EVALUATION OF WATER QUALITY AND QUANTITY IMPACTS OF PROPOSED REMOVAL OF BULK COAL SAMPLE AT 'BICKHAM', MURRURUNDI

TABLE OF CONTENTS

LIST OF PHOTOGRAPHS

(Photographs have not been included since the original document was faxed, and the results unprintable)

1. INTRODUCTION

Bickham Coal Company Pty Ltd have submitted a Review of Environmental Factors for the proposed removal of a bulk coal sample at Bickham near Murrurundi (refer Figure 1). Webb, McKeown & Associates have been engaged by Halletts, Solicitors, on behalf of the owners of Glengarry, the adjoining property to comment on water and other aspects of the proposal as it might affect the ‘Glengarry property.

The Pages River is a Schedule 3 stream, and it is particularly critical to both the local ecosystems and farming practices in the area. Glengarry has a water allocation licence to pump for irrigation from the river, and it is also an important water supply for stock purposes within the farm. This is particularly so in light of the extreme drought conditions that prevail at the present time

At the time of my field inspection, 10 November 2002, there was no surface flow in the river at most locations, but there were sizeable ponds which were obviously important for the survival of both farm animals (cattle in particular) and flora and fauna. A large number of waterbirds

were seen to be using the ponds. It was mentioned to me that there is a platypus habitat in the Pages River just upstream of the bulk sample site but I did not view it personally.

I was asked to examine the Review of Environmental Factors - Proposed Removal of Bulk Sample: Bickham Coal Company Pty Ltd, ' Murrurundi (Volumes 1 and 2) (referred to herein as the REF) and comment on those areas wherein I have expertise, these being in particular, surface and groundwater issues. I also have to hand the Supplementary Information Paper dated 12 November 2002, which was apparently handed out at a public consultation meeting on that date. In addition I have made enquiries of various officers of the Department of Land & Water Conservation and been provided with relevant background materials to assist me in expressing my opinion.

This report has been prepared by myself, Dr Stephen Nevitle Webb, BE(Hons), PhD, FlEAust, MACU, NPER3. I am a Director of Webb, McKeown & Associates, a firm of consulting water and environmental engineers specialising in flood management (hydrology and hydraulics), stormwater management and total catchment management I hold tertiary and doctoral qualifications in civil engineering and hydrology with over 30 years experience in these fields.

2. EVALUATION APPROACH

2.1. Site Inspection

As noted above, Webb Mckeown were engaged to independently evaluate the proposed bulk sample mining operation at a In order to carry out this effectively I carried out a site inspection on 10 November 2002. In the course of this site inspection I walked along the Pages River from Glengarry to the proposed bulk sample site. I viewed the water bodies along the river and inspected the general cross-sectional shape of the river channel. I took photographs of a representative sample of these water bodies. I particularly noted the water body which would apparently be the final discharge point for any runoff leaving the proposed fill area in the flint clay void.

At the site I observed the river channel in some detail and observed a number of flood debris marks left behind in the trees from a relatively recent flood. I took photographs of these and made approximate measurements of their height relative to riverbed level and top of bank. I also observed the degree of roughness of the stream channel. I noted piezometers 69A and 698 along the access road and noted a rain gauge near the subject site.

I have included Photographs I to 6 from my field visit in this report. Photographs 1 and 2 show the apparent receding water body downstream of the flint clay void. Photograph 3 shows a typically picturesque water body further downstream. Photograph 4 is taken from near the bulk

sample site looking upstream along the Pages River. Photographs 5 and 6 show debris marks (the locations of photographs 4 to 6 are shown approximately on Figure 2).

2.2. Materials

In addition to the information collected during the field visit, I was provided with Volumes 1 and 2 of the REF and a Supplementary Report issued on 12 November 2002. I also obtained topographic maps and an aerial photograph of the site to assist me in understanding the local area. Part of the aerial photograph is reproduced at Figure 1.

I have used the above information, and my extensive professional experience in both surface water and groundwater hydrology, to critique and comment on the REF as set out herein.

3. SURFACE WATER CONSIDERATIONS

There are a number of apparent deficiencies in respect of the proposed surface water management as set out in the REF. The apparent deficiencies include insufficient detail on what has been done, inappropriate measures or works, and inadequate supporting calculations to justify the conclusions reached. These apparent deficiencies can broadly be grouped under the following headings:

• evaluation of receiving waters,

• water demand,

• erosion and sediment control,

• rehabilitation of the flint clay void,

• flood estimation!

rehabilitation of the bulk sample pit

Each of these are dealt with below.

31. Evaluation of Receiving Waters

Apparent Deficiencies

From examination of the REF it is apparent that the receiving waters have not been evaluated sufficiently to allow an assessment of any impacts from the proposed works. The apparent deficiencies are set out below:

Failure to recognise the existing condition of the Pages River and identify any water dependant ecosystems which could be affected by the proposed works. Particular reference is made to the existing pristine natural state of the river in the immediate vicinity of the discharge point for the proposed flint clay void rehabilitation area, and the flora and fauna communities which it supports.

A general lack of acknowledgment and consideration of the wider flora and fauna communities supported by the Pages River, and the impact of the proposed works thereon.

There is no mention of the current uses and/or users of the Pages River, which may include, for example, water supply for irrigation or town water, recreation, etc., and the impact of the proposed works on those established uses and/or users.

Consequences of Apparent Deficiencies

In the absence of any substantive knowledge of the existing state of the Pages River, the impacts of the proposed works on the receiving waters, and the flora and fauna communities supported by the receiving waters, is not known. A generally accepted management outcome, as set out in the Draft Guidelines for Management of Stream/Aquifer Systems in Coal Mining

Developments: Hunter Region, Department of Land and Water Conservation, 2002, is that mining activities should not cause direct or indirect degradation of stream systems or associated alluvial groundwaters or land. Although it is recognised that the above referred Guidelines are Draft, and may be subject to considerable change prior to adoption, the Draft Guidelines reflect good current practice on this issue and should have been followed in the REF.

Actions Required to Remedy Deficiencies

An evaluation of the Pages River flora and fauna is required to address, at a minimum, the above referred deficiencies and thus permit a considered review of the likely impacts of the works on the local ecology.

3.2. Water Demand

Apparent Deficiencies

From an evaluation of the identified water sources and uses set out on page 33 of the REF (and noting the broad volume ‘estimates’), the REF has concluded that on both a volume and water quality basis, the water balance for the Bulk Sample is such that it can be controlled with no effect on the surrounding area, ie. "no discharge will be required” (p 34, Vol. 1). However, a number of concerns and practical limitations are identified which raise considerable doubt

about this conclusion

The key concerns and practical limitations are:

Both rainfall and evaporation have been excluded from the calculations. This is inappropriate considering that irrigation of selected crops / pasture areas is identified as the primary source of water use. If the calculations were to include rainfall and evaporation, the need for additional water storage would become evident, whereby following rainfall, irrigating crops and pastures would not be permitted as the ground would be saturated (resulting in immediate direct runoff of any irrigation water), and farm dams would be full. As such, the inclusion of rainfall and evaporation is critical and is likely to significantly alter the water demand outcomes.

With regard to the proposed irrigation of crops and pastures, it is noted that the property is currently used for “general grazing purposes” (p 17, Vol. 1) There is, however no mention or details of the crops which are proposed to be irrigated, and the need/requirement for irrigation of the pasture areas are not provided. As such, the proposed water demand for the areas to be irrigated may be overly optimistic.

Although farm dams on the site are currently empty following a prolonged dry period, assuming and relying on the farm dams being empty (whereby available capacity is stated to be 40 Ml), or close to empty (available capacity is stated to be 30 MI) at the commencement of the proposed works is unreasonable.

The basis for the very large estimated volume of water to be used for dust suppression is not apparent

Consequences of Deficiencies

The above identified deficiencies, particularly in respect of the inadequate supporting calculations and unclear or unreasonable underlying assumptions, indicate that a considerable water surplus may result from the proposed works.

Actions Required to Remedy Deficiencies

More detailed calculations are required to either confirm the current conclusions sat out in the REF. or otherwise manage the potential water surplus that is likely to result from the proposed works. At a minimum, the evaluation of water demand needs to include the consequences of rainfall and evaporation, as well as a more reasonable assessment and clarification of underlying assumptions under a range of assumed climate conditions.

3.3. Erosion and Sediment Control

Apparent Deficiencies

From an evaluation of the proposed erosion and sediment control works set out in Appendix G of the REF. numerous apparent deficiencies are identified which render the proposed control works inappropriate or insufficient

The following identified apparent deficiencies are noted:

• Runoff diversion works are proposed for the diversion of 'clean' water from areas up-slope of the proposed disturbed areas of the bulk sample site and flint clay void. However, given the size, lateral extent, and construction requirements of these proposed works, and in particular, given the steep slopes of the land surface Which prohibit effective stabilisation, these large scale diversion works are themselves a source of considerable site disturbance. Therefore, the anticipated erosion along the proposed diversion drains (being areas subject to concentrated flow), Will result in sediment laden runoff discharging to the Pages River with potential adverse impacts on the flora and fauna.

• The operational criteria set out for the proposed overburden dump sedimentation basin. whereby "the design volume should be restored within 5 days of the end of a storm" (p13. Appendix G), which is proposed to be fulfilled by irrigating the stored water, lacks practicality. In a similar way to the apparent deficiencies of the water demand assessment outlined above, this proposed irrigation approach fails to appreciate that following a rainfall event in which the water storage volume of the sedimentation basin is filled, irrigation would not be possible as the ground would already be saturated any irrigation water would just run off). Clearly a more appropriate discharge strategy is required in order to satisfy the sedimentation basin criteria.

• In accordance with the recommendations set out in Managing Urban Stormwater Soils and Construction, NSW Department of Housing, 1998, a detailed Soil and Water Management Plan is required as the proposed works will disturb more than 2,500 square metres of land.

This also needs to include recommendations for the prevention of pollutants such as chemicals, hydrocarbons, etc., entering the surface or sub-surface water system as a result of, for example, vehicle and equipment maintenance, effluent from staff facilities, etc.

The proposed sediment and erosion control measures are required to be set out on an engineering plan or plans (Sediment and Erosion Control Plan), thereby clearly showing on a suitably scaled drawing or drawings (usually A1 size):

details of the proposed overburden sedimentation basin including sediment basin floor level, capacity, embankment/formation details, stabilising treatment, etc.,

• areas where proposed stripped topsoil is to be stockpiled,

• areas where the excess sediment proposed to be removed from sediment control works after rainfall events is to be placed,

• installation details of all proposed sediment control works to be used, such as sediment fences or rock embankments. etc.

A general lack of operational detail is apparent, such as an appreciation of the necessary staging of the proposed works as mining progresses. The sequence of erosion and sediment control installation is required to be clearly set out for all stages of the operation.

This will need to integrate with the proposed sequence of works required for the removal of the bulk coal sample.

Other required details include site inspection requirements (such as self-audit programs) and maintenance procedures.

Consequences of Deficiencies

In the absence of a sufficiently detailed Soil and Water Management Plan, as is currently the case for the proposed works, unacceptable erosion and sedimentation could reasonably be expected with consequent unacceptable impacts on water quality (and flora and fauna) in the receiving waters of the Pages River.

Actions Required to Remedy Deficiencies

A detailed Soil and Water Management Plan is required, clearly identifying and addressing the site specific constraints in respect of soil erosion and sedimentation and other pollution control measures. In accordance with the recommendations set out in Managing Urban Stormwater Soils and Construction, NSW Department of Housing, 1998, the Soil and Water Management Plan will clearly identify appropriate measures for overcoming these constraints, including options for:

a staging of works.

• mitigation/control of on-site soil erosion,

• movement of water on to, through, and off the site,

• rehabilitation/maintenance of the works area.

3.4. Rehabilitation of the Flint Clay Void

Apparent Deficiencies

As set out in the REF (p25. p35 Vol. 1 and Appendix G) the overburden material proposed to be removed from the bulk sample site is to be dumped in the flint clay void, and this dumped material will be used to rehabilitate that area. Of primary concern is the apparent oversight in respect of the final landform of the rehabilitated flint clay void. Details of this concern are set out below:

As described in the REF. the overburden from the bulk sample site, estimated at 331,000 m of material will be used to rehabilitate the flint clay void, which has a capacity of approximately 500,000 m according to the REF. However, the surface contours shown on Figure 11 of the REF (after p36, Vol. 1), depicting the proposed final Iandform of the void, appear incompatible with the proposed volume of overburden fill. In fact, this final landform would only be expected if the void was completely filled, requiring some 500,000 m of overburden material, which is not proposed in the REF. The resulting imbalance of material is likely to result in the formation of a ‘gully’ in which surface runoff is concentrated through the proposed rehabilitation area leading again to likely erosion problems in the absence of clearly defined remedial measures

Other key concerns associated with the proposed rehabilitation of the flint clay void include:

• The proposed rehabilitation proposal lacks the required level of planning. A Rehabilitation Plan is necessary, including detailed landscape plans, the appropriate species to be planted and the preparation required for revegetation including sourcing seeds from local stock and undertaking extensive propagation. Such a requirement would appear especially prudent given the past failed attempt to rehabilitate the area.

• Problems with steep land slopes as set out above (Erosion and Sediment Control) also apply to the rehabilitation site where steep land slopes of 10°. which equates to gradient of approximately 18%, are expected on the basis of the final landform contours, which are shown above to be incompatible with the proposed volume of overburden fill. The formation of a ‘gully’ through the proposed rehabilitation area, which is likely to result due to the imbalance of material, will yield final land slopes in excess of the 18% gradient currently anticipated.

• No consideration is given to the stability of the rehabilitated landforrn. Given the steep slopes of the rehabilitation site, ensuring stability of the final landform requires significant and substantial geotechnical considerations, comprising for example, details of filling requirements such as keying into exiting surface and compaction, sequence of filling, etc.

• The REF reports that the overburden material to be dumped at the flint clay void would

comprise mostly of blasted rock (p25, Vol 1). This further impacts on the geotechnical considerations detailed above, the difficulties of which have been overlooked.

Rehabilitation of the area relies on re-spreading of stockpiled topsoil from the bulk sample excavation over the overburden dump final landform (as set out in Appendix G), which Is necessary for the growth of ground cover/vegetation in the rehabilitated area. However, it is noted that topsoil cover is “extremely thin to non existent (p 25, Vol 1) at the bulk sample site, and as such, there will be very minimal, if any, topsoil available to the rehabilitate the flint clay void.

Consequences of Deficiencies

The primary deficiency outlined above has considerable adverse impacts for the management of surface water and the rehabilitation strategy, as due to imbalance of material, a ‘gully’ is likely to be formed in which surface runoff is concentrated through the proposed rehabilitation area. This concentration of flow on steep land slopes presents considerable erosion and sedimentation problems and consequences for landform stability. another other key concerns detailed above highlight considerable planning failings, the consequences of which indicate that the proposed rehabilitation would be ineffective and could well create a worse situation than the present unrehabilitated state.

Actions Required to Remedy Deficiencies

Detailed geotechnical considerations are required to ensure stability of the dumped overburden material. The final landform needs to be re-evaluated in light of the imbalance of material, with considerable planning required to mitigate the soil and erosion problems and consequent landform instability. A Rehabilitation Plan needs to be prepared whereby the consequences of the site constraints for the proposed rehabilitation are taken into account These constraints include steep land slopes, overburden fill comprising predominately of rock material, and minimal, if any, available topsoil.

3.5. Flood Estimation

Apparent Deficiencies

Appendix G comprises a Flood Study of Pages River which has been undertaken to assess design flood levels for the Pages River in the vicinity of the proposed bulk sample area. This flood study has been used to conclude that “.. the proposed bulk sample lies immediately outside the extreme flood extent on the Pages River, and is approximately 7 m above the 100 year ARI flood level on the Pages River" (p 7, Appendix G). From evaluation of the Flood Study, a number of apparent deficiencies have been identified which raise considerable doubt

about this conclusion.

The key concerns are;

• From the location of surveyed cross sections shown on Figure 6 (Appendix G), it would appear that the downstream model boundary is in the immediate vicinity of the bulk sample site. There has been no information provided on the adopted downstream boundary condition, and furthermore, the apparent location of the downstream boundary has a significant influence on the estimated flood level at the location of the bulk sample site. Good practice suggests that when using a hydraulic model the boundary should be set at a considerable distance further downstream than that apparently adopted in the Flood Study so that the boundary condition does not affect the validity of flood estimates within the area of interest.

- During an inspection of the Pages River in the vicinity of the proposed works, a considerable hydraulic constriction (narrowing of waterway area) was observed in the river at the location of the proposed bulk sample site. This constriction is formed by two large rock outcrops protruding from each bank into the river, and would considerably obstruct floodwaters within Pages River thus having a considerable effect on flood levels at the proposed bulk sample site (refer Figure 2 and Photograph 4) There is insufficient detail in the Flood Study to assess whether this hydraulic constriction has been adequately represented.

• The longitudinal flood profile (Figure 7, p7. Appendix G), indicates that the estimated flood levels decrease with an increase in chainage in the vicinity of the upstream end of the hydraulically modelled Pages River reach (i.e. flood levels decrease as you move upstream). This is intuitively unexpected, and there is no explanation for these decreases in flood levels in the Flood Study.

• Inspection of the estimated flood levels shown on the cross sections provided in Appendix A to the Flood Study (Appendix G) indicates that the Probable Maximum Flood event (PMF) has been modelled, with estimated flood levels being some 5 metres above the estimated extreme flood levels near the bulk sample site. It is not understood why the extreme flood level (the peak flow for which was arbitrarily established as being three time greater than the 100 year ARI peak flow) was used and quoted in preference to the Probable Maximum Flood, especially given the considerable difference in estimated flood levels. This is of considerable importance In this particular instance, because if the Probable Maximum Flood extent were to be provided as per the other modelled flood extents on Fig 6 of Appendix C, inundation of the bulk sample pit would be clearly evident. The Extreme Flood is often used as an alternative to the PMF when PMF rainfall data are not readily available. Very often a multiple of three times the 100 year flood is used as an approximation. This has been shown to be a reasonable on some coastal catchments In Eastern NSW, but it is not reasonable in a more inland catchment such as this. In

any event, there is no point in using the Extreme Flood (which has an unknown frequency of occurrence in this case) when the PMF is clearly available as per the cross-section plots in Appendix A to Appendix G. These plots show the PMF at about 400 mAHD. The lip of the bulk sample pit near the Pages River is at about 395 mAHD, and this would almost be exceeded by the Extreme. The PMF would clearly exceed this by about 5m and completely inundate the pit.

• It is apparent from the location of the surveyed cross sections shown on Figure 6 (Appendix C) that the flood study does not encompass the area in the immediate vicinity of the flint clay void. However, it is stated in Appendix G that the proposed sedimentation basin at the downstream end of the overburden dump is located above the extreme flood level (p12, Appendix G). There appears to be no justification supporting this conclusion given that flood levels have not been estimated for this area.

During an inspection of the Pages River in the vicinity of the proposed works, considerable flood debris (leaf litter) was frequently observed on trees on the river bank at a relatively high level. This observed flood debris provides considerable evidence of flooding along the Pages River (likely to have occurred within the last 3 to 5 years). Subsequent enquiries made with the DLWC Muswellbrook Office have confirmed that major flooding along the Pages River occurred in Apr 2000. In addition to the observable flood debris which give a good indication of recorded flood levels, a stream gauging site on the Pages River recorded stream flow and river height for that flood event. However, in undertaking the Flood Study, no attempts appear to have been made to confirm the estimated flood levels based on this readily available flood information.

Consequences of Deficiencies

In the absence of a sufficiently detailed Flood Study for the Pages River, flooding on the Pages River may result in unanticipated flooding of the proposed work areas for more frequent floods.

The results in Appendix G clearly show than an Extreme Flood may inundate the pit and a PMF certainly would inundate it completely.

Actions Required to Remedy Deficiencies

A more detailed flood study is required, addressing at a minimum, the above listed apparent deficiencies. The estimated flood levels should be verified against the readily available observable/recorded flood information for the April 2000 flood event.

The consequences of inundation of the pit by the Pages River for large floods needs to be addressed both from a flood damages perspective and from a safety and environmental impact

viewpoint.

3.6 Rehabilitation of the Bulk Sample Pit

Apparent Deficiencies

As noted in the Government Department responses setting out their requirements in Appendix B (note particularly the requirements of DLWC and NPWS), the REF was required to address the issue of rehabilitation of the pit remaining after the bulk sample is removed. This has apparently been overlooked in the REF. Reference is made to the effect that if the mine proceeds the bulk sample pit will become absorbed within the overall mine plan with, presumably, its overall rehabilitation plan. What happens if the mine does not proceed?

Use of the mine pit as a possible potable water source for Murrurundi or for agricultural purposes do not stack up. The town of Murrurundi may have looked at acces through the site, but the water that remains in the pit after mining is highly unlikely to be suitable for a town water supply. It is likely to have a significant degree of salinity, is likely to have an unacceptable hardness level, and there is the worrying potential for high acidity to occur as referred to elsewhere. The use as a town water supply is also likely to be incompatible with the farm's ongoing use for agricultural purposes due to likely pollution problems from farm or native animals.

Consequences of Apparent Deficiencies

If mining does not proceed because the bulk sample proves to be unsuitable for some reason, or market conditions change, a large permanent hole with steep sides will remain. It would in fact appear to be even less acceptable than the existing topography of the old flint clay void. Given the possible water quality issues outlined above, and the potential for it to be hydraulically connected to the Pages River aquifer or surface water body (see elsewhere), the pit could be a long term problem for the area. It is difficult to imagine that it will provide the "benefits" alluded to in the REF.

Actions Required to Remedy Deficiencies

As the Government Responses have required (note particularly the requirements set out by DLWC and NPWS), the REF needs to provide a comprehensive rehabilitation plan for the newly created pit in the event that the mine does not proceed. The plan needs to anticipate and address any foreseeable problems.

4 SUB-SURFACE WATER CONSIDERATIONS

There are a number of deficiencies in respect of proposed management of sub-surface water as

set out in the REF. The apparent deficiencies include insufficient or inadequate data collection, and inadequate analysis and interpretation of results. These apparent deficiencies can be broadly grouped under the following headings:

• groundwater occurrence and interaction with surface waters,

• dewatering assessment.

• groundwater quality.

• proposed injection of surplus groundwater,

• effects of blasting on groundwater regime.

Each of these are dealt with below.

4.1. Groundwater Occurrence and Interaction with Surface Waters

Apparent Deficiencies

Although it is evident from an evaluation of the REF that the occurrence of groundwater has been recognised and considered, as reflected by the proposed bulk sample extraction methodology, it does appear, however, that there is currently a very limited understanding of the distribution of groundwater at this site. This limited understanding in turn results in considerable deficiencies in the knowledge which is required to adequately manage the impacts of groundwater on the current proposal, and conversely, manage the impacts of the current proposal on the groundwater system. These apparent deficiencies are set out below:

• It is noted that over the period of monitoring, some piezometers showed a falling water level. while others showed a rising water level. It is concluded that no consistent pattern of seasonal recharge-discharge has yet emerged' (p9, Appendix J). Identification understanding of such a pattern is critical to effectively managing groundwater impacts.

• There is considerable variation in the aquifer permeabilities encountered on the site. For the purposes of undertaking supporting calculations, it appears that these variations have been grouped into simplified 'representative' permeability values (Table 6, p11, Appendix J). Given that dewatering is proposed to enable the extraction of the proposed bulk sample, adequate knowledge of such a key parameter is essential. The implications of this are further detailed in the following section (Dewatering Assessment).

• It appears that the current understanding of groundwater in respect of interactions (between individual aquifers) and connectivity with surface water sources at the site, is very limited. It would appear from the drilling results documented in Section 4 of Appendix J that the aquifer

encountered at the bore sites referred to therein is a confined aquifer (or in fact is more likely to be a number of confined aquifers associated with individual or groups of coal seams) - This evaluation is made knowing that groundwater was first intersected at depths of 35 metres or greater, reported in Appendix J as being well below the level of the river bed, and knowing that the water level in those bores has since risen to a level above the river bed. Therefore, this groundwater is under pressure (i.e. a confined aquifer) or alternatively, the bores may have intersected an aquifer(s) at a higher levels which were not recorded during the initial drilling (in which case, such aquifers may well be directly connected to the Pages River). In either case, the complexities of the groundwater system encountered do not appear to be well understood (as evident through a lack of documentation/evaluation thereon). For example, if the system was well understood, It would be known whether the encountered aquifer is confined, and if so, the properties of the confining layer(s), groundwater flow paths would be identified, etc. There also has apparently been little or no attempt to understand and interpret the alluvial aquifer located along the Pages River in the vicinity of the site. This is a very important aquifer which is currently the only source of water for maintaining the river ecosystems, and providing essential stock watering, along the river in the current severe drought

• At several locations within the REF the likely presence of "fault zones" is alluded to. Despite the frequent references in the REF to lack of connectivity between the groundwater and surface water systems in this area, the presence of "fault zones" if they are in the right place and have the right amount of continuity, provide the perfect vehicle for connectivity. If they are present they need to identified and mapped.

• These requirements are reflected in the Draft Guidelines for Management of Stream/Aquifer Systems in Coal Mining Developments: Hunter Region, Department of Land and Water Conservation, 2002. This sets out the need for an understanding of the geological structures and linkages between the mine area and adjacent streams, and clearly states that likely pro and post mining interconnectivity between hard rock aquifers and alluvium and/or riverine corridors is to be established prior to mining, whereas in the REF. the philosophy appears to be one of determining such interconnectivity during and subsequent to the proposed bulk sample mining process. Although it is recognised that the above referred Guidelines are Draft, and may be subject to considerable change prior to being adopted, the proposed requirements set out above are considered more a reflection of good current practice.

Consequences of Deficiencies

In the absence of sufficient understanding of the occurrence of groundwater and groundwater interactions at the site, as is currently the case, unacceptable impacts on local groundwater resources can clearly be anticipated. This lack of site specific knowledge is also reflected in key parameters used for supporting calculations, as detailed in the following section (Dewatering

Assessment). Critical and necessary evaluation of the impact of the removal of the bulk sample can only be made with a sufficient understanding d the occurrence of groundwater and groundwater interactions at the site. Failure to properly understand the existing system means that it is not possible to safely design a dewatering system that will not have adverse consequences. Of particular concern is the apparent presence of “fault zones” which have apparently not been properly delineated. If present in the right locations these could provide the “connectivity” between the deep underground aquifers being dewatered and the alluvial aquifer along the Pages River. Given the importance of this aquifer, particularly under current conditions, any leakage from it or pollution of it by poor quality water could have serious consequences.

Actions Required to Remedy Deficiencies

Further monitoring of groundwater behaviour is required for the purposes of further data collection and subsequent analysis in order to enhance site specific knowledge. This is required so that the impact of the occurrence of groundwater on the current proposal, and conversely, the impact of the current proposal on the groundwater system, can be adequately anticipated, evaluated and subsequently managed.

More piezometers will need to be installed in order to identify and monitor the full range of aquifers present on site (in particular, the alluvial unconfined aquifer adjoining the Pages River). These and the original piezometers also need to be monitored over a reasonable period of time to establish baseline conditions. Comprehensive pump testing is also required to establish aquifer parameters and aquifer interactions.

The Government Responses call for a full groundwater study. The REF in Section 3.4 alludes to a “full ground water study” being carried out. This is clearly not the case. One would expect, as a minimum, a full description of the local aquifer system, adequate monitoring of all the critical aquifers, and a groundwater model based on this understanding being set up to predict the likely consequences of the mining operation.

4.2.. Dewatering Assessment

Apparent Deficiencies

Due to the occurrence of groundwater at the proposed bulk sample site. dewatering is a key requirement of the proposed extraction process. However, from examination of the REF, several deficiencies are evident in respect of the proposed management and anticipated Impacts of the dewatering process. The key deficiencies are:

• The pump tests undertaken to determine the permeability values for the aquifers encountered

on the site, whereby a low capacity sampling pump was run for a maximum of 3 hours, (refer p9, Appendix J) are inadequate for the stated purpose. In order to adequately determine permeability values suitable for the stated purpose, and yield results consistent with the proposed dewatering process, long term, high capacity pump testing would be required.

• Further to the proposed pump testing, and as alluded to in Section 4.1 above, more piezometers are required in order to obtain a better understanding of the groundwater system at this location and the likely interactions between the various aquifers and the surface water system. Such additional piezometers need to be installed and monitored to establish baseline conditions prior to carrying out further pump tests.

• Insufficient details are provided to support the analytic approach used to estimate the drawdown resulting from the proposed dewatering process (what “analytic" approach was in fact applied anyway? It needs to be named and described). For example, the permeability value has a considerable effect of the estimated drawdown, and the value adopted for use in the analytic approach is not stated. Not only is the ‘selected’ value not stated, the pump testing undertaken to establish the value is inadequate (as detailed above). Furthermore, assumptions made on the type of aquifer system to be dewatered (confined or unconfined), the number and distribution of individual aquifers, etc., are not documented.

As alluded to earlier, there has been insufficient identification of the hydrogeology at this site to determine whether the ‘fault zones’ apparently present in this area are in locations where they could affect the connectivity between aquifers and between surface and underground waters.

Consequences of Deficiencies

Given the information in the REF. and in particular in Appendix J. one can have little confidence in the projections of likely groundwater drawdown due to dewatering. Given the uncertainties in the methodology and parameter values, sensitivity testing would have provided a better appreciation of the likely consequences of the dewatering. It is likely that sensitivity testing using the wide range of permeabilities identified would show vastly different drawdown distributions over the sensitivity range. This would in turn point to the need to better understand the aquifer system and determine more reliable permeability values.

The lack of understanding of the geology and hydrogeology also means that “fault zones" could provide connectivity between the underground system and the Pages River leading to unexpected depletion of the surface water from the Pages River during dewatering, or alternatively, recharge of the system with poorer quality water as the groundwater profile recovers after mining.

As discussed in more detail in section 4,3, there are uncertainties in regard to water quality

from the dewatering water. Disposal/usage of it could be a problem which has yet to be properly resolved. Dewatering, and the consequent production of large volumes of water, could therefore produce unresolvable disposal problems.

Actions Required to Remedy Deficiencies

More piezometers need to be installed and monitored in order to better understand the aquifer system More pump tests over longer durations then need to be carried out to better establish aquifer parameters. As noted in Section 4.1, a groundwater model set up using these parameters then needs to be used to establish the long term effects of pumping for dewatering.

Greater certainty on the actual quality composition of the dewatering water produced from the pumping is required (see Section 43 below).

4.3. Groundwater Quality

Apparent Deficiencies

The occurrence of highly acidic groundwater (with sampled pH values as low as 4.56 at this site), presents considerable management disposal problems. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Australian and New Zealand Environment and Conservation Council, 2000 Indicates that water with a pH value of less than 5 has a high corrosion potential. Therefore corrosion and deterioration of for example, well and pumping equipment, pipelines, channels, irrigation systems and storage tanks would be expected. The potential impacts on receiving waters could also be a major issue. The mooted disposal methods (primarily irrigation and dust suppression) would not be feasible if such water was produced.

It is normal for coal seam aquifers to produce high salinity groundwater. The salinity values produced so far from this site are relatively benign. This is unexpected. More testing should be carried out to ensure that the sampling carried out to date Is representative of the entire system. This could be carried out in conjunction with the installation of further piezometers.

Consequences of Apparent Deficiencies

The presence of significant quantities of highly acidic or highly saline groundwater would make usage/disposal of surplus water from the dewatering operations highly problematical. The options for disposal are already difficult (see Section 3.2) on even a quantity basis; if quality became a further issue then usage/disposal of surplus water could become an insurmountable issue.

Actions Required to Remedy Deficiencies

More widespread sampling and testing of groundwater is required. This could be carried out in conjunction with the already mooted additional piezometer network installation. Depending on the results the whole water demand management issue may need to be re-visited.

4.4. Proposed Injection of Surplus Groundwater

Apparent Deficiencies

The recently produced Supplementary Information Paper dated 12 November 2002, alluded to the possibility of injection of surplus dewaterlng water as a means of disposal. The brief commentary in the information paper needs to be greatly expanded to look at the consequences of this proposal. Where would it be carried out, what quantities would be Involved, what would the quality of the water be, what would the extent of the groundwater mound be. What would the consequences of the operation be on the Pages River and existing groundwater aquifers? All of these questions need to be answered in a satisfactory manner.

Disposal of water by this means would be expensive in terms of the initial capital costs and the longer term running costs. It is also likely that maintenance costs could be high due to likely blockage of the screens and aquifer pores over time, leading to the need for frequent maintenance. It would seem that such a proposal would only be used in the event of failure of the previously mooted disposal methods due to quantity or quality problems.

I have articulated in Section 3.2, the likely problems with surplus water generated by the dewatering operations, and in Section 4.3, I have raised issues with regards to possible water quality issues with this water. A comprehensive assessment of this proposed disposal method needs to be undertaken.

Consequences of Apparent Deficiencies

As with the dewatering, and many other issues in the REF. more information is required on how the injection operation is to be carried out. The consequences of failing to examine this properly include the potential for unexpected impacts on groundwater levels within and outside of the property, potential impacts on the Pages River in terms of flows and water quality, etc.

Actions Required to Remedy Deficiencies

If water injection is seriously proposed as a disposal method for surplus dewatering water, then a complete description of the proposal is required; the questions set out above need to be

answered; and a new report produced satisfactorily describing the outcomes.

4.5 Effects of Blasting on Groundwater Regime

Apparent Deficiencies

Blasting is proposed for the removal of the overburden and the coal seams. This is normal practice and would presumably be carried out using all the normal safeguards. However, no mention has been made of the possibility of the blasting affecting the integrity and inter-connectivity of the groundwater aquifers. This issue needs to be addressed once an understanding of the nature and distribution of the aquifer system is obtained, as alluded to earlier.

Consequences of Apparent Deficiencies

If blasting does lead to connectivity being established between the coal seam aquifers and the alluvial aquifer along the Pages River, this could lead to similar consequences as the presence of "fault zones" as alluded to earlier. It could lead to drawdown of the Pages River, or pollution of the river water by poorer quality underground waters.

Actions Required to Remedy Deficiencies

Once a better understanding of the groundwater system and its interactions is obtained, the possibility of blasting affecting the distribution of underground waters needs to be examined to ensure no adverse consequences.

5. SUMMARY AND CONCLUSIONS

From my evaluation of the Review of Environmental Factors - Proposed Removal of Bulk Sample: Bickham Coal Company Pty Ltd "Bickham Murrurundi (Volumes 1 and 2), and the Supplementary information Paper dated 12 November 2002. I am able to conclude that there are numerous apparent deficiencies with the current proposal in respect of surface water and sub-surface water management These apparent deficiencies could reasonably be expected to result in unacceptable adverse impacts on current uses and/or users of the Pages River. including the flora and fauna communities which it supports.

The apparent deficiencies identified in respect of surface water management include insufficient detail on what has been done, inappropriate measures or works, and inadequate supporting calculations to justify the conclusions reached. These broadly encompass the issues of:

• evaluation of receiving waters,

• water demand,

• erosion and sediment control,

• rehabilitation of the flint day void,

• flood estimation,

• rehabilitation of the bulk sample site.

With regard to the overall adequacy of the REF's estimation of the effects on surface water, the REF In Section 2.7 at pages 14 and 15, in referring to issues raised in the Community Consultation program, states that "These concerns have been comprehensively answered." One of the concerns referred to is "potential adverse effects on the Pages River". Given the many problems outlined throughout this report, it is apparent the concerns have not been comprehensively answered

The apparent deficiencies Identified in respect of sub-surface water management include insufficient or inadequate data collection, and inadequate analysis and interpretation of results.

These broadly encompass the issues of:

• groundwater occurrence and interaction with surface waters,

• dewatering assessment.

• groundwater quality,

• proposed injection of surplus groundwater,

• effects of blasting on groundwater regime.

With regard to data collection and analysis in particular, at a number of points within the REF one of the apparent justifications of the proposal is that it will provide invaluable data on how the possible future coal mine might affect the local area. This may well be true, but the issue at the moment is whether the mining proposed to be carried out to obtain the bulk sample will adversely affect the environment. The REF needs to establish that the currently proposed operation is safe. Collecting data for an even larger potential impact on the environment cannot be a justification for doing the present operation.

Since the REF has failed to investigate and properly respond to a number of important issues, there is a clear danger that the taking of the Bulk Coal Sample could have unintended adverse environmental effects that have not been investigated or quantified- The REF needs to

adequately address the issues raised in the Government responses and the further issues raised in this report.

Webb, McKeown & Associates Pty Ltd