located on the western side of the creek line.

Canopy species along this reach of the creek line included Red Stringybark, Snow Gum and Ribbon Gum. An understorey is present and consists of Silver Wattle, Black Wattle, Black She-oak, Native Blackthorn, Sifton Bush, Violet Kunzea and Common Tea Tree. The groundcover is dominated by a mixture of grasses and herbs, with Red Grass, Lomandra spp. and Weeping Grass. No flora species identified within Reach 2 of the creek line are listed under either the NSW Threatened Species Conservation Act 1995 or the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

One noxious weed species, Blackberry, has been identified along this reach of the creek line. Blackberry is classified as a Class 4 noxious weed under the NSW Noxious Weeds Act 1993. Blackberry specimens ranged from small to medium sized thickets. Radiata Pine, although not a noxious weed, is an introduced species and as can be seen in Plates 1, 3 and 5, occurs frequently along this reach of the creek line. Non-native species will be managed in accordance with the site Biodiversity Management Plan.

Fauna habitat along Reach 2 of the creek consisted of ponds of water, a mix of young and mature canopy and large woody debris. It is possible that this fauna habitat supports the foraging and roosting of a range of threatened fauna species.
The creek line and adjacent habitat provides potential foraging and sheltering habitat for ground dwelling mammals, amphibians and reptiles within woody debris. Potential roosting habitat (hollow-bearing trees) for arboreal mammals, birds and bats may also be found within, along and adjacent to the creek line.

There will be some minor disturbance of this vegetation associated with the works required to improve long term geotechnical stability along Reach 2. This only applies to the steeper slopes surrounding the creek line and these are not currently heavily vegetated. Revegetation of disturbed areas will commence as soon as slope stabilisation works are completed. These works are not expected to impact on vegetation in undisturbed areas and, overall, the rehabilitation works will improve the habitat value of the vegetation along Reach 2.

The Ben Bullen Creek Rehabilitation Plan will include a specific program for the enhancement or establishment of vegetation along Reach 2 and will include:

- details of the proposed rehabilitation works, including the proposed species list for revegetation works. The revegetation works will include a variety of species selected from the species available within the target vegetation community
- the management controls that will be put in place in relation to the rehabilitation works to manage surface water and potential flora and fauna impacts
- details regarding the proposed revegetation of disturbed areas and the ongoing management of revegetated areas.

6.4.2 Riparian Ecosystems

There will be some minor disturbance of riparian vegetation associated with the works required to improve long term geotechnical stability along Reach 2. This only applies to the steeper slopes surrounding the creek line and these are not currently heavily vegetated. Revegetation of disturbed areas will commence as soon as slope stabilisation works are completed. The works are not expected to impact on vegetation in adjacent areas.

The retention of the existing alignment in the final landform will not have an impact on any groundwater dependant ecosystems as, to the extent that these occur in the area, they have re-established under the existing hydrogeological conditions which will be retained under the existing alignment.

The Ben Bullen Creek Rehabilitation Plan will include a specific program for the enhancement or establishment of riparian vegetation along all reaches of the creek line. The Ben Bullen Creek Rehabilitation Plan will also include a monitoring program which will include the monitoring of stream health.

6.4.3 Aquatic Ecosystems

The works associated with improving the geotechnical stability of sections of the creek bank in the current alignment are unlikely to have a significant impact on aquatic ecosystems due to sedimentation controls which will be put in place around disturbed areas. The resulting improvements to geotechnical stability will provide greater short term and long term stability for the aquatic ecology in the creek. Similarly, works associated with the removal of the coal conveyor and associated embankment and the haul road at the downstream end of Reach 2 will be managed to minimise risks to water quality. These controls will be identified in the Ben Bullen Creek Rehabilitation Plan, which will also include a specific program for the enhancement or establishment of aquatic ecosystems along all reaches of the creek line.
With appropriate controls in place as proposed, the rehabilitation works along Reach 2 are unlikely to have any significant impacts on downstream ecosystem health and the early revegetation of banks in Reach 2 is likely to improve the overall health of the Ben Bullen Creek ecosystem in the short and long term.

### 6.4.4 Fish Passage

The existing alignment of Ben Bullen Creek through Reach 2 has minimal fall and there are unlikely to be any significant impediments to fish passage in this section of the creek. The Ben Bullen Creek Rehabilitation Plan will include consideration of any impediments to fish passage along the creek line and will identify appropriate mitigation and management measures.

### 6.4.5 Ecological benefits of retaining existing alignment of Ben Bullen Creek

The advantage the retention of the existing alignment has over the re-establishment of the pre-mining alignment is that the existing biodiversity values will be maintained and the final rehabilitation of Ben Bullen Creek will occur much earlier and be assisted by the presence of vegetation already present in some areas. Revegetation of areas adjacent to the current alignment can occur much earlier than would be the case if the creek line needed to be re-established in its pre-mining alignment. This will have almost immediate benefits for the ecological function of the Ben Bullen Creek system both through Reach 2 and downstream in Reach 3.

This is in contrast to the existing situation with the currently approved landform and proposed re-instatement of the pre-mining alignment through the mine infrastructure area. There is little or no existing riparian vegetation surrounding the currently approved pre-mining alignment. In the early stages following construction and commissioning, stream health along the re-established section of creek line would be poor due to the extent of earthworks required. The healthy functioning of this section of the creek, if realigned, would require the planting of riparian vegetation and the establishment of a stable stream bed. Significant geotechnical and revegetation works would be required to incorporate the existing void dam into the creek alignment (refer to Plate 4). Riparian vegetation through the rehabilitated infrastructure area and void area would take time to establish and it would only be in the medium to long term (10+ years) that any creek line re-established in the pre-mining alignment would reach the level of ecosystem functioning that is already present in the current Reach 2 alignment of Ben Bullen Creek.

Furthermore, until vegetation is established along the pre-mining alignment, the poor stream health in the newly established creek channel is likely to have implications for the healthy functioning of the creek downstream. The scouring that would likely occur during high flow events as the stream bed becomes established would also impact on the health of Ben Bullen Creek in Reach 3 through increased turbidity and sedimentation. Such impacts would be less likely if the existing alignment through Reach 2 is retained as the creek bed is already well established.

While it is noted that the rehabilitation of the areas adjacent to the existing alignment will continue irrespective of which creek alignment remains in the final landform, the existing vegetation will assist in the establishment of more permanent riparian vegetation and this is a significant advantage of retaining the existing alignment in terms of maintaining and improving stream health.
6.5 **Comparison of Existing and Pre-Mining Creek Alignment Options**

The re-establishment of the pre-mining alignment has no merits in comparison to the proposed retention and enhancement of the existing Ben Bullen Creek alignment other than the re-establishment of the pre-mining alignment. While re-establishment of the pre-mining alignment may result in a creek alignment being similar to the pre-mining environment there are few remnants of the former creek line remaining and the channel and riparian areas would need to be created along much of the length of the re-established alignment. This would require the excavation of a channel and, depending on the depth and condition of bedrock in the area, may require significant, and potentially ongoing, geotechnical works to ensure channel and bank stability. This is to be contrasted to the existing alignment which has been in place for approximately 30 years and, as a result, has become an established environment with stable stream bed and channel.

The earthworks associated with the construction of a different channel would also have localised impacts on air quality and, while these are unlikely to exceed any applicable assessment criteria, this is an additional impact that would not occur with the retention of the existing alignment of the channel as the primary creek line. Similarly, additional earthworks include a risk to surface water quality. While surface disturbing works are required in this mine infrastructure area under either scenario due to the need to decommission surface infrastructure, disturbance in an area that would be an active drainage channel increases the risk of turbid run-off entering waterways. Furthermore, some scouring in a newly created creek bed is inevitable during high flow events and this would increase turbidity and sedimentation downstream. Maintaining the existing alignment would avoid these risks.

Revegetation of the riparian areas adjacent to the existing alignment is already occurring and is well established in some areas. Enhancement of the riparian vegetation will require relatively little additional work with natural succession effects assisting the process. Reinstatement of the pre-mining alignment would require complete revegetation which cannot commence until mining is complete, infrastructure removed and the creek channel has been created. Established riparian vegetation in the final landform will occur much faster if the existing creek line channel is retained as the primary creek alignment. Assuming re-establishment of the pre-mining channel does not commence for another 5 years, a conservative estimate is that establishment of a healthy riparian ecosystem along the re-established creek line would be at least 10 to 15 years behind that which would occur if the current alignment is retained and enhanced as proposed.

The short, medium and long-term merits of retaining the existing alignment of Ben Bullen Creek compared to the reinstatement of the pre-mining alignment are summarised in **Table 6.2**.
Table 6.2 –Short, Medium and Long-Term Merits of Proposed Modification

<table>
<thead>
<tr>
<th>Proposed Modification Retaining Existing Creek Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short Term 1-5 years</strong></td>
</tr>
<tr>
<td>• Higher level of ecological diversity is already present and can be enhanced through selective planting and weed management.</td>
</tr>
<tr>
<td>• Rehabilitation works, including any bank stabilisation works can be undertaken while mining operations continue. Rehabilitation of most of Reach 2 creek line not delayed by closure.</td>
</tr>
<tr>
<td>• Lower risk of exposing unknown contaminants as minimal surface disturbance is required.</td>
</tr>
<tr>
<td>• Creek bed is already stable and little or no works required to manage stream bank erosion risks.</td>
</tr>
<tr>
<td>• Significant cost saving as the existing alignment is already formed and will not require extensive establishment works.</td>
</tr>
<tr>
<td><strong>Medium Term 5-10 years</strong></td>
</tr>
<tr>
<td>• Existing ecological environment is already established, significantly reducing the rehabilitation timeframe.</td>
</tr>
<tr>
<td>• The existing alignment is longer than the pre-mining alignment and will result in slower flows during flood events that will have less erosive power and create greater long term stability.</td>
</tr>
<tr>
<td>• Channel stability is already well established and there is little risk of further works being required to reduce erosion risks.</td>
</tr>
<tr>
<td>• Revegetation already well established.</td>
</tr>
<tr>
<td><strong>Long Term &gt;10 years</strong></td>
</tr>
<tr>
<td>• Less stabilisation works will be required.</td>
</tr>
<tr>
<td>• Ecological environment is already established and will provide continued habitat for fauna species within the area.</td>
</tr>
<tr>
<td>• Reduced long-term stability risks.</td>
</tr>
</tbody>
</table>

Overall, there are significant advantages in retaining the existing creek line alignment relative to the reinstatement of the pre-mining alignment with the only disadvantage being that the final alignment will not follow the pre-mining alignment. This notional advantage of the pre-mining alignment over the current diverted alignment is considered to be largely theoretical, particularly when it is acknowledged that the landform context in which the creek line is located, while rehabilitated, will remain significantly altered by the mining activities that have occurred at the site over the past 60 years and the northern section of the pre-mining alignment would flow through part of the final open cut void.
7.0 Final Landform

Mine closure planning at Baal Bone Colliery is already significantly progressed. The principal objective for the rehabilitation of mined land at Baal Bone is to return the site to a condition where its landforms, soils, hydrology, flora and fauna are self-sustaining and compatible with the surrounding land fabric. As detailed in earlier sections of this report, the retention and enhancement of the existing alignment of Ben Bullen Creek in the final landform is a preferable environmental outcome and is likely to see the site successfully rehabilitated in a shorter period of time.

An indicative final landform plan for Ben Bullen Colliery which retains the existing alignment of Ben Bullen Creek is shown in Figure 3.1.

The rehabilitation objectives for Ben Bullen Creek are identified in DA Schedule 3 Condition 22, and will form part of the broader mine closure planning and final landform development process. The rehabilitation objectives for Ben Bullen Creek in the Project Approval are to achieve hydraulic and geomorphological stability with established riparian vegetation (refer to Section 3.1). These objectives will be applied to the proposed alignment of Reach 2 of Ben Bullen Creek. This will result in an integrated aquatic and riparian environment within the broader site rehabilitation of the site; and will be achieved within a shorter timeframe.

The Ben Bullen Creek Rehabilitation Plan will include measures to achieve these rehabilitation objectives. As required under the current Project Approval conditions, this Plan will need to be approved by the DP&E prior to implementation. The MOP/Rehabilitation Management Plan approved by DRE will also include details regarding the design and implementation of remediation works that may be required. Both plans will detail relevant sediment and erosion control measures that may need to be implemented during the rehabilitation process.

The new MOP (in accordance with the DRE 2013 MOP Guidelines) will include further information for the rehabilitation of the entire site, including the Ben Bullen Creek alignment. The MOP and the Ben Bullen Creek Rehabilitation Plan will include information regarding:

- final land use options;¹
- rehabilitation objectives
- completion criteria
- rehabilitation methodology
- rehabilitation monitoring.

¹ Note: Broad rehabilitation objectives for the Ben Bullen Creek alignment are provided in Table 6 of the Project Approval (refer to Section 3.1)
8.0 Management and Monitoring Measures

Operations at Baal Bone Colliery are currently undertaken in accordance with the conditions of the Project Approval including implementation of the approved Water Management Plan (Condition 14), Biodiversity Management Plan (Condition 21) and a Rehabilitation Management Plan (Condition 23).

Wallerawang will continue to operate in accordance with approved management plans and will revise the relevant management plans to provide for the modification to the rehabilitation plans for Ben Bullen Creek.

A specific Ben Bullen Creek Rehabilitation Plan will be prepared as is already required by Condition 16 of Schedule 3 of the Project Approval. The Ben Bullen Creek Rehabilitation Plan will include the following:

- assessment of the geomorphic and geotechnical properties of the creek line to be rehabilitated
- assessment of the flood hydraulics of the creek line to be rehabilitated
- staging and timing of the remediation works
- detailed design of bed and bank remediation works
- relevant sediment and erosion control measures
- revegetation and rehabilitation methods
- a program to monitor surface water flows, quality, stream health and channel stability
- an implementation program.
9.0 Conclusion and Justification

9.1 Justification

This assessment and the Phase 1 Report (refer to Appendix 2) have identified significant benefits in maintaining and rehabilitating the existing alignment of Reach 2 of Ben Bullen Creek rather than reinstate the pre-mining alignment. The key benefits which justify the modification are:

- creek line rehabilitation activities can progress while Baal Bone Colliery is still in operation, allowing the final rehabilitation of the area to be completed much earlier
- the existing creek line is known to be geomorphologically stable, reducing the long-term stability risk and risk of downstream impacts
- only minor works are required to improve the geotechnical stability of the creek and bank areas, reducing the long-term stability risk and risk of downstream impacts
- the existing alignment has existing biodiversity values which will assist in the rehabilitation process, meaning that the timeframe required to complete rehabilitation of the creek is reduced
- the earthworks required to reinstate the creek to its pre-mining alignment are substantial and would result in environmental impacts which, whilst manageable, can be avoided if the existing alignment is retained
- final rehabilitation of the site can be achieved earlier with reduced risk to the downstream environment.

In addition to the above environmental benefits, the rehabilitation of the site can be achieved in a shorter time frame with lower upfront costs and reduced ongoing maintenance costs.

The surface infrastructure area has been significantly transformed by the operation of Baal Bone Colliery and will not be able to returned to a pre-mining landform. On this basis, it is considered that there is little benefit in re-creating the pre-mining creek alignment through this area when the surrounding terrain will remain significantly transformed by past mining activities. There are few remnants of the pre-mining creek alignment evident within the surface infrastructure area and the creek line would need to be constructed in a similar manner to a new diversion. It is considered that this option has the potential to result in increased downstream environmental impacts following commissioning whilst offering very little benefit.
9.2 Conclusion

The proposed modification to the conceptual final landform plan to retain Ben Bullen Creek in its current alignment through Reach 2 provides numerous environmental benefits and will result in a more effective and efficient rehabilitation program relative to the existing approved final landform which requires the reinstatement of the pre-mining alignment of Ben Bullen Creek.

The rehabilitation of Reach 2 of Ben Bullen Creek in the approved pre-mining location would require extensive construction works through the mine infrastructure area which have the potential to result in downstream environmental impacts and would extend the mine site rehabilitation period.

Both the Phase 1 Report and the assessment in this report clearly identify the benefits of retaining the existing Ben Bullen Creek alignment through Reach 2. The proposed modification is being sought to enable these benefits to be realised.
10.0 References

AECOM Australia (2010) *Environmental Impact Assessment - Baal Bone Colliery*


URS (2014) *Phase 1 – Options Analysis and Concept Design. Baal Bone – Ben Bullen Creek Rehabilitation*
Letter from Department of Planning and Environment – Dated 27/08/2014
Mr Mark Bulkeley  
Operations Manager  
Baal Bone Colliery  
PO Box 13  
LITHGOW NSW 2790

Dear Mr Bulkeley

**Baal Bone Coal Project (09_0178)**  
**Draft Water Management Plan/Ben Bullen Creek Restoration**

I refer to your letter dated 13 June 2014, and attached draft Water Management Plan (WMP) for Baal Bone Colliery, as required under the Minister’s approval for the mine. I also refer to the meeting between the Department and the company regarding the restoration of Ben Bullen Creek, held on 5 June 2014. I apologise for the time taken to provide this advice.

Firstly, the Secretary has approved the company’s request to stage the submission of the WMP, as its subcomponent Ben Bullen Creek Natural Channel Design and Restoration Plan is not yet finalised.

I understand that the company wishes to retain Ben Bullen Creek in its current alignment, instead of restoring it to its pre-mining flowpath, as required under the current conditions of approval. I note this position is backed by the findings of the *Ben Bullen Creek Rehabilitation Phase 1 Options Analysis and Concept Design* report, prepared for the company.

The Department considers that the best way to progress this matter is for the company to seek a modification to the project approval under Section 75W of the *Environmental Planning and Assessment Act 1979*. The application should be accompanied by an Environmental Assessment (EA), which:

- confirms the proposed approval pathway and describes the proposed modification to the conditions of approval;
- compares in detail the short, medium and long-term merits of retaining the creek in its current alignment with restoring the creek to its pre-mining flowpath;
- includes an assessment of:
  - short-term and long-term geomorphic and geotechnical integrity of the proposed alignment of Ben Bullen Creek;
  - baseline data and/or hydrologic modelling of surface water flows and quality in Ben Bullen Creek, including sections downstream of the current diversion that could be impacted by the proposed modification.
  - flood hydraulics and velocities associated with, or which may be affected by, the current diversion;
  - appropriate design of any proposed creek bed and bank remediation works, and the staging and timing of these works;
  - biodiversity impacts, including:
    - current aquatic and riparian ecosystems and their functionalities;
    - potential impacts and/or benefits of remediation works on ecosystem functionality;
    - how aquatic and riparian ecosystems would be further enhanced, established and monitored over time; and
    - impediments to fish passage, and the proposed removal of these impediments;
  - activities that could cause soil erosion and generate sediment, and short-term and long-term measures to minimise soil erosion and potential for transport of sediment to downstream waters;
how the proposed alignment of Ben Bullen Creek would be integrated within the rehabiliated landscape; and
proposed measures to monitor surface water flows, quality, stream health and channel stability; and

- details the consultation undertaken with key Government agencies (including Division of Resources and Energy, Environment Protection Authority, NSW Office of Water and Office of Environment and Heritage), and addresses any issues raised by these agencies during this consultation.

The application should be made online, via the Baal Bone Coal Project page on the Department’s website (www.planning.nsw.gov.au). Following receipt of the application and EA, the Department will contact the company to discuss the necessary administrative arrangements.

Please contact Paul Freeman if you have any questions in regard to these matters.

Yours sincerely

[Signature]
Howard Reed
Manager, Mining Projects
As nominee of the Secretary
APPENDIX 2

Phase 1 - Options Analysis and Concept Design. Baal Bone –
Ben Bullen Creek Rehabilitation – URS, 2014
Phase 1 – Options analysis and concept design

May 2014
43197274/NC-WAT-RPT-001/04

Prepared for:
Glencore (The Wallerawang Collieries)

Prepared by URS Australia Pty Ltd
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<td>Principal Water Engineer</td>
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Baal Bone - Ben Bullen Creek Rehabilitation

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Phase 1 - Options analysis and concept design

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43197274/NC-WAT-RPT-001/04

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<td>ACARP</td>
<td>Australian Coal Association Research Program</td>
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<tr>
<td>AR&amp;R</td>
<td>Australian Rainfall and Runoff</td>
</tr>
<tr>
<td>BBC</td>
<td>Baal Bone Colliery</td>
</tr>
<tr>
<td>CAA</td>
<td>Coal Assets Australia</td>
</tr>
<tr>
<td>DP&amp;I</td>
<td>Department of Planning and Infrastructure</td>
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<tr>
<td>DTM</td>
<td>Digital Terrain Model</td>
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<tr>
<td>km</td>
<td>kilometres</td>
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<tr>
<td>NW Act</td>
<td>NSW Noxious Weeds Act 1993</td>
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<td>URS</td>
<td>URS Australia Pty Ltd</td>
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EXECUTIVE SUMMARY

In approving the construction and operation of the Baal Bone Colliery site (BBC), the Department of Planning and Infrastructure (DP&I) placed a number of conditions on project approval. Condition 15 required BBC to prepare and have approved a 'Ben Bullen Creek Natural Channel Design and Restoration Plan'. This report does not constitute the Natural Channel Design and Restoration Plan, but is the first step in its creation.

The first step in developing the plan is to identify the most feasible and scientifically advantageous approach to providing the long term stability and function of Ben Bullen Creek. From the outset, two options were investigated: (i) restoring the creek to its assumed pre-disturbance flow path and (ii) rehabilitating the creek in its current location.

The first option meets the requirements of the condition of consent for the mine; however there are potentially greater environmental and economic benefits to be gained by maintaining the existing course of the creek (second option).

This report provides the results and conclusions from the initial investigation of the two options discussed above. It examines the risks and opportunities of each option based on desktop analysis and site inspection. The analysis included geomorphic, geotechnical and ecological assessments as well as hydraulic modelling.

The recommendation of this report is that the existing course be maintained for Ben Bullen Creek (second option). A wide range of impacts have been considered in coming to this recommendation and the main reasons for its selection are listed below.

- Potential to expose legacy contamination from the long history of industrial activity at the workings area. Major earthworks would be necessary in this area to establish the assumed pre-disturbance flow path.
- Existing ecological value exists along the current alignment which can be improved upon. Establishing the assumed pre-disturbance flow path may have negative impacts on this value.
- Remediation works for the current flow path do not need to wait for mine closure before they can commence. This give an increased period of inspection and maintenance to maximise the benefits gained. That is, the final landform can be proven ahead of mine closure.
- The current flow path is geomorphologically stable and requires relatively minor adjustments for remediation.
- The longer path of the current creek line has (in common language) less erosive power, suggesting greater long term stability.

It is recommended that once the report is finalised, it is forwarded to DP&I for review. Following that review it would be useful for BBC, URS and DP&I to hold a meeting to discuss the report and the next steps in the process.
INTRODUCTION

1.1 Background to Project

Baal Bone Colliery (BBC) is an underground and open cut coal mine located 25 kilometres (km) north-west of Lithgow in the NSW western coal fields. The mine is currently under care and maintenance and has been utilised as an underground training mine for new employees and contractors within Coal Assets Australia (CAA).

The BBC site originally commenced as an open cut mine in the 1940s and was previously known as the Ben Bullen State Mine. When mining ceased in 1952, minimal rehabilitation was carried out by the former mine owners and the site was left with Ben Bullen Creek winding through spoil stockpiles and past historical highwalls. When the current BBC operations commenced in 1982, a diversion of Ben Bullen Creek was constructed around the current pit top area. At this time some basic rehabilitation works were carried out and over time, natural ecological systems have developed. Ben Bullen Creek is part of the Central West Catchment of NSW and drains into Jews Creek and then into the Turon River to the north-west of the site. The full length of Ben Bullen Creek traversing the Baal Bone site is approximately 4 km.

Under the current project approval (09_0178) the owner of the site is required to restore Ben Bullen Creek to its pre-disturbance flow path, with established riparian vegetation. A preliminary creek re-establishment plan was developed in the report “Natural Channel Design Ben Bullen Creek Diversion” (Revegetation Contractors Pty Ltd, 2007) and this was referenced in the 2010 Environmental Assessment (ACOM). This study divided the creek into three reaches across the site as shown in Figure 1-1. The plan described the re-establishment of Reach 2 of the creek (approximately 1.2 km) to a path across the pit top infrastructure area and adjacent to the underground adits at mine closure (shown as the orange line in Figure 1-1). There is no evidence of the location of the pre-disturbance flow path; however, the alignment identified was considered generally representative of the likely path. The rehabilitation of Reaches 1 and 3 of Ben Bullen Creek have generally been completed.

Since this time, BBC has further investigated options for Reach 2 of the Creek. This has involved consideration of the ecological features that have naturally developed in the existing diversion. Technical advice was sought to consider the risks and opportunities of these features in contrast to those of reinstating Reach 2 across the pit top area, as required by the current project approval.

1.2 Objectives of the Study

In approving the construction and operation of the site, the Department of Planning and Infrastructure (DPI) placed a number of conditions on project approval. Condition 15 required BBC to prepare and have approved a 'Ben Bullen Creek Natural Channel Design and Restoration Plan'. Condition 18 states that:

18. The Ben Bullen Creek Natural Channel Design and Restoration Plan must include:
   (a) geomorphic and geotechnical assessment of the existing Ben Bullen Creek diversion;
   (b) assessment of flood hydraulics of the existing diversion;
   (c) staging and timing of remediation works;
(d) detailed design of bed and bank remediation works;
(e) revegetation and rehabilitation methods;
(f) a program to monitor surface water flows, quality, stream health and channel stability; and
(g) an implementation program.

This report does not constitute the Natural Channel Design and Restoration Plan, but is the first step in its creation. In order to establish the best solution for the rehabilitation of the creek, it is proposed to undertake a three phase study, as follows:

- Phase 1 – Options analysis and concept design
- Phase 2 – Preliminary design and cost estimates
- Phase 3 – Detailed design and tender documentation

This report represents Phase 1 of the investigation and identifies the most feasible and reasonable approach to providing the long term stability and function of Ben Bullen Creek through Reach 2. From the outset the two options to be investigated are: (i) restoring the creek to its assumed pre-disturbance flow path and (ii) rehabilitating the creek in its current location.

The first option meets the requirements of the condition of consent for the mine; however there are potentially greater environmental and economic benefits to be gained by maintaining the existing course of the creek.

This report provides the results and conclusions from the initial investigation of the two options discussed above. It examines the risks and opportunities of each option based on desktop analysis and site inspection. The analysis included geomorphic, geotechnical and ecological assessments as well as hydraulic modelling.

The following sections describe the work carried out to investigate the current state of the Ben Bullen Creek (baseline) and to assess the two remediation options available to the site.
CONSULTATION WITH THE DP&I

On the 9 January 2014 URS discussed the initial findings of this report with the DP&I via a telephone conversation. The conversation took place between Paul Freeman at the DP&I and William Miles, Principal Planner at URS.

URS outlined the findings of the report and the work that had been completed. URS highlighted the recommendation that the best ecological outcome would be to rehabilitate the creek in its current alignment (as justified in this report).

After this overview, the following points were discussed:

1. DP&I noted that this report will need to be provided to them for review before they can agree to its conclusions.

2. Following this review, DP&I will inform BBC of the next steps in the process to change the wording within Project Approval (09_0178) condition 24.

3. It is likely that this process would involve BBC completing a Modification Application under Section 75W of the Environmental Planning and Assessment Act 1979.

4. The application will need to be supported by technical studies.

5. DP&I may issue formal DGRs or informal assessment requirements depending on the nature of the modification.

6. It was noted that the report discusses the Ben Bullen Creek Natural Channel Design and Restoration Plan ("the plan") and that the findings of this report will be built upon to develop the plan so that rehabilitation efforts focused on the preferred alignment.

7. It was also noted that the report does not address drop structures within the creek as its focus is on the best future alignment of the creek. However this issue will be considered as part of development of the plan once the creek alignment is confirmed.

It is recommended that once the report is finalised, it is forwarded to DP&I for review. Following that review it would be useful for BBC, URS and DP&I to hold a meeting to discuss the report and the next steps in the process.
3 DATA COLLECTION

3.1 Data from BBC

A range of data was obtained from site personnel and used during the study to achieve a detailed understanding of the creek and surrounding area. These sources include aerial photography, reports, plans, other documents and survey information.

3.1.1 Aerial Photography

Aerial photography of the study area was provided by BBC. Table 3-1 lists the available imagery.

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<tr>
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<tr>
<td>September 2012</td>
<td>Satellite Imagery supplied by AAM with LiADR</td>
</tr>
<tr>
<td>1971</td>
<td>Scan of aerial image supplied by BBC</td>
</tr>
<tr>
<td>1950</td>
<td>Scan of aerial image supplied by BBC</td>
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Table 3-1 Available Aerial Photography

The aerial photography was used to compare historical landscape features to the current topography.

3.1.2 Reports, plans and other documents

Several reports and plans were reviewed to understand the site and its operation. These included:

- Natural Channel Design – Ben Bullen Creek Diversion (Revegetation Contractors Pty Ltd, June 2007)
- Baal Bone Environmental Management Strategy (Xstrata Coal, July 2012)
- Environmental Assessment – Baal Bone Colliery (Aecom, March 2010)
- Project Approval (Minister for Planning, January 2011)

3.2 Survey Data

LiDAR data for the study area from 2012 was supplied by BBC. The accuracy of this data had not been verified and therefore ground truthing was required.

A ground survey was carried out by Craven, Elliston & Hayes (Lithgow) on 28th November 2013. This consisted of a number of cross sections of the creek throughout the site. The information was compared with the LiDAR data to ensure that the ground levels were accurate.

This data allowed the creation of a two dimensional hydraulic model that would allow a detailed analysis of the flow behaviour at all points along the creek.
SITE INSPECTION AND ANALYSIS

4.1 Objective

In order to establish the preferred approach for the rehabilitation of the creek, a number of subject matter experts visited the site to inspect the current state of the creek and the assumed pre-disturbance path.

Sections 4.2, 4.3 and 4.4 describe the findings of the subject matter experts during this visit. The following disciplines were present; Geomorphologist, Geotechnical Engineer and Ecologist. A Water Engineer was also present and their findings have been included in the development of the modelling, reported in Section 5.

4.2 Preliminary Geomorphic Assessment

This section of the report provides a geomorphological assessment of Ben Bullen Creek. The purpose of the assessment was to identify the geomorphic characteristics of the existing watercourse, with particular consideration to the benefits of restoring Reach 2 (see Figure 1-1) of the creek to its assumed pre-disturbance flow path or rehabilitating it in its current location. This initial assessment has been based on observations made during the site inspection and review of available aerial photographs.

4.2.1 Landscape and Geomorphological Setting

Ben Bullen Creek is part of the Macquarie Catchment of NSW and drains into Jews Creek and then into the Turon River to the north west of the site which lies within the Murray Darling Basin.

The upper reaches of the catchment consist of rugged hills with steep sided ridgelines rising to over 1,050 m elevation and covered in undisturbed forest. In this area the creek is undefined and consists of many gullies that converge into one creek depression just south of the mine boundary. The full length of the creek traversing the Baal Bone site is approximately 4 km falling from approximately 900 m to 860 m above sea level. Downstream of the mine site the creek flows through open farmland as a small creek depression.

No pre-mining aerial photography was found for the site; however an image from 1950 shows the early stages of mine development. This shows the creek in what is presumed to be its natural alignment, which appears to be slightly west of the current water storage pond. This is shown in comparison to the current site layout in Figure 4-1.
A study of aerial photographs from 1950 and 1971 (supplied by BBC) shows that the majority of the creek alignment within Reach 2 has been modified by coal mine development. It appears that none of this early alignment remains and all areas have been significantly changed by mine operations. Reach 2 of the creek (approximately 1.2 km in length) has been diverted around the pit top infrastructure area and currently meanders around stockpiles and at the foot of high walls. The base of the creek is founded on bedrock and this is surrounded by spoil piles or high wall. There does not appear to be a formal channel bank, simply a transition from a rock bed to high slopes and walls.

The width of the channel varies from 5 m to 7 m in the stockpile areas, up to approximately 20 m when running along the toe of the existing high wall. The spoil banks show the development of some vegetation growth, predominantly in the form of pine trees, which indicates the potential for vegetation establishment in these materials. Some sections of the bed in Reach 2 contain a layer of sediment suggesting a limited amount of deposition. The creek bed is also well grassed with some areas of reed growth up to 2 m to 3 m in height. The reeds are typically upright and stable in appearance, suggesting they have not been subject to large flows in recent months. This suggests a low energy system that transports a limited volume of fine silt.

Reach 1 and Reach 3 of the creek were also modified during coal mine development to bypass around the edge of the open pits. Subsequently these reaches also include sections of creek formed in spoil material and bedrock.

Mine development appears to have modified the catchment of the creek, lengthening flow paths and increasing storage. It is assumed that flow still reaches the main channel, however it is likely that significant attenuation occurs (described further in Section 5.3 of this report). Particularly in Reach 1 of the creek, it appears that the majority of rainfall from the western rehabilitation area is absorbed into the ground. The surface flow that remains is guided to a storage area before being released to the creek.
At the time of the inspection the channel along Reach 1 was predominately dry with isolated areas of ponded water. Minor to low flow was observed in the middle and lower reaches. In particular, there is very little evidence of any coherent flow, or the development of natural geomorphological features which would be expected from a functioning geomorphological system. The figures below demonstrate the lack of geomorphological features in each reach.

Plate 4-1  Typical Section from Reach 1

Plate 4-2  Typical Section from Reach 2
Plate 4-3  Typical Section from Reach 3

The topography of Reach 1 indicated that flows within the upper Reach travel upstream and pond in an area of localised depression near the site’s southern boundary. Figure 5-2 is a long section plot of the creek bed and highlights this local depression.

It is unclear how flow behaves in this area or how often the water level gets high enough to overtop the high point in the channel and flow down the creek. Inspection of the LiDAR data suggests the highpoint is 3 m above the point of ponding. It would take a significant event to fill the available storage, so it is assumed that smaller events cause ponded water that infiltrates the spoil bed and moves downstream as subsurface flow.

Some rehabilitation work has already been completed along the upper and lower reaches of the creek to develop natural channel characteristics. This work has included the construction of drop structures, as well as surface treatment and planting to stabilise the banks of the creek.

4.2.2  Summary

The preliminary geomorphological assessment did not find anything of fluvial geomorphological significance at Ben Bullen Creek which would have particular benefit to restoring Reach 2 to its assumed pre-disturbance flow path in preference to rehabilitating in its current location. Both options will require the full length of the creek to be rehabilitated to establish a functioning geomorphological system.

The existing channel shows no evidence for flood flows and it is expected that it will have a characteristic low flow even after heavy rainfall. This is helpful in that the area does not require management for high flood flows, and it is considered reasonable to expect that riparian ecosystem diversity could be established relatively quickly.
The main difference between the two options in a geomorphological context is likely to be a difference in flow path along Reach 2. The topography of the site indicates that the existing diversion route is likely to be longer than the creek's assumed pre-disturbance flow path which may result in a loss of energy within the fluvial system.

There is no evidence from this initial assessment to suggest that restoring the creek to its original position would provide significant geomorphological benefit to the creek system. This option will require equal input in rehabilitating the existing stockpiles and high walls; but also provides the additional challenge of identifying the creek's original alignment in a landscape which has changed with coal mine development.

It is considered there are potentially greater benefits to be gained by maintaining the existing diversion location which was assessed to be stable and showing the potential to rehabilitate from existing vegetation cover.

The delineation of the upstream catchments is described in Section 5 of this report. It is suggested that there is benefit in understanding how flow reaches the site. This would allow the design flows to be derived with more confidence. The work reported in this document is appropriate for this initial assessment. However, determining how rainfall is handled in the catchment and what the division is between groundwater, surface storage and surface flow should be the focus of the next stage of the restoration effort.

4.3 Preliminary Geotechnical Assessment

4.3.1 Reach 1

The base and western batter of the creek channel are mostly in mine spoil which is probably unconsolidated rather than having been placed in compacted layers. Parts of the eastern batter are also in mine spoil, with the remainder being natural hillside colluvium and weathered rock. Batters are mostly 3H:1V or flatter, with some localised steeper areas on the west batter to about 2.5H:1V. It is considered that from the geotechnical viewpoint, the observed natural and mine spoil batters in Reach 1 will have ample long-term stability. Ponded water in the creek bed in this area was observed to be highly turbid (Plate 4.4), indicating that some of the local soils are dispersive. It should be noted that Reach 1 is not affected by current operations however spoil is found across the site, so similar soils may be found in other areas. Future restoration strategies will need to take this into account in the later phases of this project.
Plate 4-4  Southern end of Reach 1: left batter is mine spoil at about 4H:1V, right batter is natural hillslope. Note turbid ponded water, indicative of dispersive soils

At the southern end of Reach 1, about 50 m upstream of a long rock lined section of the channel which serves as a drop structure, there was evidence of a scour point and collapse of the mine spoil forming the base of the channel (Plate 4-5). These features are probably a consequence of “piping” of the channel base soils into the underlying spoil, but this is not likely to be a significant on-going issue from the viewpoint of geotechnical stability. Minor restoration will be required to address the piping issues.
Plate 4-5  Reach 1: looking upstream to scour point and collapse of channel floor about 50 m upstream of drop structure

Plate 4-6  Reach 1: highwall on eastern side of pool below drop structure – top stratum will erode back to 1.5H:1V, but overall stability of highwall is considered satisfactory

At the downstream end of the drop structure there is a large pool which probably serves as a stilling basin. It is bounded on the east side by a sub-vertical highwall about 8 m high. The topmost stratum in this highwall is residual soil and extremely weathered sandstone/conglomerate, which is showing significant erosion (Plate 4-6). If left untreated, it can be expected that over the long term this stratum will erode to a stable slope of about
1.5H:1V, but the overall stability of the highwall should be satisfactory. Even if the highwall was to have a major stability failure, the effect of the resultant slide debris on the hydraulics of the stream would be minor because of its substantial width at this location. An approach to stabilise this will be assessed further in Phase 2 of the project.

4.3.2 *Reach 2 - Existing Creek Diversion (western alignment)*

Unconsolidated mine spoil forms both banks of the current creek alignment for the first 500 m of Reach 2, with flow in a westerly direction. The batters are often approaching angle of repose (steeper than 2H:1V), and with heights ranging from 5 m to 15 m. As such, most would currently be at the borderline of acceptable long term geotechnical stability. Regrating the slopes to a shallower angle, along with suitable capping would improve the geotechnical stability whilst providing more suitable conditions for revegetation. Phase 2 of this investigation will consider options to stabilise these batters which may include re-grading of the slopes and the planting of vegetation.

The current creek alignment then turns north, and for about 350 m runs along the toe of a highwall up to about 15 m high. The top stratum of this highwall is a bed of relatively sound sandstone which is underlain by a fine-grained material (probably mudstone/claystone) which has eroded and undercut the sandstone capping (Plate 4-7).

![Plate 4-7 Reach 2 (west alignment): highwall, with sandstone capping being undercut, posing potential long term safety concern](image)

This undercutting is likely to progress in the longer term to the extent there could be failures of the overhanging cap. Because of the substantial width of the stream along this reach, such failure would be of no consequence to the hydraulics of the stream, but the presence of a highwall with an undercut edge would be a potential long term public safety concern if access to the edge cannot be adequately restricted.

Options for removing the highwall will be considered in Phase 2 of this investigation and may include;
• cut it back to a batter suitable for revegetation (although at present there are space constraints on this imposed by the coal handling area immediately to the west);
• buttressing it to create a batter of reworked mine spoil; or
• a combination of cutback and buttressing.

4.3.3 Reach 2 – Assumed Pre-disturbance Course (eastern alignment)

For re-direction of the creek to approximately follow its original alignment through the current surface infrastructure area, the channel would be constructed through unconsolidated mine spoil. Batters which are sufficiently flat for geomorphic and vegetation requirements can be assumed to be satisfactory from the geotechnical viewpoint.

The northern part of this alignment utilises the existing water storage dam, which is bounded on its eastern side by a subvertical longwall about 10 m high (Plate 4-8). The topmost stratum of this longwall is colluvium and weathered sandstone/conglomerate similar to that previously described for the northern end of Reach 1. This stratum can be expected to slowly erode to a long term batter of about 1.5H:1V. The underlying coal measures rocks would likely be geotechnically stable in the long term in their current sub-vertical configuration. Nevertheless, from a public safety point of view it may be preferable to cut the highwall back and/or place soil against it - a resulting batter which is suitable for revegetation will also be geotechnically acceptable.

Plate 4-8 Reach 2 (eastern alignment): highwall forming eastern side of dirty water dam, weathered sandstone upper stratum eroding back to likely 1.5H:1V long term batter. Highwall in top of frame has previously been cut back to 1.5H:1V for full height

4.3.4 Reach 3.

Much of this part of the stream alignment has been cut through unconsolidated mine spoil. Some of the batters are significantly steeper than 2H:1V, in which case their long term
geotechnical stability may not be satisfactory. However, these steeper areas will probably need to be flattened for revegetation establishment and maintenance reasons, and this will also provide a geotechnically acceptable landform.

4.4 Preliminary Ecological Assessment

4.4.1 Reach 1

The upstream portion of the study area consists of areas that have undergone past rehabilitation works and areas of natural and regenerating vegetation. The rehabilitation works along this reach of the creek line generally occurred along the western edge, with a good diversity of Acacia spp., Eucalyptus spp. saplings and other native herbs and grasses occurring frequently. The eastern edge consisted of a mix of regenerating and mature canopy. In-stream vegetation along this reach was only present in the downstream stretch of the reach. This in-stream vegetation was dominated by native reeds including Phragmites australis (Common Reed) and Juncus spp.

The rehabilitation areas on the western edge of the creek line consist of a mix of canopy, understory and groundcover. General species observed within the rehabilitation areas include a canopy of Casuarina cunninghamiana (River She-oak), Eucalyptus macrocarpa (Red Stringybark), Eucalyptus pauciflora (Snow Gum), Eucalyptus rossii (Inland Scribbly Gum), Eucalyptus stellulata (Black Sally) and Eucalyptus viminalis (Ribbon Gum).

The understorey consists of Acacia dealbata (Silver Wattle), Acacia decurrens (Black Wattie), Acacia falciformis (Hickory Wattie), Acacia rubida (Red Stem Wattle), Allocasuarina littoralis (Black She-oak), Bursaria spinosa (Native Blackthorn), Daviesia latifolia, Callistemon citrinus (Lemon-scented Bottlebrush), Cassinia arcuata (Sifton Bush), Kunzea parviflora (Violet Kunzea) and Leptospermum polygalifolium (Common Tea Tree).

The groundcover was dominated by a mixture of grasses and herbs, with Bothriochloa macra (Red Grass), Lomandra spp. and Microlaena stipoides (Weeping Grass) occurring more frequently.

No flora species identified along the section of the creek line are listed under either the NSW Threatened Species Conservation Act 1995 (TSC Act) or the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The noxious weeds Rubus fruticosus (Blackberry) and Lantana camara (Lantana) were identified along the reach of the creek line. These species are classified as a Class 4 noxious weed under the NSW Noxious Weeds Act 1993 (NW Act). Blackberry and Lantana specimens ranged from small plants to medium sized thickets. Pinus radiata (Radiata Pine), although not a noxious weed, is an introduced species and occurs frequently along the downstream portion of this reach.

Fauna habitat along this reach of the creek line consisted of ponds of water, exposed rock areas associated with artificially constructed drop structures, a mix of young and mature canopy, large woody debris, stags (dead trees) and a natural spring (Plate 4-9). This fauna habitat has the potential to provide foraging and roosting habitat for threatened fauna species that may potentially utilise the site. The creek line and adjacent habitat provides potential foraging and sheltering habitat for ground dwelling mammals, amphibians and reptiles within
woody debris and rocky areas. Potential roosting habitat (hollow-bearing trees) for arboreal mammals, birds and bats may also be found within, along and adjacent to the creek line.

Plate 4-9  Fauna habitat along the creekline, an artificial pool-and-riffle feature comprised of a rocky batter, ponded water and young canopy of Acacia spp.

4.4.2 Reach 2 - Existing Creek Diversion (western alignment)

The existing creek diversion (western alignment) portion of the study area contained a number of past rehabilitation works which displayed varying levels of success. The rehabilitation works along this reach of the creek line generally occurred along both banks, with the western side having greater success. In-stream vegetation along this reach was dominated by Common Reed and less frequently Juncus spp.

The vegetation along this reach of the creek consists of scattered canopy and understorey species, with scarce groundcover on the slopes adjacent to the creek line. Beyond the immediate slopes along the creek line, a structured vegetation community consisting of a canopy, understorey and groundcover exists on the western side (Plate 4-10).

A good diversity of Acacia spp, Eucalyptus spp, and other native herbs and grasses were located along the creek line. Canopy species along this reach of the creek line included Red Stringybark, Snow Gum and Ribbon Gum. An understorey is present and consists of Silver Wattle, Black Wattle, Black She-oak, Native Blackthorn, Sifton Bush, Violet Kunzea and Common Tea Tree. The groundcover was dominated by a mixture of grasses and herbs, with Red Grass, Lomandra spp, and Weeping Grass. No flora species identified within the section of the creek line are listed under either the NSW TSC Act or the Commonwealth EPBC Act.
There was one noxious weed identified along this reach of the creek line, Blackberry, which is classified as a Class 4 noxious weed under the NSW Noxious Weeds Act 1983 (NW Act). Blackberry specimens ranged from small to medium sized thickets. Radiata Pine, although not a noxious weed, is an introduced species and occurs frequently along this reach of the creek line.

Fauna habitat along this reach of the creek consisted of ponds of water, a mix of young and mature canopy and large woody debris. It is possible that this fauna habitat supports the foraging and roosting of threatened fauna species possibly found in the area including:

- *Anthochaera phrygia* (Regent Honeyeater),
- *Callocephalon fimbriatum* (Gang-gang Cockatoo),
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo),
- *Climacteris picumnus victoriae* (Brown Treecreeper (eastern subspecies)),
- *Daphoenositta chrysoptera* (Varied Sittella),
- *Glossopsitta pusilla* (Little Lorikeet),
- *Melanodryas cucullata* (Hooded Robin),
- *Ninox strenua* (Powerful Owl),
- *Stagonopleura guttata* (Diamond Firetail),
- *Chalinolobus dwyeri* (Large-eared Pied Bat),
- *Miniopterus schreibersii oceanaensis* (Eastern Bent-wing Bat),
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle),
- *Mormopterus norfolkensis* (Eastern Freetail Bat) and
- *Scotopanax ruppellii* (Greater Broad-nosed Bat)

The creek line and adjacent habitat provides potential foraging and sheltering habitat for ground dwelling mammals, amphibians and reptiles within woody debris. Potential roosting habitat (hollow-bearing trees) for arboreal mammals, birds and bats may also be found within, along and adjacent to the creek line.
Plate 4-10  Vegetation on the western side of the creek line, dominated by a canopy of Ribbon Gum

4.4.3  Reach 2 – Assumed Pre-disturbance Course (eastern alignment)

The assumed pre-disturbance creek alignment (eastern alignment) consists of areas of surface infrastructure that will require removal, areas that are dominated by Radiata Pine on western side and an existing high wall on the eastern side.

Fauna habitat along this reach is poor, with fauna habitat consisting of Radiata Pine and ponded water. This fauna habitat provides potential foraging habitat for some threatened species, particularly birds. The ponded water provides potential foraging and sheltering habitat for amphibians.

4.4.4  Reach 3

The downstream portion of the study area consists of areas that have undergone past rehabilitation works. The rehabilitation works along this reach of the creek line generally occur along both sides, with a good diversity of Acacia spp., Eucalyptus spp. saplings and other native herbs and grasses occurring frequently. Radiata Pine is dominant along most of the banks. In-stream vegetation along this reach was dominated by Common Reed and less frequently Juncus spp.

No flora species identified within the section of the creek line are listed under either the NSW TSC Act or the Commonwealth EPBC Act.

There was one noxious weed identified along this reach of the creek line, Blackberry, which is classified as a Class 4 noxious weed under the NSW Noxious Weeds Act 1993 (NW Act).
Blackberry specimens ranged from small to medium sized thickets. Erosion issues are occurring along steeper slopes and should be targeted for any remedial works that will be undertaken. An example of this is further targeted revegetation works on upslope areas of the creek bank, especially in areas with bare ground. This would require establishing a groundcover and understorey as a priority, in an effort to minimise bare soil and the associated erosion.

Fauna habitat along this reach of the creek line consisted of ponds of water, exposed rock areas associated with artificially constructed drop structures, a mix of young and mature canopy and large woody debris. This fauna habitat has the potential to provide foraging and roosting habitat for threatened fauna species that may potentially use the site. The creek line and adjacent habitat provides potential foraging and sheltering habitat for ground dwelling mammals, amphibians and reptiles within woody debris and rocky areas. Potential roosting habitat (hollow-bearing trees) for arboreal mammals, birds and bats may also be found within, along and adjacent to the creek line.
HYDRAULIC MODELLING

5.1 Hydrology

The rational method as described in Australian Rainfall and Runoff (AR&R) was used to estimate peak flows for a range of design events.

The section below describes the process used to determine the peak flow estimates.

5.2 Survey Data

The supplied LiDAR data was used to construct a Digital Terrain Model (DTM) of the area in the civil design software 12D. This DTM was then used to delineate the catchment contributing to Ben Bullen Creek in conjunction with other data sources.

5.3 Catchment delineation

The Ben Bullen Creek catchment was separated into two smaller catchments, upper (red) and lower (blue), as shown in Figure 5-1.

The upper catchment consisted mainly of undisturbed forest found to the south east of the mine, with the downstream boundary of this catchment terminating near a pond in the south of the mine site. Review of the topography in the vicinity of this pond revealed a large low point in the channel slope. This caused the channel to have a "reverse grade" for a short reach i.e. instead of the creek flowing downstream the gradient in this area appears to flow upstream. This was confirmed during the site visit and is shown in Figure 5-2.

Section 4.2.1 has already described the appearance of this reverse grade and it is clear that the 3 m rise will cause a significant volume to be stored in this upper reach of the creek. The exact impact of this reverse grade is unclear at this stage and would require further investigation. This impact of this on the calculation of peak flows is discussed in Section 5.4.

The lower catchment consisted mainly of the disturbed mine area. It was difficult to determine the flow path within this area due to the surface works interrupting the natural drainage of the catchment. It is likely that the flow paths were lengthened in order to bypass the rail loop and other infrastructure, slowing the rate at which water reaches the creek. The mine rehabilitation areas would also have an effect on the surface runoff in this catchment due to the higher rates of infiltration.
Figure 5-1  Ben Bullen Creek Catchment Delineation

Figure 5-2  Channel Long Sections Including Reach with Reverse Gradient
5.4 Calculation of Peak Flow

The method used to calculate the peak flows is described in Appendix A. The results are presented below and these were used in the hydraulic modelling to predict the behaviour of the creek. The same flow values were used for all model scenarios.

<table>
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<tr>
<th>ARI</th>
<th>Upper Catchment Q (m³/s)</th>
<th>Lower Catchment Q (m³/s)</th>
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<td>2</td>
<td>0.0</td>
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<td>50</td>
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The factors described in Section 5.3 all suggest that the calculations of peak flow for these catchments are likely to be overestimates. This is further supported by reports from site staff that suggest the creek very rarely experiences any significant flow. It would be possible to improve the calculations if flow measurements for the creek were taken during rainfall events.

Initial flow estimates were very conservative, suggesting significant flow depths during relatively minor storms. In order to reduce the flow used in the hydraulic modelling to more realistic, but still conservative levels, the coefficients of runoff for the contributing catchments were revisited. It was decided that a lower coefficient would better represent the flow reaching the creek. This is because the artificially lengthened drainage paths, informal surface storage and significant areas of spoil placement would all reduce the flow in the creek during the storm peak. It was also assumed that all storm flow from the upper catchment below the 10 year design storm level will be retained by the reverse grade slope. It is assumed that this flow will pond in the southern extent of the site and seep downstream as groundwater. This process will take some time and therefore the flow will not contribute to a storm peak. This assumption is supported by the scour point shown in Plate 4-5. Initial inspection of this feature suggests it was created by piping below the surface, suggesting that there is a significant groundwater flow in this location. As stated previously, further investigation is required to understand the processes currently active in this reach.

5.5 Hydraulic Modelling

The objective of the hydraulic modelling was to compare the flow behaviour for the existing course against a representation of the assumed pre-disturbance course. The hydraulic modelling program TUFLOW was used to undertake this comparison. TUFLOW is a computer program for simulating depth-averaged, two and one-dimensional free-surface flows such as those that occur from floods and tides. In order to do this it needs detailed topography data of the study area.

5.5.1 Model Construction

5.5.1.1 Channel roughness

One of the primary factors that govern creek behaviour is the resistance to flow or hydraulic roughness. The TUFLOW model uses Manning’s ‘n’ values to represent the hydraulic roughness of the area. Table 5-2 shows the material type and the assigned roughness value with Figure 5-3 showing where they were applied within the model. The default roughness for all areas of the model was a value of 0.04 unless otherwise covered by a roughness polygon.
These roughness values were based on standard values as shown in Open Channel Hydraulics (Chow, 1959). The value for buildings is set very high to allow the impact of a building where the survey may not show its presence. Not all material types included in the standard table have been used in the model.

Table 5-2 Materials and Roughness Coefficients

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<td>Pasture</td>
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<td>Forest</td>
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<td>8</td>
<td>Mine Site Rehabilitation</td>
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5.5.1.2 Boundaries

The TUFLOW model requires all boundaries of the hydraulic model to be specified in terms of water depth/time (h/t), discharge/time (Q/t) or discharge/water depth (Q/h) relationships. The development of such a relationship requires detailed catchment modelling. This model was concerned with the investigation of peak conditions, so where necessary a standard relationship was used. This can be improved in later stages of the design process, should more detailed results be required.

The boundary conditions used in the modelling of the area consisted of:

- **Upstream boundaries** – Using the peak flows determined in Section 5.4, inflow hydrographs were developed using standard bell-shaped Q/t relationships. The flood hydrograph for the upper catchment was used at the upstream boundary of the TUFLOW model whilst the lower catchment flowed into the model just downstream of the upstream boundary as shown in Figure 5-3.

- **Downstream boundaries** – discharge rating curves (Q/h relations) were used as the downstream boundary condition for flows leaving the model.
5.5.1.3 Existing Case

The DTM, derived from the LIDAR survey, was used to create a 2d hydraulic TUFLOW model of the existing creek system. Given that the path of the creek is undefined in areas near the south-eastern mine border, water entered the model and was allowed to flow downstream as per the topography.

5.5.1.4 Design Case

A basic creek channel was designed digitally and read into the TUFLOW model. An embankment was also constructed in the model to divert water away from the existing channel into the proposed channel.

5.6 Results

Before analysing the results, it is important to note that the hydrological estimates are considered conservative and therefore the hydraulic modelling should also be considered conservative. The accuracy of the model can be improved with flow and level measurements on the creek during rainfall periods. The data can then be used with local rainfall data to verify the model's behaviour.

Creek stability is a balance between erosion and deposition that does not result in sudden changes in the shape of a creek. A stable system will still show signs of erosion and deposition; however, these will generally be slow acting processes. An industry accepted study into creek stability was carried out by the Australian Coal Association Research Program (ACARP); Bowen Basin Diversions – Design and Rehabilitation Criteria (ACARP, 2002). Guidelines on the parameters required for a generally stable creek were developed for the
channels in the Bowen Basin, Queensland. This work is therefore not necessarily directly comparable to other catchments across Australia, but it serves as a guide to the likely state of the channel.

The ACARP report requires that the channel type be identified; incised, limited capacity or bedrock controlled. Reach 2 of Ben Bullen Creek is bedrock controlled; however this is not a state that has developed naturally. A bedrock controlled channel is considered able to resist higher erosive characteristics. The characteristics used to assess the stability of the channel are; bed shear stress (BSS, N/m²), stream power (SP, W/m²) and velocity (V, m/s). These characteristics are assessed for the 2 and 50 year design events because these are considered representative of the channel forming flows.

Table 5-3 and Table 5-4 provide the modelling results and also the guideline values for a bedrock controlled channel. These are median average results (as required by the ACARP guidance) for the creek reaches identified in Figure 1-1. Figure 5-4 and Figure 5-5 provide an overview of the water depth for the existing course during the 2 and 50 year design events. Further figures, providing depth and velocity results for the two options, are provided in Appendix B.

**Table 5-3**  
2 Year ARI Results

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</tbody>
</table>
### Figure 5-4  Water Depth Results for the 2 Year ARI Event

### Table 5-4  50 Year ARI Results

<table>
<thead>
<tr>
<th></th>
<th>Existing Course</th>
<th></th>
<th></th>
<th>Assumed pre-disturbance Course</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BSS (N/m²)</td>
<td>SP (N/m/s)</td>
<td>V (m/s)</td>
<td>BSS (N/m²)</td>
<td>SP (N/m/s)</td>
<td>V (m/s)</td>
</tr>
<tr>
<td>Reach 1</td>
<td>194.3</td>
<td>651.9</td>
<td>3.5</td>
<td>187.3</td>
<td>638.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Reach 2</td>
<td>99.6</td>
<td>277.8</td>
<td>2.9</td>
<td>161.5</td>
<td>534.8</td>
<td>3.3</td>
</tr>
<tr>
<td>Reach 3</td>
<td>21.7</td>
<td>32.6</td>
<td>1.5</td>
<td>21.9</td>
<td>33.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Limits</td>
<td>&lt; 120</td>
<td>100 - 300</td>
<td>2 - 3</td>
<td>&lt; 120</td>
<td>100 - 300</td>
<td>2 - 3</td>
</tr>
</tbody>
</table>
Figure 5-5  Water Depth Results for the 50 Year ARI Event

It can be seen that the creek is transitioning from a steep, upper catchment channel to a flatter, more meandering, mid-catchment channel. This is shown by the model results containing high values for Reach 1 (steep), low values for Reach 3 (flat) and Reach 2 falling between.

In Reach 2 the results for the existing course are all within the suggested limits, but those for the assumed pre-disturbance results exceed the 50 year guidelines. There is no information on how 'stable' the original channel (i.e. pre-mining) was. Direct comparison with the ACARP guidelines would suggest that this reach was in a period of change (due to exceedance of the guidelines). However, it is important to reiterate that the guidelines may not be applicable in this instance and therefore comparisons need to be rationalised.

Creek systems adapt to changes in hydrologic conditions over time. It is reasonable to assume that the pre-mining state was a stable system, typical of upper reaches of 'highland' rivers. The aim of this investigation is therefore to identify a state that will provide long term stability after mine closure. This can be estimated by finding the option with modelling results
that are in general agreement with the suggested guidelines as the adopted benchmark for this initial work.

However the analysis does show that when compared with a common (and accepted) benchmarks, the current alignment results in more "benign" hydraulic conditions which are within accepted parameters for morphological stability. Furthermore, comparison of results for the two alignments suggests that the current course of the creek will represent more favourable conditions for successful restoration.

Reach 1 consists of a number of low gradient sections separated by rock drops. The flow therefore travels slowly over the channel sections, with the high velocity, high power locations constrained to the protected rock drops suggesting that these high values are kept in check by the armoured portions of the reach. This conclusion is substantiated by site observations.

It should be remembered that the hydrology modelling is considered conservative at this early stage of the restoration work. This suggests that flows may reduce further with further refinement of the modelling, thereby adding more confidence to the likely success of achieving favourable hydraulic conditions. In any case the results for the existing course will remain lower than the assumed pre-disturbance line.
6 RISK IDENTIFICATION AND OPTION COMPARISON

6.1 Introduction

A workshop meeting was held between the subject matter experts present on the site assessment day. This allowed the potential risks for the remediation to be identified and discussed with BBC personnel. The aim of the meeting was to compare the likely risks of the two remediation options to identify a preferred option.

During the meeting it was identified that even if the assumed pre-disturbance flow path were constructed, some form of drainage would be required along the existing path. This is because the land currently drains to the existing creek and it would take significant works to change this. This level of works would also remove the majority of the vegetation that currently exists on the spoil piles. Therefore the option to develop the assumed pre-disturbance flow path actually includes most of the works required to keep the existing flow path. This means that many of the risks associated with the existing creek line are also associated with the pre-disturbance flow line. This is considered further in Section 6.2.

It was also assumed that the culvert overflow for the water storage on the assumed pre-disturbance flow line would be maintained as an open channel for both options.

6.2 Risk Identification

The table below presents the risks involved with each option. The risks have not been quantified at this stage, however they give an indication to the issues that will be faced in the later design stages.

Table 6-1 Risks Associated with Each Option

<table>
<thead>
<tr>
<th>Existing Course</th>
<th>Pre-Disturbance Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown ground conditions/quality in the spoil piles that form the batters of the diversion</td>
<td>Unknown ground conditions/quality in the spoil piles that form the batters of the diversion (existing course kept/modified for surface drainage)</td>
</tr>
<tr>
<td>Vegetation removal due to works on spoil piles</td>
<td>Unknown ground conditions/quality in the spoil under the pre-disturbance path given a long history of industrial use. Contamination Risk</td>
</tr>
<tr>
<td>Highwalls may pose safety risk</td>
<td>Vegetation removal due to works on spoil piles</td>
</tr>
<tr>
<td>Culverts may be Microbat habitat</td>
<td>Shorter channel length and steeper grade may lead to increased erosion</td>
</tr>
<tr>
<td></td>
<td>Highwalls may pose safety risk</td>
</tr>
<tr>
<td></td>
<td>Possible flood flow interaction with adjacent underground adits</td>
</tr>
</tbody>
</table>

6.3 Other Considerations

There are other issues with the development of each option that are not risks, but may help to identify a preferred option.

The existing course contains two culvert crossings that have an effect on the flow regime in the channel. If these culverts are removed the design will have to consider whether the
ponding caused by the crossings is ecologically desirable and whether to maintain a similar effect. This could be achieved by designing a constriction in the open channel that would maintain a similar discharge to the culvert structure. This approach will be refined in Phase 2 of this investigation.

The assumed pre-disturbance course will not be able to be established until mine closure. This will impact the time that the mine will spend on maintaining the development of vegetation cover. This is in contrast to the existing course where works can begin immediately and additional vegetation can be maintained for the period until mine closure.

6.4 Recommendations

It is recommended that the existing course be maintained for Ben Bullen Creek. A wide range of impacts have been considered in coming to this recommendation and the main points are highlighted below.

There has been a long history of industrial activity at the working area of the mine. There is therefore a risk of exposing legacy contaminants should major earthworks be carried out. Review of the current topography and drainage across the working area show that surface water flows to the existing water storage dam. As stated earlier, the current culvert overflow will be developed into an open channel reach that will allow free drainage of the storage when water levels allow. This means that the spoil that is currently located under the working area does not need to be significantly disturbed and can be revegetated following mine closure.

There is currently ecological value along the existing alignment which can be built upon through rehabilitation works. Currently there is structured vegetation, a diverse mixture of flora species and fauna habitat potential. With some further remedial works, including further rehabilitation works along the eastern bank (e.g. mulch, plantings and installation of woody debris) the ecological value of the creek line will improve. Where existing vegetation is removed as part of the civil works, this could be reused as mulch, initial ground cover or woody debris, to aid any fresh rehabilitation works.

The assumed pre-disturbance alignment for the creek line traverses the existing pit top area and consequently contains low ecological value. It would require substantial rehabilitation works to replicate the ecological value of the existing creek alignment. This alignment is not preferred, and potential re-alignment may have impacts upon the ecological values (in-stream vegetation and flora species) of the current creek system. As mentioned earlier, there is also a risk of exposing legacy contaminants if significant earthworks are carried out.

The remediation of the existing course can commence in a timely manner following receipt of required approvals allowing for additional benefits. Once the construction works are complete, the revegetation effort can begin. If the site is operational, staff will be available to review the progress of the vegetation on a regular basis. This will allow any issues to be identified and remedial action taken in a timely manner. Whilst this would still occur after mine closure, the time between inspections would be much greater and duration of monitoring would be shorter. It is likely that this would impact on the success of the revegetation process.

The existing course is geomorphologically stable and requires only minor adjustments to improve the geotechnical stability and revegetation potential of the banks. The modelling is a conservative estimate of channel conditions, but this also suggests the channel is stable.
The longer path of the existing course has less erosive power and is therefore more likely to remain stable in the long term. The assumed pre-disturbance path also passes close to the adits, posing a potential risk of flood waters entering the underground workings.

6.5 Identifying Additional Value

During the site visit, it was suggested that the pine trees found on the spoil slopes in Reach 2 of the creek may be useful as woody debris in the channel and on the banks following remediation. Some of the pines can be left in place, but others will ideally be removed to make way for a better mix of species. Woody debris is important in creating variations in the stream flow, providing habitat for wildlife and also providing mulch for vegetation.

6.6 Forward Work Plan

The intention of this report is to act as the first step in developing a Natural Channel Design and Restoration Plan. This first step identifies a recommended option for the restoration of Ben Bullen Creek and identifies the main issues that will be considered during the design phase. The following phases will develop preliminary designs and cost estimates, followed by the final detailed design.

Table 6-2 presents an outline of the expected timing for the following two phases of the investigation. An essential first task is to request an amendment to the required submission date for the Natural Channel Design and Restoration Plan. This will allow the option recommended here to be developed into a full design and submitted to the EPA.

Table 6-2 Plan for Future Work

<table>
<thead>
<tr>
<th>Task</th>
<th>Time (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application to amend submission date</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 2</strong></td>
<td></td>
</tr>
<tr>
<td>Develop concept plans</td>
<td></td>
</tr>
<tr>
<td>Cost Estimate</td>
<td></td>
</tr>
<tr>
<td>Review by EPA</td>
<td></td>
</tr>
<tr>
<td><strong>Phase 3</strong></td>
<td></td>
</tr>
<tr>
<td>Detailed Design</td>
<td></td>
</tr>
<tr>
<td>Tender Documentation</td>
<td></td>
</tr>
</tbody>
</table>
LIMITATIONS

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Any estimates of potential costs which have been provided are presented as estimates only as at the date of the Report. Any cost estimates that have been provided may therefore vary from actual costs at the time of expenditure.
APPENDIX A  HYDROLOGY CALCULATIONS

The rational method, as described in the AR&R, is based on the following equation:

\[ Q_r = 0.278C_r I_{c, y} A \]

Where:

- \( Q_r \) = Flow for a given design storm (m³/s)
- \( C_r \) = Runoff coefficient for a given design storm
- \( I_{c, y} \) = Rainfall intensity for the time of concentration for a given design storm (mm/hr)
- \( A \) = Catchment area (km²)

A.1 Coefficient of Runoff

The coefficient of runoff is based on a base value, defined as the value for a design storm with a return period of 10 years (C10). This is found using the maps in Volume 2 of the AR&R, and the map used in this case is Figure 1.1. This has been adjusted to take account of the extended flow paths and higher ground absorption on the rehabilitation areas, as described in the main report.

The coefficient is then multiplied by a frequency factor to give coefficients for the other design storms. The method for determining the frequency factor is also given in the AR&R and are dependent on the location of the site.

A.2 Time of Concentration

The time of concentration is given by a simple formula that is based on the catchment area:

\[ t_c = 0.76 \times A^{0.35} \]

Where:

- \( t_c \) = Time of concentration (hr)
- \( A \) = Catchment area (km²)

A.3 Intensity

The intensity is found by using the time of concentration with the IFD table.

Before peak flows can be estimated, the rainfall at a particular location must first be estimated. The BoM website was used for this and the only input required was the coordinates of the sites. The coordinates used were -32.275 and 150.050.

The result is a table and graph that give rainfall intensity (in mm/hr) for a range of design storms and durations. Table-A-1 gives the IFD table for the site.
Table A-1     IFD Baal Bone Colliery

<table>
<thead>
<tr>
<th>DURATION</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>5Mins</td>
<td>61.38</td>
<td>79.99</td>
<td>104.86</td>
<td>120.46</td>
<td>141.05</td>
<td>169.21</td>
<td>191.50</td>
</tr>
<tr>
<td>6Mins</td>
<td>57.59</td>
<td>74.96</td>
<td>98.05</td>
<td>112.52</td>
<td>131.63</td>
<td>157.70</td>
<td>178.38</td>
</tr>
<tr>
<td>10Mins</td>
<td>46.91</td>
<td>60.90</td>
<td>79.08</td>
<td>90.40</td>
<td>105.43</td>
<td>125.81</td>
<td>141.96</td>
</tr>
<tr>
<td>20Mins</td>
<td>33.94</td>
<td>43.88</td>
<td>56.25</td>
<td>63.82</td>
<td>74.00</td>
<td>87.71</td>
<td>98.48</td>
</tr>
<tr>
<td>30Mins</td>
<td>27.54</td>
<td>35.48</td>
<td>45.12</td>
<td>50.96</td>
<td>58.86</td>
<td>69.46</td>
<td>77.75</td>
</tr>
<tr>
<td>1Hr</td>
<td>18.64</td>
<td>23.88</td>
<td>30.03</td>
<td>33.68</td>
<td>38.69</td>
<td>45.38</td>
<td>50.56</td>
</tr>
<tr>
<td>1.5Hr</td>
<td>14.58</td>
<td>18.64</td>
<td>23.32</td>
<td>26.09</td>
<td>29.90</td>
<td>34.99</td>
<td>38.92</td>
</tr>
<tr>
<td>2Hrs</td>
<td>12.17</td>
<td>15.54</td>
<td>19.41</td>
<td>21.69</td>
<td>24.82</td>
<td>29.01</td>
<td>32.24</td>
</tr>
<tr>
<td>2.5Hrs</td>
<td>10.55</td>
<td>13.47</td>
<td>16.80</td>
<td>18.76</td>
<td>21.46</td>
<td>25.06</td>
<td>27.84</td>
</tr>
<tr>
<td>3Hrs</td>
<td>9.38</td>
<td>11.98</td>
<td>14.92</td>
<td>16.65</td>
<td>19.04</td>
<td>22.23</td>
<td>24.69</td>
</tr>
<tr>
<td>4Hrs</td>
<td>7.78</td>
<td>9.94</td>
<td>12.36</td>
<td>13.80</td>
<td>15.77</td>
<td>18.40</td>
<td>20.43</td>
</tr>
<tr>
<td>5Hrs</td>
<td>6.74</td>
<td>8.61</td>
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<td>11.93</td>
<td>13.63</td>
<td>15.90</td>
<td>17.64</td>
</tr>
<tr>
<td>6Hrs</td>
<td>6.00</td>
<td>7.66</td>
<td>9.51</td>
<td>10.60</td>
<td>12.11</td>
<td>14.11</td>
<td>15.66</td>
</tr>
<tr>
<td>12Hrs</td>
<td>3.92</td>
<td>4.99</td>
<td>6.15</td>
<td>6.83</td>
<td>7.77</td>
<td>9.01</td>
<td>9.97</td>
</tr>
<tr>
<td>24Hrs</td>
<td>2.65</td>
<td>3.35</td>
<td>4.05</td>
<td>4.45</td>
<td>5.03</td>
<td>5.77</td>
<td>6.35</td>
</tr>
<tr>
<td>48Hrs</td>
<td>1.81</td>
<td>2.25</td>
<td>2.66</td>
<td>2.88</td>
<td>3.20</td>
<td>3.63</td>
<td>3.95</td>
</tr>
<tr>
<td>72HRS</td>
<td>1.39</td>
<td>1.73</td>
<td>2.01</td>
<td>2.16</td>
<td>2.39</td>
<td>2.69</td>
<td>2.91</td>
</tr>
</tbody>
</table>

A 4

Calculations

The following tables give the figures used to develop the design storm peak flows and the flows themselves:

Table A-1     Upper Catchment Calculations

A       12.7 km²

\[ t_c = 120 \text{mins} \]

<table>
<thead>
<tr>
<th>ARI</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity (mm/hr)</td>
<td>14.58</td>
<td>18.64</td>
<td>23.32</td>
<td>26.09</td>
<td>29.90</td>
<td>34.99</td>
<td>38.92</td>
</tr>
<tr>
<td>FFv</td>
<td>0.57</td>
<td>0.70</td>
<td>0.86</td>
<td>1.00</td>
<td>1.14</td>
<td>1.33</td>
<td>1.50</td>
</tr>
<tr>
<td>Cr</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Q (m³/s)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>18.4</td>
<td>31.6</td>
<td>49.3</td>
<td>82.2</td>
</tr>
</tbody>
</table>
Table A-1  Lower Catchment Calculations

$A = 3.8 \text{ km}^2$

$t_c = 76\text{ mins}$

<table>
<thead>
<tr>
<th>ARI</th>
<th>1</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity (mm/hr)</td>
<td>18.64</td>
<td>23.88</td>
<td>30.03</td>
<td>33.68</td>
<td>36.69</td>
<td>45.38</td>
<td>50.56</td>
</tr>
<tr>
<td>FFv</td>
<td>0.57</td>
<td>0.70</td>
<td>0.86</td>
<td>1.00</td>
<td>1.14</td>
<td>1.33</td>
<td>1.50</td>
</tr>
<tr>
<td>CV</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Q (m$^3$/s)</td>
<td>4.5</td>
<td>7.1</td>
<td>11.0</td>
<td>14.4</td>
<td>18.8</td>
<td>25.8</td>
<td>32.4</td>
</tr>
</tbody>
</table>
APPENDIX B  MODEL RESULT FIGURES

B.1 Water Depth for the Existing Course

Figure-B-1  Water Depth - Original Course - 2 Year ARI Event
Figure-B-2  Water Depth - Original Course - 50 Year ARI Event
B.3 Water Depth for the Assumed Pre-Disturbance Course

Figure-B-4 Water Depth - Pre-Disturbance - 2 Year ARI Event
Figure B-5  Water Depth - Pre-Disturbance - 50 Year ARI Event
Figure-B-6  Water Depth - Pre-Disturbance - 100 Year ARI Event
B.5 Water Velocity for the Existing Course

Figure-B-7 Water Velocity - Original Course - 2 Year ARI Event
Figure-B-9  Water Velocity - Original Course - 100 Year ARI Event
B.7 Water Velocity for the Estimate Pre-Disturbance Course

Figure-B-10 Water Velocity - Pre-Disturbance - 2 Year ARI Event
Figure-B-11  Water Velocity - Pre-Disturbance - 50 Year ARI Event
Figure B-12  Water Velocity - Pre-Disturbance - 100 Year ARI Event
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APPENDIX 3

Agency Comments (DRE, NOW, OEH, EPA)
Hi Paul

In order to assist Baal Bone Colliery in the preparation of the s.75W application, DRE would recommend a comprehensive **Rehabilitation** section broadly structured as follows:

- **Final Land Use Goal** – statement outlining the intended final land use of the modification area and any other options considered
- **Rehabilitation Objectives** – identify strategic rehabilitation objectives that support the achievement of the final land use
- **Strategic Completion Criteria** – identify strategic biophysical indicators and completion criteria that can be used to measure the performance of the rehabilitation in achieving the objectives. Completion criteria can be broad (i.e. ranges) at this stage and crystallised further in the MOP as required
- **Rehabilitation Methodology** – identify and briefly describe the likely rehabilitation methods likely to be used
- **Rehabilitation Monitoring** – describe the rehabilitation monitoring methods to be used to measure progress against objectives and completion criteria
- **Conceptual Final Landform Plan** – a plan at a suitable scale and level of detail to describe the final landform outcome

Depending on the scale of the modification, an amendment to the approved Mining Operations Plan (MOP) may be required.

However, I will provide this advice as part of my comments back to you once I have reviewed the application.

Please give me a call if you need further info.

Thanks and regards

---

From: Craig Campbell  
To: Paul Freeman  
Subject: RE: Ben Bullen Creek Restoration - comments due today  
Date: Monday, 16 February 2015 1:06:58 PM

---

From: Paul Freeman  
Sent:Monday, 16 February 2015 10:21 AM  
To: Liz Mazzer; michelle.crawford@environment.nsw.gov.au; craig.campbell@industry.nsw.gov.au; 'allan.adams@epa.nsw.gov.au'; darryl.clift@epa.nsw.gov.au  
Subject: RE: Ben Bullen Creek Restoration - comments due today

Dear All,

I wish to remind you that preliminary comments are due today on Ben Bullen Creek restoration.
If you wish to discuss the matter further, please contact me on 9228 6587.

Kind regards

Paul Freeman
Senior Planner, Mining Projects
NSW Department of Planning & Environment
23-33 Bridge Street, Sydney NSW 2001
GPO Box 39, Sydney NSW 2001
(02) 9228 6587
www.planning.nsw.gov.au

From: Paul Freeman
Sent: Thursday, 5 February 2015 10:26 AM
To: 'Liz Mazzer'; 'michelle.crawford@environment.nsw.gov.au'; Tim Baker;
'allan.adams@epa.nsw.gov.au'; 'darryl.clift@epa.nsw.gov.au'
Cc: 'craig.campbell@industry.nsw.gov.au'
Subject: Ben Bullen Creek Restoration

Dear All,

I wish thank you for your attendance and input at yesterday’s meeting at Baal Bone Colliery.

The Department’s advice to the company on the proposed modification is attached.

If you have any preliminary comments to make on the proposal, please provide these to the Department by Monday 16 February 2015. Further opportunity for comment will be available during the assessment process.

If you wish to discuss the matter further, please contact me on 9228 6587.

Kind regards

Paul Freeman
Senior Planner, Mining Projects
NSW Department of Planning & Environment
23-33 Bridge Street, Sydney NSW 2001
GPO Box 39, Sydney NSW 2001
(02) 9228 6587
www.planning.nsw.gov.au
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Dear Paul

RE   Baal Bone Coal Project – Ben Bullen Creek Restoration

I refer to your email dated 5th February 2015 requesting comments on the above proposal from the Office of Environment and Heritage (OEH) following the onsite meeting held on 4th February 2015.

OEH has reviewed the Environmental Assessments requirements provided to the proponent by the Department of Planning and Environment and makes the following recommendations:

Weed Management

OEH officers observed that there is a high number of Radiata Pine (*Pinus radiata*) throughout the site. The Environmental Assessment should include specific management actions regarding this species.

Rehabilitation

The rehabilitation plan should include species from the entire range of strata that match the target vegetation community.

Should you require further information regarding issues that are the responsibility of the OEH please contact Michelle Crawford, Conservation Planning Officer on (02) 6883 5339.

Yours sincerely,

SONYA ARDILL
Senior Team Leader Planning, North West Region
Regional Operations
Attention: Paul Freeman

Dear Paul

Baal Bone Coal Project (09_0178) Draft Water Management Plan/Ben Bullen Creek Restoration

I refer to your email dated 5th February 2015 requesting preliminary comments from the NSW Office of Water in relation to the proposed restoration of Ben Bullen Creek at Baal Bone Colliery. This request followed a site inspection on the 4th February 2015 with interagency staff. It is understood the proposal is to retain Ben Bullen Creek in its current modified alignment rather than returning it to its pre-mining path as required under the current conditions of approval. This would require a modification to the project approval under Section 75W of the Environment Planning and Assessment Act 1979.

The NSW Office of Water has reviewed the environmental assessment requirements detailed in your letter to Baal Bone Colliery dated 27th August 2014. It is requested the following additional assessment requirements be addressed by the proponent in preparation of an environmental assessment to support the modification proposal.

- Assessment of potential groundwater/surface water connectivity within the proposed alignment and consideration of mitigating and monitoring measures to address significant gains or losses in water volume.
- Detail of proposed final landform and water management for the previously approved creek alignment. This is to include an assessment of water take from both surface water and groundwater, and the interaction of any retained water storages with the groundwater and surface water system.
- Design of proposed creek restoration works to be consistent with the Office of Water guidelines for Controlled Activities on Waterfront Land (July 2012). The introduction of geomorphic complexity more characteristic to a river style for this locational setting is recommended to increase geomorphic functioning and habitat diversity.

Should you have any further queries in relation to this submission please do not hesitate to contact Tim Baker on (02) 6841 7403.

Yours sincerely

Mitchell Isaacs
Manager Strategic Stakeholder Liaison
9 February 2015
Ben,

EPA comments follow.
If you wish to discuss the matter further, please contact me on 9228 6587.

Kind regards

Paul Freeman
Senior Planner, Mining Projects
NSW Department of Planning & Environment
23-33 Bridge Street, Sydney NSW 2001
GPO Box 39, Sydney NSW 2001
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Paul

A creek flow path is just that, a flow path. The long established environmental values are the important attributes of a creek, and as these where extinguished when the original flow path was realigned and filled in and/or used as a dirty water storage, there is nothing to be gained from going back to the original flow path, except perhaps where the new realigned flow path is found to be problematic (ie: such as were it was established through a landscape (such as a waste rock emplacement area), that is a potential source of ongoing pollution to the creek.

Regards

Darryl Clift
Head Central West Unit | NSW Environment Protection Authority | ☎: (02) 6332 7602 | Mobile ☎: 0427 935 262 | ☎: (02) 6332 7630| ©: darryl.clift@epa.nsw.gov.au
Dear All,

I wish to remind you that preliminary comments are due today on Ben Bullen Creek restoration. If you wish to discuss the matter further, please contact me on 9228 6587.

Kind regards

Paul Freeman
Senior Planner, Mining Projects
NSW Department of Planning & Environment
23-33 Bridge Street, Sydney NSW 2001
GPO Box 39, Sydney NSW 2001
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Dear All,

I wish thank you for your attendance and input at yesterday’s meeting at Baal Bone Colliery.

The Department’s advice to the company on the proposed modification is attached.

If you have any preliminary comments to make on the proposal, please provide these to the Department by Monday 16 February 2015. Further opportunity for comment will be available during the assessment process.
If you wish to discuss the matter further, please contact me on 9228 6587.

Kind regards

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