



Bickham Coal Mine

Water Resource Assessment

UPDATE OCTOBER 2006

Background

This paper provides an update on the technical investigations being undertaken for the Bickham Coal Mine Water Resource Assessment, which was requested by the Department of Planning, NSW, as a precursor for the lodgement of any Environmental Assessment for any proposed mine. The studies have been designed to respond to the scope of the water resource assessment and comments received to date through the consultation process. The scope of the water resource assessment can be found on the Bickham Coal Mine website (www.bickhamcoal.com.au).

Update on Technical Studies

Over the past months, groundwater and surface water testing and monitoring have continued to ascertain water quality and quantity of the groundwater and surface water in the Kingdon Ponds and Pages River catchments. Groundwater modelling has not yet been completed. The groundwater regime at Bickham is very complex and it is a challenge to mathematically represent the complexity in a groundwater model. Further time is needed to complete the modelling process, with a model capable of predicting the potential impacts of the proposed mining operation with sufficient accuracy and reliability to meet the needs and expectations of all stakeholders. The groundwater modelling is being peer reviewed by an independent peer reviewer, Assoc Professor Noel Merrick of the Centre of Groundwater Studies at UTS.

Bulk Sample Dewatering: During the extraction of the bulk sample in 2005, two dewatering bores at the bulk sample site were pumped for six months at a production rate 80 kL/d. The monitored lowering in groundwater levels were:

- up to 3 m at bores 525m to the west
- up to 0.6 m at bores 340m north
- none at bores 840m south
- none at bores 170m to 340m east towards Pages River
- no change in water levels in Pages River.

No change was noted in the water quality in the bores and the Pages River.



Hydraulic Testing: this comprised pumping tests or falling head permeability tests. The results show generally confined aquifer conditions, low permeability and low storage.

Extended pumping tests were undertaken on bores close to Pages River for evidence of hydraulic connection between the river and the bores. Tests on bores near the G seam outcrop showed no evidence of interception or recharge from the river or from alluvium.

Water Level Monitoring: was conducted monthly in all bores, and monthly at seven stations along the Pages River. This monitoring indicates that groundwater levels are higher than the Pages River at all sites except at the most downstream bore in the coal measures (bore OH75B) where the groundwater level and river level are virtually the same.

Water Quality Monitoring: was conducted quarterly in all bores and monthly at seven locations along the Pages River. Monitoring also included quarterly surveys of salinity (electrical conductivity (EC)) and pH at 200m intervals along the Pages River.

The results also indicate that there are significant differences between the water quality in the Pages River and the hard rock groundwater. In general, salinity (as indicated by EC readings) in the bores near to the Pages River is lower than in the river itself. Monitoring shows little evidence of possible groundwater discharge to river.

A long profile survey of the Pages River was also undertaken by canoe. Major (saline) inflows were detected upstream of Bickham. The results show evidence of small low salinity inflows through the Bickham project area.

Stream Flow Monitoring: Stream flows were measured at five locations through the Bickham project area on 16 August and 20 September 2006 when the flow in the river was very low. These low flow conditions were ideal for detecting any inflows to or outflows from the Pages River. The results suggest that groundwater inflow of about 0.2 ML/day may occur in the reach of the river adjacent to the proposed mine pit.

Radon Survey: was undertaken to ascertain any connectivity between the groundwater in the coal measures and the Pages River. Radon is a naturally occurring isotope with a 3-day half-life, and it is a gas, so it does not survive very long in the river water. Elevated concentrations of radon in samples of river water could indicate zones of groundwater inflow. Samples were collected at 200m intervals along the river for radon analysis and also from each of the monitoring bores located close to Pages River.

Qualitative analysis of the survey results indicates that there is probably some groundwater inflow to Pages River between the upstream and downstream ends of the Bickham property. The results indicate that approximately 30% of the total inflow occurs from the alluvial flats upstream of the proposed mine, approximately 20% from the section of Pages River north of the proposed mine, 0% from the section of Pages River underlain by coal measures east of the mine (where the G seam outcrops in the river-bed) and 50% from the section of river downstream from any coal measures outcrops, where the river is underlain by basalt.

Further field work is being carried out to quantify these inflow rates.

Flood Assessment: Flood flows have been estimated using a flood model which used data from the Bickham gauge. The resulting flood levels and flow velocities in the channel and on the floodplain have been assessed for the Pages River between Splitters Creek and the southern boundary of the Bickham property. The model results indicate in the section of river upstream of the Bickham gorge the floods of concern are the five and 10 year floods as these are the ones which have the highest potential for channel scouring because the majority of flow concentrated in the river channel. For larger floods there is some backup for water experienced creating a pool effect with lower flow velocities in the channel.



Groundwater Modelling

Groundwater modelling has not yet been completed. The groundwater regime at Bickham is very complex and it is a challenge to mathematically represent the complexity in a groundwater model. Establishing a steady and stable model that adequately represents the aquifer permeabilities and storage properties, recharge by rainfall infiltration directly to the low permeability hard rocks and the relationship between the hard rock aquifers and Pages River, has taken considerable time and effort, with each model run taking about six hours.

Further time is needed to complete the modelling process, with a model capable of predicting the potential impacts of the proposed mining operation with sufficient accuracy and reliability to meet the needs and expectations of all stakeholders. It is not possible at this time to predict when the modelling will be completed. It is acknowledged that the community is eager to see the results of the model and its implications. However, the focus of Bickham Coal Company and the consultants is on accuracy and a thorough assessment.

The groundwater modelling is being peer reviewed by an independent peer reviewer, Assoc Professor Noel Merrick of the Centre of Groundwater Studies at UTS.

Ground Water Levels and Quality

From the investigations undertaken, and outlined above, the results suggest that the groundwater levels are generally higher than Pages River levels nearby and generally reflect the topography. This indicates that local recharge to the groundwater is by the infiltration of rainwater and not recharge from the Pages River. Discharge from the groundwater is by natural seepage, evapotranspiration and direct evaporation.

Groundwater Quality

Based on the water quality monitoring outlined above the groundwater quality in the coal measures is generally good, and of lower salinity than the water in Pages River. Pockets of higher salinity have been observed in places, especially in the Kingdon Ponds catchment. Higher salinity is also generally observed in the marine Bickham Formation and the Werrie Basalt underlying the coal measures. The pH is mostly close to neutral, but there are small pockets of low pH groundwater.

Water quality monitoring indicates that the quality in the Pages River is very variable, and is influenced by the water quality coming from the upper parts of the catchment, well upstream of Bickham. There appears to be little impact of the local groundwater on water quality in Pages River.

Groundwater Interactions

The hard rock aquifers within the Permian coal measures and parts of the overlying Bickham Formation are of primary interest, as these are the units likely to be impacted by the proposed mining project.

The basement units underlying the lowest coal seam (the G seam) will not be directly dewatered, and will not be significantly impacted by the dewatering. There is only small localised development of discontinuous alluvium within the potential impact zone of the project, and these alluvial sediments are not connected with the extensive alluvium aquifers upstream of Bickham and downstream of Gundy.

Significant investigations have been undertaken to understand the nature and degree of interconnection between Pages River and the groundwater within the coal measures, especially the most permeable part of the coal measures sequence, the G seam.

These detailed investigations include:

- Geological mapping of the coal seam outcrops
- Absence of major faulting and jointing either in outcrop or in drill-cores
- Water quality differences between the river and coal measures groundwater
- Radon survey
- Hydraulic testing, which suggests impermeable barriers between the G seam and the river
- Water level monitoring
- Direct measurements of streamflow that show only small increases in streamflow through the project area

These investigations indicate small volumes of groundwater discharge to Pages River from the coal measures. This discharge would be difficult to detect at times of higher streamflow in Pages River.

Buffer Zone between the Pit and the Pages River

The buffer zone between the pit and Pages River will be a minimum of 150 m. The impact of blasting on the buffer zone was assessed to determine if blasting could affect the permeability between the pit and Pages River. The principal finding was that there would be negligible impact on the pit walls more than 15m from the face and there would be no effect on the permeability between the pit and the Pages River.





Impact on Flood Conditions of Overburden Dump

As mentioned earlier, the flood model indicated that the floods of concern are the five and 10 year floods as these are the ones which lead to highest velocities in the channel adjacent to the proposed dump. The model results indicate that with the proposed overburden dump present there would be very minor changes in flood levels for the 100 year flood, but the five and 10 year floods would be unaffected and would still have the greatest potential to cause scouring in the channel.

Management of Water

The object of the proposed water management system is to maintain separation of water from different sources for appropriate uses.

- **Natural catchments:** runoff quality will continue to be similar to that from other pastured areas in the Pages River and Kingdon Ponds catchments. The largest dam on the site will remain and will be supplemented with other smaller dams. Any overflow would be discharged to the Pages River or Kingdon Ponds.
- **Rehabilitated overburden dumps:** once revegetated, runoff would be of a similar quality to natural catchments and could be used for stock water, or supplementary water for the mine. Any overflow could be discharged to the Pages River or Kingdon Ponds.
- **De-watering bore(s):** water from any dewatering bore would be naturally occurring groundwater and, as outlined above, is relatively low salinity water. There are a variety of options for the use of this water including discharge to the river or to use it for irrigation.
- **Recent overburden dumps:** these areas would be rehabilitated as soon as practical and all runoff would be directed to sediment dams. These dams would be designed and operated in accordance with DEC requirements. Once the sediment has settled there is the option to discharge water from these dams.

- **Pits, haul roads and work areas:** these areas will be minimised and a system to isolate “dirty” water would be designed and implemented. Runoff water would be re-used for dust suppression and coal handling. It is expected that the mixture of surface and groundwater will have a suitable EC to be suitable for irrigation to help establish vegetation on recently completed overburden dumps. No water from this area will be discharged from site.

Demand for Water During Operation

Water requirements will change over the life of the mine as the configuration of the mine changes and due to seasonal variability. It is expected that water requirements will therefore range between 140 – 340 megalitres/year. Water will be used for dust suppression, coal stockpiling and handling and rehabilitation. It is anticipated that all water for mine operational purposes will be sourced from within the mine area.

Further information

Further information on the water resource studies and the consultation process can be obtained by contacting Parsons Brinckerhoff’s consultation team. We look forward to your involvement in the project.

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