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Date: 15 May 2013

To: Mr Howard Reed
Manager, Mining Projects
Major Projects Assessment
Department of Planning and Infrastructure
23-33 Bridge Street
SYDNEY NSW 2000

From: Dr Noel Merrick

Re: **North Wambo Underground Mine Modification – Long-Term Groundwater Recovery**

Dear Howard,

Please find below a detailed discussion on the impact of the North Wambo Underground Mine Modification (the Modification) on the long-term recovery of groundwater levels.

Based on the detailed modelling and assessment conducted for the Groundwater Assessment (Appendix B of the EA) it cannot be considered that the alluvium and surface water sources would receive an increase in poor quality saline groundwater from the Permian aquifer post-mining as a result of the Modification.

Conceptualisation of the Groundwater System

A cross section of the conceptual hydrogeological regime is enclosed as Figure 2, with the location of the cross section shown on Figure 1.

The stratigraphy in the Wambo area comprises the Triassic Narrabeen Group, Permian coal measures and more recent (Quaternary) alluvial deposits associated with major drainage pathways. The Triassic Narrabeen Group forms the prominent escarpment on elevated areas to the south-west of Wambo and unconformably overlies the Permian coal measures. The Permian strata containing the Newcastle and the Wittingham Coal Measures dip gently to the south-west and subcrop in the Wambo area.

The pre-mining piezometric surface is likely to have reflected topography, with elevated water levels/pressures in areas distant from the major drainages and reduced levels in areas adjacent to the alluvial lands.

Groundwater discharge to rivers and creeks would mostly occur due to shallow 'interflow' (i.e. movement of perched groundwater through regolith layers or alluvium after rainfall recharge has occurred). The discharge rates from deeper, hard rock aquifers to surface water features is limited due to the very low vertical permeability of the Permian strata (Section 2.6.3 of the Groundwater Assessment).

Evidence from temporal groundwater monitoring hydrographs within the alluvium indicates that the shallow aquifer is responsive to rainfall recharge and it is likely that the alluvium plays an important role in supplying recharge to the underlying Permian strata as well as contributing to baseflow of the perennial surface water features (Section 2.6.1 of the Groundwater Assessment).

Although there would be upflow in places and downflow in other places, the Groundwater Assessment found there was a natural downwards flow of groundwater of about 0.025 ML/day on average from the alluvium to the underlying rock prior to mining.

Summary of Proposed Modification

The location of the Modification longwall panels (Longwalls 9 and 10) in relation to mapped alluvium is shown on enclosed Figure 3.

The predicted incremental 20 millimetre subsidence contour due to the extraction of the Modification longwall panels is located outside the estimated limit of alluvium for Wollombi Brook and North Wambo Creek.

As fracturing would not occur beneath the Wollombi Brook alluvium as part of the approved or modified operation, the degree of hydrological connection between the coal seams and the Wollombi Brook alluvial aquifer would not be exacerbated by the North Wambo Underground Mine.

In addition, the Modification would result in no additional hydrological connection between the coal seams and the North Wambo Creek alluvial aquifer.

The depth of cover of the Modification longwall panels in the vicinity of the Stony Creek alluvium varies from approximately 180 m to 220 m. Therefore it is not anticipated that the Modification would create additional hydrological connection between the coal seams and the Stony Creek alluvial aquifer.

The Modification is not predicted to have a significant impact on the regional groundwater regime (Figures 5.5 to 5.8 of the Groundwater Assessment).

The Modification could also not be considered to have a significant impact on the recovery of groundwater levels. For the hydrographs shown in Figure 5.12 of the Groundwater Assessment, there is no difference between drawdown and recovery hydrographs for the approved layout and the Modification.

Long-Term Recovery of Groundwater Levels

The numerical groundwater model simulated a zone of increased permeability above extracted areas (Section 3.6 of the Groundwater Assessment). The numerical groundwater model also includes waste rock emplacements to the north of the North Wambo Creek alluvium. The former open cut mining areas will act as groundwater sinks in the short to medium term, but will reach an equilibrium with the surrounding Permian aquifers following recovery.

The rocks in the connective-cracking part of the fractured zone above extracted longwall panels will have a substantially higher vertical permeability than the undisturbed host rocks. This will encourage groundwater to move out of rock storage downwards towards the goaf. In the upper part of the fractured zone, where disconnected cracking occurs, the vertical movement of groundwater should not be significantly greater than under natural conditions.

The strata movements and deformation that accompany subsidence will alter the hydraulic and storage characteristics of aquifers and aquitards. As there will be an overall increase in rock permeability, groundwater levels will be reduced either due to actual drainage of water into the goaf or by a flattening of the hydraulic gradient without drainage of water (in accordance with Darcy's Law). There is an increase in effective porosity ('specific yield') as a result of subsidence effects.

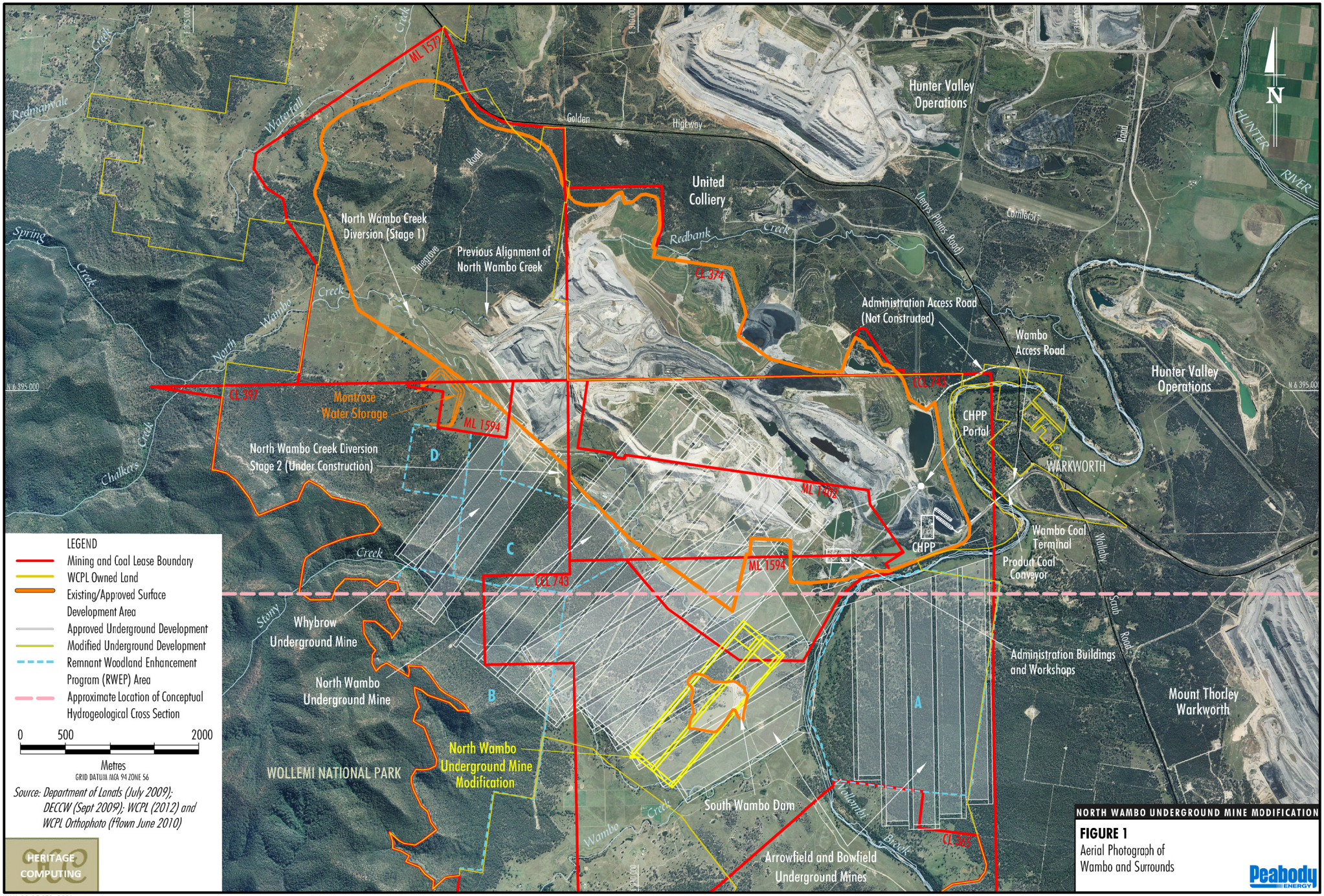
As described above, the Modification is not predicted to create additional hydrological connection between the coal seam and alluvial aquifers.

The Groundwater Assessment included a post mining recovery run simulation (Section 5.7). This simulation found that groundwater levels in the Permian overburden would reach a new equilibrium at levels slightly lower than those occurring under pre-mining conditions. On this basis, any discharge from the Permian system to the alluvial system occurring post-mining would be less than that occurring under pre-mining conditions.

Therefore the Modification would not result in an increase in groundwater flux of more saline groundwater from the Permian system to the alluvium and so would not impact the long-term average salinity of Wollombi Brook.

Yours sincerely

Dr Noel Merrick



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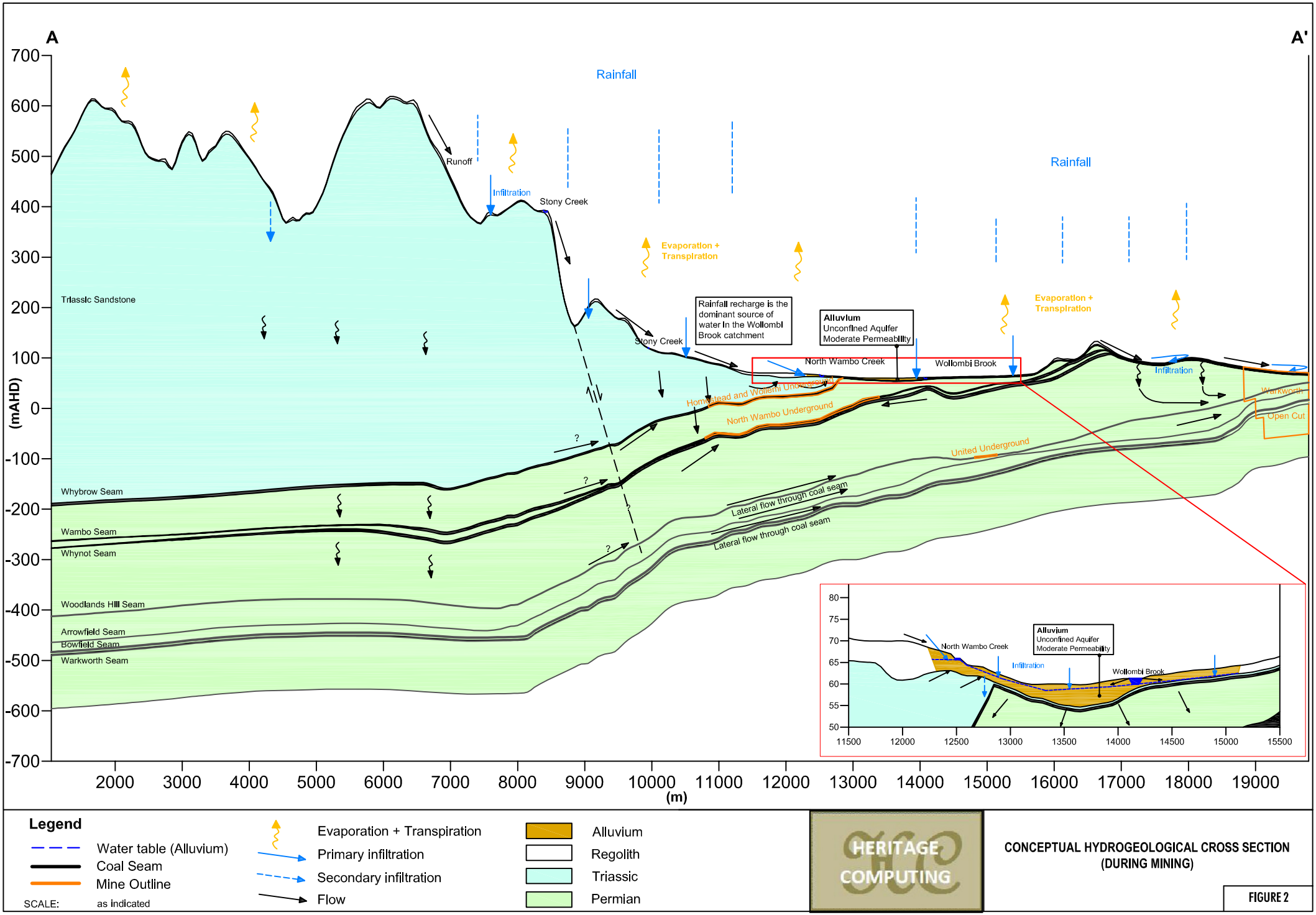
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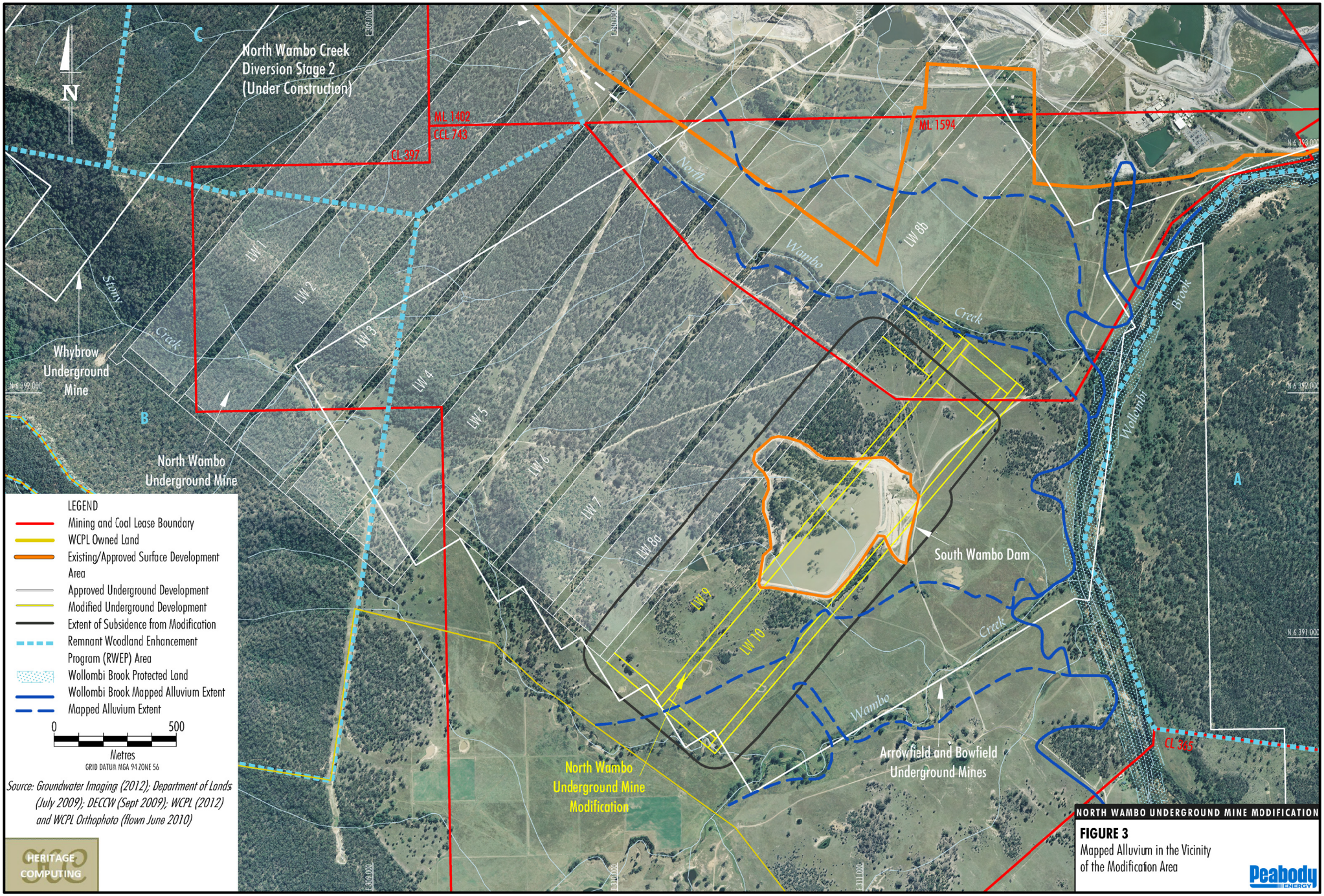
A'
Rainfall
Runoff
Infiltration
Stony Creek
Evaporation + Transpiration
Rainfall recharge is the dominant source of water in the Wollombi Brook catchment
Alluvium
Unconfined Aquifer
Moderate Permeability
North Wambo Creek
Wollombi Brook
Triassic Sandstone
Homestead and Wollemi Underground
North Wambo Underground
United Underground
Warkworth
Open Cut
Whybrow Seam
Wambo Seam
Whynot Seam
Woodlands Hill Seam
Arrowfield Seam
Bowfield Seam
Warkworth Seam
Lateral flow through coal seam
(mAHD)
(m)
Legend
Water table (Alluvium)
Coal Seam
Mine Outline
SCALE: as indicated
Evaporation + Transpiration
Primary infiltration
Secondary infiltration
Flow
Alluvium
Regolith
Triassic
Permian
HERITAGE COMPUTING
CONCEPTUAL HYDROGEOLOGICAL CROSS SECTION (DURING MINING)
FIGURE 2



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