REVIEW OF TAHMOOR SOUTH

PROPOSED MINE PLAN

OCTOBER 2020

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REPORT ON: Review of Tahmoor South Proposed Mine Plan

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EXECUTIVE SUMMARY

The amended mine plan for Tahmoor South is essentially an extension of existing workings, without which the Tahmoor mine will have largely extracted its current resources. The amended mine plan is different to the original EIS mine plan which proposed wider panels and higher extraction and would have required additional or replacement LW equipment. The design change from one domain of long panels into two domains of shorter panel length is based on practical operational reasons and it is likely that the previous EIS plan may not have been entirely practical for a few reasons. The reduction in extraction height is to match the current LW equipment. The reason for the removal of panel LW109 near Dog Trap Creek is not clear but assumed due to surface impact reasons.

The maximum extraction height of 2.6m is set by the LW equipment and cannot be exceeded unless new shields are obtained. Extraction height is largely irrelevant over all but the last two panels in Tahmoor South, LW107B and LW108B as this is the only area where the seam thickness exceeds 2.6m (note a small portion of LW106B is also over 2.6m). Over the rest of the area the extraction height will be between 2.6m and the lowest practical operating height which could be between 2.1m and 2.4m.

Several alternative configurations and mining methods were considered in this report and compared on a project NPV basis. In order, the options and their calculated NPV_7 are as follows. Panel widths are quoted as total void width:

1.	Extract 14 LW panels at 283m width	$360M
2.	Extract 12 LW panels at 283m width, then 3 LW panels at 225m width	$345M
3.	Extract 12 LW panels at 283m width, then 3 LW panels at 175m width	$312M
4.	Extract 15 LW panels at 283m width, with angled mains	$256M
5.	Extract 12 LW panels at 283m width, then stop mining	$231M
6.	Extract 14 LW panels at 283m width, with angled mains	$230M
7.	Extract 17 LW panels at 225m width	$189M
8.	Extract 12 LW panels at 283m width, then change to partial extraction methods	$69M
9.	Extract 21 LW panels at 175m width	-$6M

These results indicate:

- Maintaining the current panel width over the proposed extraction area provides the highest project value;
- Not mining panels 107B and 108B in the Bargo area erodes significant value;
- Angling the mains to avoid Bargo provides better value than not extracting LW107B and LW108B but only if some additional reserves can be added adjacent to LW108B, i.e. another small panel;
- Reducing the widths of all panels erodes significant project value;

- Narrowing the panel widths just within the Bargo area reduces value, but only slightly and would be considered the next best options to the proposed plan;
- First workings or partial extraction methods are not shown to be economic at current prices.

In addition to the sensitivity as ranked above, the economic evaluation indicates the project is highly sensitive to coal sales pricing and the forex rate. The coking coal price change from May 2020 to June 2020 (USD110 to USD103) and accompanying forex change (0.65 to 0.70) is shown to negatively impact project NPV_7 by $300M (if this lower price was carried across the mine life). Note that the NPV values ranked above reflect the May 2020 pricing.

The project is shown to continue to provide a direct benefit to the State of NSW primarily in the way of royalty payments in the order of $200M total. Additional benefits could come from taxation however this would be highly dependent upon project cash flows hence will be sensitive to panel width, mining method and sales pricing.

The proposed mine plan has a high development requirement and the analysis conducted in this report indicates a high reliance on improved development productivity to deliver the proposed targets.

In comparison to other Australian LW mines, Tahmoor is a low productivity, deep, gassy mine with limited upside capacity. Notwithstanding this, the proposed mine plan should enable the mine to continue operating and providing benefits to the State of NSW for the remaining mine life. However any significant restrictions in operating conditions (panel width, size of resource, etc) may negatively influence the investment decision by the owners.

It is noted that during the period of this review, Tahmoor Coal issued a further amendment to their mine plan in which the most westerly two longwall panels were removed from the extraction plan in order to minimise subsidence impacts upon the Bargo township.

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1.0 INTRODUCTION

The Planning & Assessment Group (PAG) of the NSW Department of Planning, Industry and Environment has commissioned the services of MineCraft Consulting Pty Ltd (MineCraft) as an independent underground longwall coal mine planning expert to conduct a review of the mine layout proposed in the Tahmoor South Coal Project's Amendment Report. The expert is also required to undertake desktop analyses of alternative mine plan options to assess mine economics and to assist PAG assess the opportunities and limitations (including costs and benefits) of the amended mine plan for longwall mining and alternative mine plan options including bord and pillar / partial extraction mining techniques to enable it to provide a thorough and detailed assessment.

1.1 Project Background

The Tahmoor South Coal Project (the Project) seeks the continued and extended operation of the Tahmoor Mine, located 80km southwest of Sydney within the Southern Coalfield of NSW. The mine extracts coal from the Bulli Seam using the longwall mining methods at depths of cover ranging from 255m to 375m. The Project is proposing to extend Tahmoor Mine's operations to mine within the southern portion of the Colliery Holding boundary and extract run-of-mine (ROM) coal from the Bulli Seam at the rate of 4Mtpa until 2035.

A mine plan was proposed in the Project's Environmental Impact Statement (EIS) which was placed on public exhibition from 23 January to 05 March 2019. A key issue for the Project relates to the extent of the longwall mining and the associated subsidence impacts on dwellings in the township of Bargo.

Tahmoor Coal Pty Limited has since proposed an alternative mine plan in an Amendment Report in response to this concern. The Amendment Report proposes a reconfigured mine plan layout to comprise two series of shorter longwalls, removal of one longwall (LW109) near Dog Trap Creek, reduced longwall void width (from 305m to 283m) with an unchanged overall tailgate chain pillar width of 38m, and a reduction in extraction height (from 2.85m to 2.6m). The amended mine plan results in a reduction in the total amount ROM coal to be extracted over the life of the project from 48Mt to 43Mt.

Subsidence effects due to the amended mine plan are stated to be less by approximately 15% compared to the EIS mine plan and 180 fewer houses will be impacted in Bargo within the subsidence affectation zone (refer Section 7.1.2.4 of the Amendment Report).

1.2 Scope of Work

The scope of work for the review was issued by PAG as follows:

1. Undertake an initial review of the proposed mine plan as set out in Section 2.1 and shown in Figure 2.1 of the Amendment Report and assessed for subsidence impacts in Appendix B of the Amendment Report.

2. Investigate the suitability of alternative bord and pillar or low subsidence (i.e. up to 100mm vertical subsidence) partial extraction techniques for the geotechnical environment Tahmoor Mine operates under currently and will in the future for mining from the Bulli Seam for the depths of cover, structural competency of the roof and the horizontal stress environment for the proposed mining area. The study area for this investigation should be focused on the township of Bargo.
3. Undertake a comparative revenue generation options assessment for the following alternatives:
   - The proposed mine plan in the Amendment Report as the base case;
   - The proposed mine plan without the proposed LW107B and LW108B;
   - Bord and pillar mining method (subsidence < 20mm);
   - Partial extraction mining method (subsidence up to 100mm vertical subsidence);
   - Any other longwall layouts that would recover similar ROM coal quantity as proposed in the Amendment Report but with the potential to reduce subsidence impacts in the subsidence affectation zone, paying particular attention to:
     i) Longwall widths (including void widths of 283m, 225m and 175m);
     ii) Extraction heights, reduced to an appropriate level before the mine economics shows negative Net Present Value (NPV).
4. In respect of the options outlined in point 3 above, the coal mining expert is required to, as a minimum:
   a) Examine and report on the:
      i) Extent of roadway development and associated mining costs;
      ii) Extent of any additional requirements for management of underground gas (refer Section 3.2.4 of the Amendment Report);
      iii) Potential implications for "development float", mine sequencing and continuity of mining;
      iv) Changes in total coal recovery;
      v) Changes in the relative rate of return on capital and NPV and income to the State of NSW (refer Amendment Report Appendix L) using independent coal pricing assumptions and including analyses of sensitivity to coal pricing.
   b) Report on the sensitivity of reducing extraction heights for the longwall void widths investigated.
   c) Summarise the comparative review outcomes.
   d) Make recommendations for any additional information required to inform the comprehensive assessment of the project's proposed mine plan.

1.3 Data Sources and Methodology

This review was conducted as a desktop exercise using reference information on the Project, specific data supplied by SIMEC, assumptions based on first principles and the author’s expert knowledge. No site visit was conducted.

The information used for this review was initially sourced from public domain, primarily the PAG website https://www.planningportal.nsw.gov.au/major-projects/project/10966 which contains the Project EIS, project addendum and supporting documents. Some confirmation information and basic AutoCAD data was provided by SIMEC via an information request submitted via PAG, mainly related to the mine constraints, geological and surface features, mine equipment, rosters and manning levels. Mine productivity and coal yield information was gained from production reports produced by Coal Services, NSW. A telephone conference was held with the Tahmoor Project Team where various questions were discussed.

The adopted methodology was to utilise MineCraft's inhouse methods, systems and expertise to undertake the review including the use of MineCraft's Scheduling Module, Longwall Productivity Module and Operating Cost Module.

The adopted methodology was to:

- Develop mine constraint plans based on information supplied by SIMEC including cadastral, surface and geological data;
- Portray the current proposed mine layout at 278m panel centre distances onto the constraint plans and then recast the mine layout design using AutoCAD for longwall panel widths of 220m and 170m (centre distances);
- Calculate the ROM reserves within each layout using the MineCraft Scheduling Module;
- Estimate the current longwall productivity kpi's using the MineCraft Longwall Productivity Module and then calculate the relevant kpi's for the different panel widths and extraction heights;
- Recreate a base mine schedule for the 278m layout using the derived LW productivity parameters and other parameters based on industry typical performance;
- Apply the base mine schedule to the alternate mine layouts using the derived LW productivity parameters and adjust the development requirements to ensure longwall continuity;
- Consider possible alternate mining methods comprising both first workings and secondary extraction;
- Establish concept mine layout designs for each method and estimate the likely percentage recovery;
- Estimate the productivity kpi's for each method and determine the ratio between number of production units and annual output in order to determine likely annual outputs;
- Establish a production schedule for each method;
- Collate the production output parameters from each schedule;
- Establish an operating cost framework for the base case layout using the MineCraft Operating Cost Module and using industry benchmark cost kpi's as input data. Using the base production schedule, establish an annual operating cost profile for the base case;

- Using the alternate production schedules, establish annual operating cost profiles for the alternate panel width cases and partial extraction method;
- Calculate the net present value of the annual cash flow from each case.

1.4 Report Qualifications

This review was conducted as a desktop exercise and is considered a comparative review rather than an absolute review. In this context it is acknowledged that the base case assumptions may not precisely match the actual mine data in terms of performance and costs, however they are expected to be sufficiently approximate to allow a comparison of the economic impact from alternate mine plans and/or methods.

The review included the calculation of net present value (NPV) which is based on estimated cash flows from the Project. It is highlighted that the NPV values shown in this report are not expected to be a reflection of the actual Project NPV as the information used is not sufficiently precise. Rather they are used to demonstrate a comparison between options. Several inputs to the cash flows have been kept constant across all options including capital cost and sales price. It is acknowledged that different panel width configurations and a different mining method could cause capital cost variations, and different sales volumes may cause average sales prices to vary. However it was not considered feasible in this review to apply more accuracy in these regards.

NPV is highly sensitive to several factors including coal prices, marketing agreements, foreign exchange rates, taxation rates, etc for which exact details are not known. Therefore a consistent approach to this data has been used across all options

2.0 BACKGROUND INFORMATION

Tahmoor mine commenced operations as an underground mine in 1979. Several changes of ownership have occurred over time including Clutha, BP Coal, Rio Tinto, Austral Coal, Centennial Coal, Xstrata, and the current owners, the SIMEC Group.

Historically the mine has not been a high productivity mine, producing between 1.5 and 2.7Mtpa over the years. This is possibly a consequence of several aspects including the:

- Mining environment - thin seam, high gas content, outburst risk, high stress environment and occasional faulting;
- Mining equipment - low capacity longwall (2,000tph) and low capacity drift conveyor (1,600tph). This compares to modern longwall mines (e.g. Ulan West, Narrabri) with 3,500tph – 4,500tph longwall systems and drift conveyors from 5,000tph – 6,500tph.
- Roster – five or six day operations over most of its life.

In 2018 and 2019 the mine produced 2.1Mt and 2.4Mt, the longwall producing 1.9Mt and 2.1Mt respectively and with development production making up the total output. By deduction, development production is around 25kt per month, which at 24t per metre equates to 1,030m advance per month or 240m per week.

Tahmoor is a high development ratio mine in comparison to several new high producing Australian mines which is due to features including:

- Development of back bleeder main headings to manage seam gas;
- Relatively short length LW panels;
- The low development ratio coal has already been extracted (the mine is old);
- Dual LW installation roads, one serves as a stress relief road (refer definitions).

Tahmoor operate up to four development crews to achieve the typical average weekly advance of 240m/week which is low in comparison to typical industry development rates. It is likely that the fourth CM unit is not operated all the time and gateroad advance rates would be in the order of 80m to 100m per week and main heading rates of approximately 40m to 50m per week.

The longwall equipment was supplied by DBT (now CAT) and consists of a 278m long AFC rated at 2,000tph and LW supports with a maximum open height of 2.6m and an operating range of approximately 2.1m to 2.6m. The LW typically operates in the Bi Di mode of operation.

Coal clearance from the mine is via a series of underground conveyors feeding into an underground bin at the drift bottom. Coal is fed from the bin onto the drift conveyor which is rated at 1,600tph. The conveyor sizes match the current LW process capacity.

The Project intends to extract the Bulli seam from the Tahmoor South Area. The Bulli seam thickness ranges from 1.4m to 3.4m and is typically between 2m and 2.6m. There is a zone of seam thinning where the seam is less than 2m extending in an East-West band across the LW101A – LW106A panels and there is a seam thickening zone towards the Southeast where the seam thickness is between 2.8m and 3.4m.

The current LW equipment can reportedly operate between 2.1m* and 2.6m and hence in the areas less than 2.1m, floor stone will be extracted to maintain adequate height, and in the seam thickening areas, coal will have to be left in the floor. Alternatively Tahmoor would have to invest in larger height LW shields however the extent of thick seam resource is unlikely to justify the capital cost of new shields (approximately $70M). A lower cost option would be second hand shields, however the market for these is not reliable.

Note * While the shields can reportedly operate at 2.1m it is postulated that Tahmoor extract at a minimum height of approximately 2.4m for operational and ergonomic reasons. This height minimum matches the reserve recovery of 43Mt as claimed in the Amendment Report.

The mine operates seven days per week with approximately 400 permanent employees. However only half days are operated on the weekends so effectively it is a six day roster in terms of available hours. The mine experiences a low operational time availability due to many reasons including extended travel time, gas delays, delays installing tailgate support and low conveyor availability. Thin seam conditions require a high percentage of stone to be excavated in all roadways and particularly the main headings. The depth of workings and high stress environment requires high levels of ground support.

The mine design features LW panels oriented in an NNW - SSE direction which is favourable for stress and cleat. This is important for mine safety and productivity.

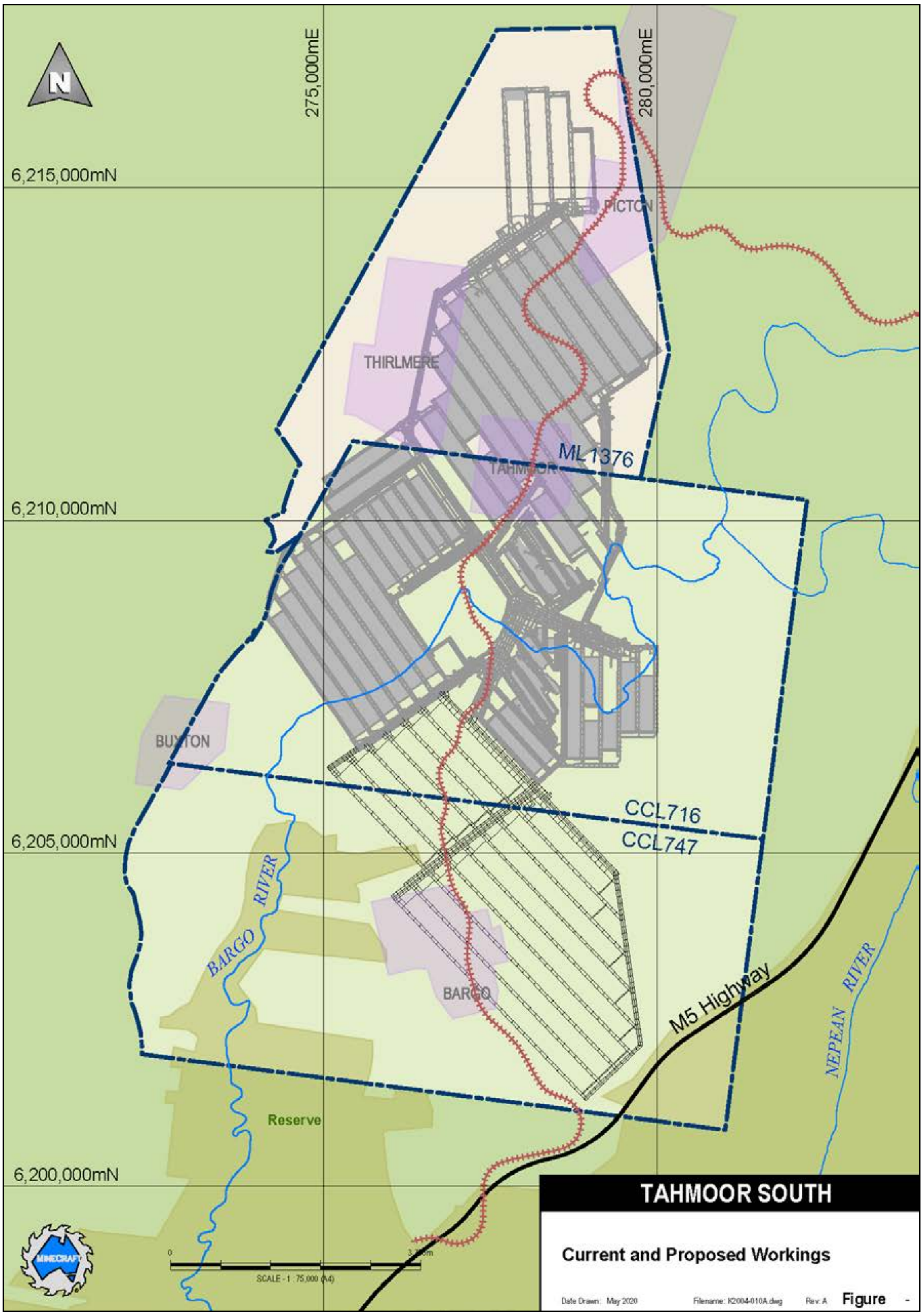

Figure 2.1
Tahmoor Mining Areas

3.0 LONGWALL EXTRACTION

3.1 Proposed Mine Plan

The current proposed mine plan for Tahmoor South is based on a longwall panel width of 278m centres (283m total void) and is shown in Figure 3.1. This plan is the amended mine plan from what was initially exhibited in the EIS Report and the following amendments have been made to the mine plan to reduce the extent and magnitude of anticipated surface subsidence:

- Removal of LW109, which was directly beneath Dog Trap Creek;
- Reconfiguration of the longwall layout to comprise two series of shorter longwall panels;
- Reduction in the proposed longwall width, from approximately 305m to approximately 285m;
- Reduction in the height of extraction within longwall panels from up to 2.85m to up to 2.6m.

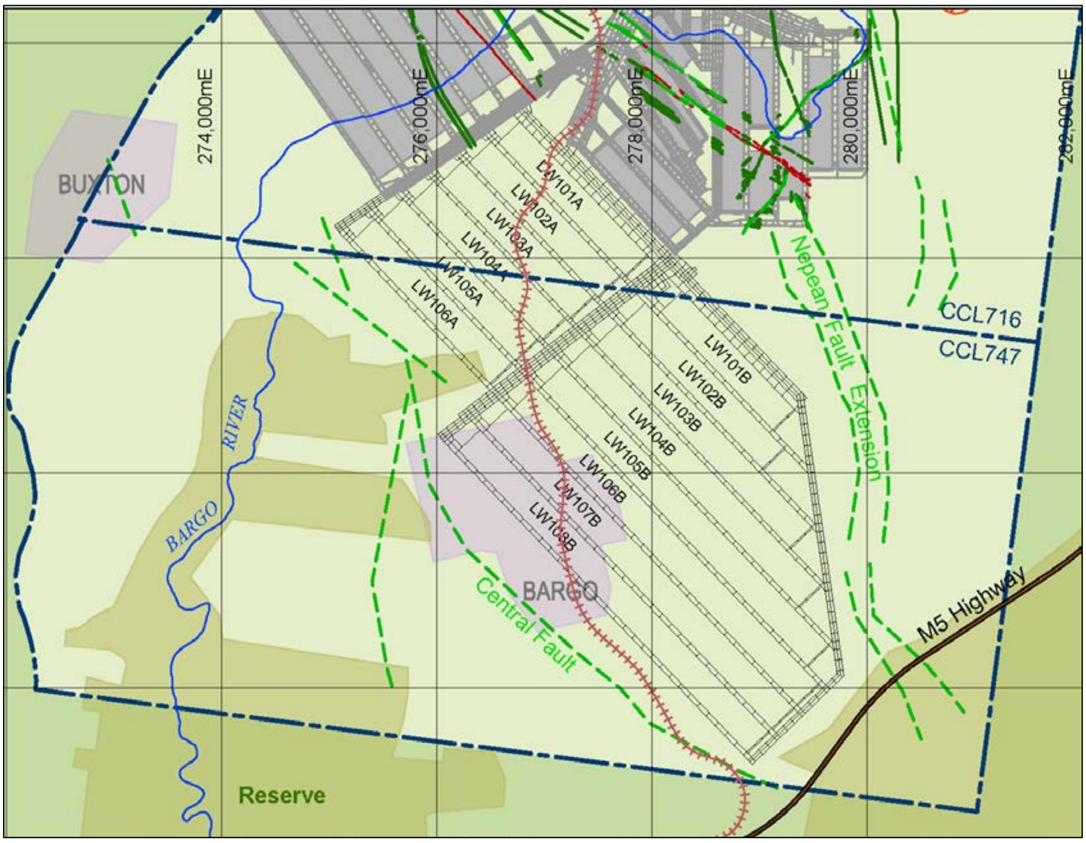

Figure 3.1
Tahmoor South Proposed Mine Plan

In reviewing the amendments the following comments are made:

- The reconfiguration of the mine into two sets of shorter panels provided a number of operational benefits including:
  a) Suitable location of the two new shafts and a reportedly better ventilation solution;
  b) The footprint of LW101A is wholly within the current mining lease, as is parts of LW102A and LW103A. Therefore if the EIS was approved, these panels could be developed either wholly or partially without requiring the new mine lease approval;
  c) The panel lengths in the previous plan were reaching up to 6km and possibly too long for practicality;
  d) The reconfiguration eased the development requirements for the first LW production, taking into account the various delays in commencing development of Tahmoor South.
- Removal of LW109 near Dog Trap Creek. This panel was very short (1,070m) in the EIS Plan and its original length was probably previously reduced by the proposed TSC2 downcast shaft location thus making this panel low in economic ranking. Due to its requirement to use the main headings as a tailgate this panel would have been extracted last in the mine, hence diluting its low economic ranking. Its removal from the current amended plan is not clearly understood from a mining viewpoint and it assumed related to surface impacts on Dog Trap Creek.
- Reduction in panel width. The amended panel width of 278m matches the current panel width. Increasing the width would require additional equipment purchases and related capital cost for probably minimal benefit.
- Reduction in the extraction height from 2.85m to 2.6m. The current LW shields can only operate up to 2.6m hence new shields would have been required to extract any higher. New shields could cost in the order of $70M and for the small area where the seam height exceeds 2.6m, may not provide sufficient pay back. Further comment on extraction height is made later in the report.

In summary, the amended layout is more practically suited to ongoing operations at Tahmoor and likely lower capital cost as it suits the current LW equipment. In terms of LW width and extraction height there is little difference from current practice. The main difference will be where the seam thickens over 2.6m as coal will be left behind in the floor (last three panels LW106B – LW108B) which notwithstanding a waste of resource, may create some operational challenges in keeping the excavation at 2.6m or less (refer section on cutting height).

3.2 Alternate Width Longwall Layouts

Alternate width mine layouts were created using AutoCAD for longwall panel widths of 220m and 170m (centre distances) or 225m and 175m total void widths. For each alternate layout the same constraints and design principles were applied including lease boundaries, (approximate) mining limit to the west, mid panel main headings, shaft locations and back bleeder main headings.

The alternate width mine layouts are shown in Figures 3.2 to 3.3.

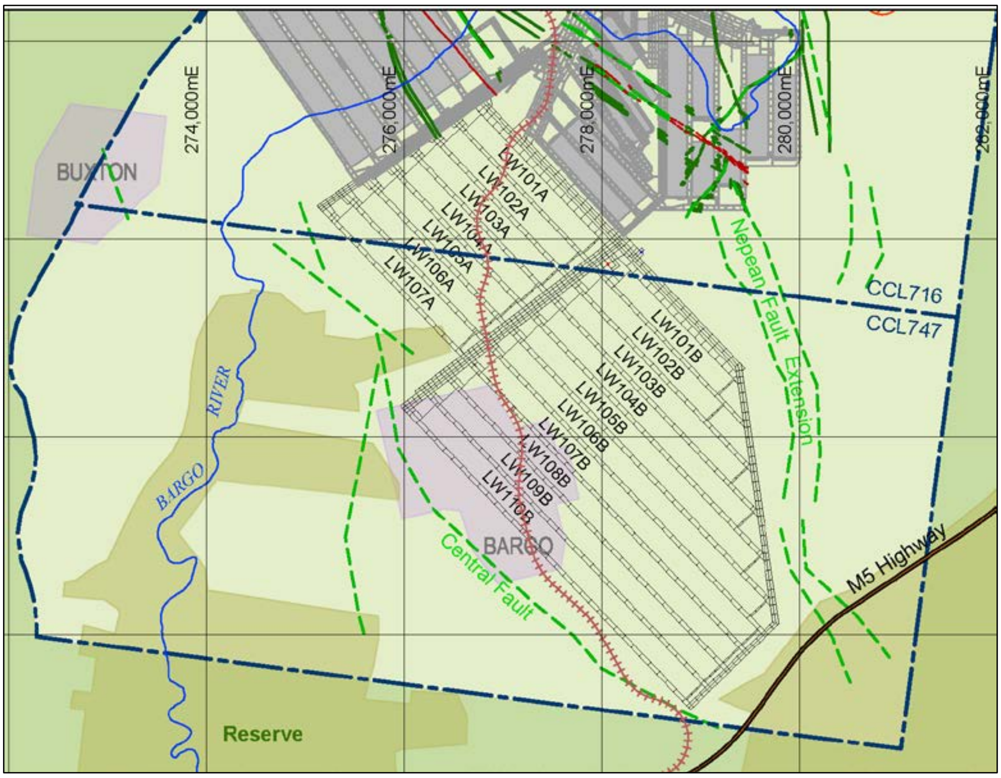

Figure 3.2
220m Mine Layout

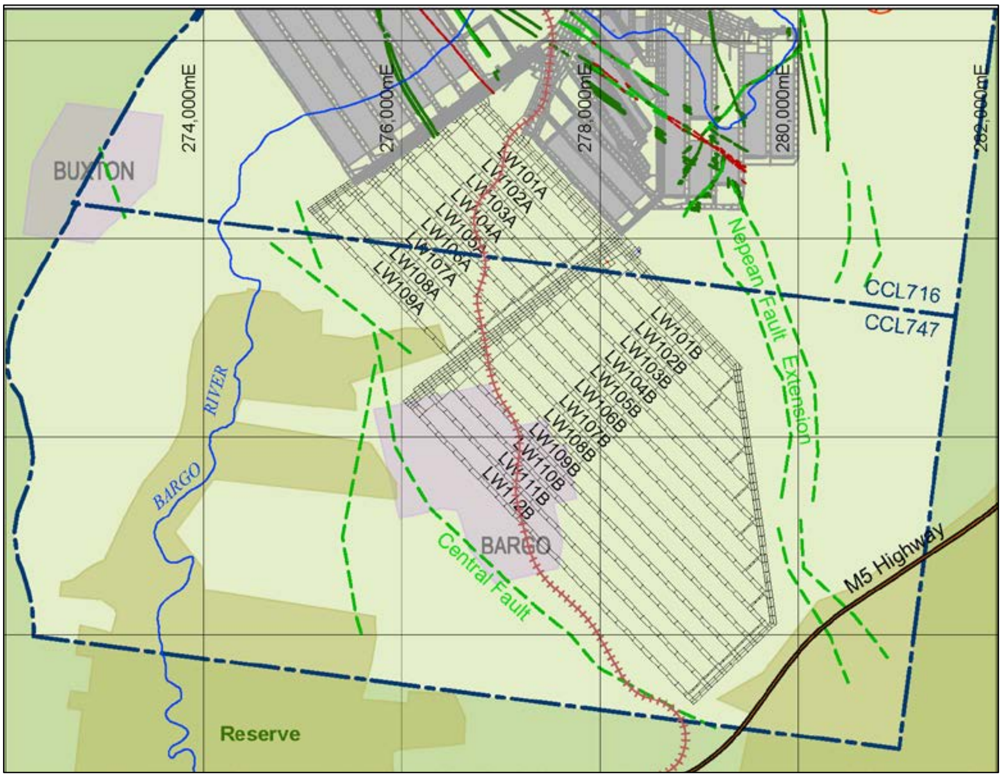

Figure 3.3
170m Mine Layout

3.2.1 Hybrid Width Panels

Variable width LW panels could also be considered whereby the panel widths are reduced in the area around Bargo township. Two concepts are shown, reducing the width from 278m to 220m from LW105B and reducing the width from 278m to 170m from LW106B (refer Figures 3.4 and 3.5).

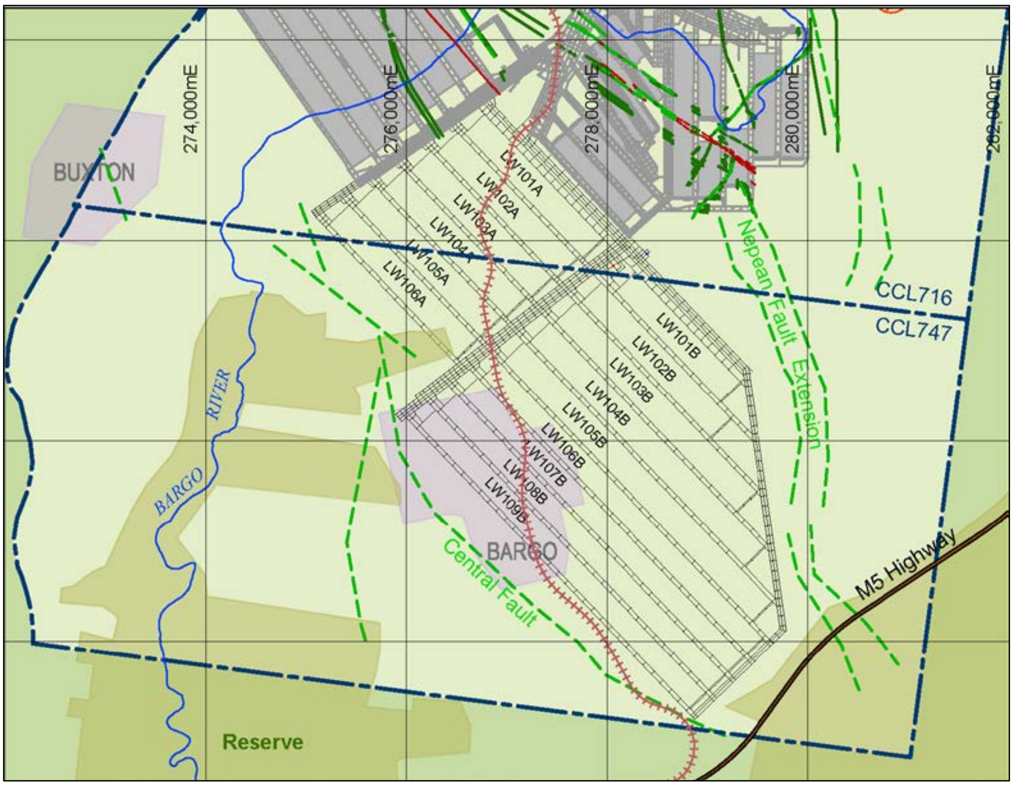

Figure 3.4
Hybrid 278m and 220m Panel Width

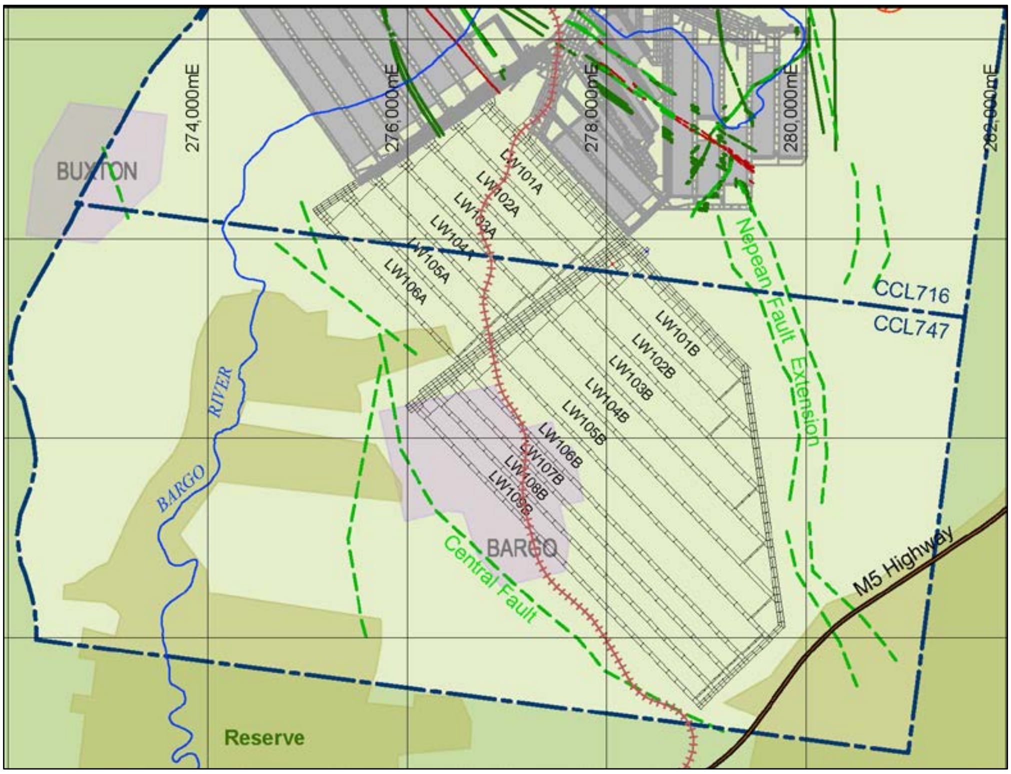

Figure 3.5
Hybrid 278m and 170m Panel Width

3.3 LW ROM Reserves

The ROM reserves for each LW layout were calculated using the MineCraft Scheduling Module using first principle assumptions. The results are summarised in Table 3.1.

Table 3.1
LW ROM Reserves

Parameter	278m	220m	170m	278m/220m	278m/170m
Gateroad Development (km)	104.5	126.0	150.6	114.2	114.1
Main Headings Development (km)	60.0	61.5	62.5	61.4	60.5
Total Development (km)	164.5	187.5	213.1	175.6	174.6
Development ROM (Mt)	4.0	4.5	5.1	4.2	4.2
No of LW Panels	14	17	21	15	15
Longwall ROM (Mt)	38.8	37.5	35.6	39.4	38.0
Total ROM (Mt)	42.7	42.1	40.7	43.6	42.2
Development Ratio (dev m/LW kt)	4.2	5.0	6.0	4.5	4.6

It is noted that the difference between cases is not linear due to the geometry of the panels with respect to the western mining limit. In this respect the 220m layout extends slightly more to the west than either the 283m or 170m layout. However a general trend can be observed with reducing panel width where:

- The number of longwall panels increase;
- The longwall ROM reserve decreases (owing to a greater percentage of gateroads);
- The development metres increase;
- The development ratio increases;
- The total ROM reserve reduces.

In regard to the development ratio, this is high for all cases and compares, for example, to the proposed Dendrobium Extension where the development ratio at 300m panel width was 3.4 and at 175m panel width the ratio was 5.2.

3.4 Longwall Productivity

Longwall productivity is measured in terms of tonnes per hour (Actual Operating Rate) and operating hours per week (Operational Availability). The Actual Operating Rate is determined by various items including the LW Nameplate Capacity, cutting height, web depth, cutting method (eg Uni Di, Bi Di), panel width and Process Reduction Factor (measure of human skill and efficiency, and impact of difficult mining conditions).

Panel width impacts upon the longwall productivity as narrower panels reduce the time that the LW is operating at its most productive mode (its main cutting run) as opposed to the lower productive snaking operation (double shuffle at the end of each run). For example the snake distance is around 26m at each gate end, so 52m in total. For a panel width of 278m, this leaves 223m for the main, high productive cutting run. For a panel width of 170m, this reduces to 118m for the main cutting run.

Table 3.2
Longwall Productivity KPI's – Current Tahmoor Operation – Bi Di at 2.4m Extraction

Parameter	Value	Basis
LW Nameplate Capacity	2,000tph	Assumed
Panel width (centres)	278m	EIS Study
Cutting Height	2.4m	EIS Study
Cutting Web	0.9m	Internal database
Drum Diameter	1.7m	Assumed, industry typical
AFC Pan Length	1.75m	Internal database
Snake Length	26m	Assumed, industry typical
Operating Mode	Bi Di	Assumed
Process Cycle Capacity	1,700tph	Calculated
Actual Operating Rate	930tph	Calculated from PRF
PRF	55%	Assumed, industry typical for Tahmoor style conditions
Planned Operating Hours per Week	120	Assumed based on effective 6 day roster
Actual Operating Hours per Week	60	Indicated by Tahmoor
Operational Availability	50%	Calculated
Weekly Production	55,700t/wk	Calculated
Weekly Retreat	56m/wk	Calculated
Longwall Move Duration	6 weeks	Assumed, industry typical, includes bolt up, ramp up

A Tahmoor longwall model was created using the data shown in Table 3.2 and calibrated to the typical 2019 monthly performances of around 2Mt per year (source NSW Coal Services). The kpi's from this model calculate to a weekly productivity of 55,700 tonnes per week in Bi Di mode.

3.4.1 Future Longwall Productivity

The Tahmoor amended report indicates an increased productivity from the Tahmoor South area leading to an increased annual production level of 3.6Mt per year. Information from Tahmoor in this regard indicate improvements would come from increased operating time due to an improved coal clearance system (new trunk conveyors and less conveyors in the network), and reduced travel time (closer to the drift bottom). Additionally improved longwall control technology would deliver an improved PRF (efficiency). The forecast longwall productivity has been estimated for different panel widths adopting similar kpi's as shown in Table 3.2 however with key differences:

- Improved operating hours from 60 to 75 hours per week;
- Improved PRF from 55% to 60%.

The estimated longwall productivities for varying panel widths at Tahmoor South with the productivity improvements are shown in Table 3.3.

Table 3.3
Longwall Productivity KPI's – Varying Panel Width – Bi Di at 2.8m Extraction

Panel Width (centres)	Process Cycle Capacity (tph)	PRF (%)	Actual Operating Rate (tph)	Actual Operating Hours (hrs/wk)	Weekly Production (tonnes/week)	Weekly Retreat (m)
278m	1,700	60	1,010	75	75,940	76
220m	1,620	59	955	75	71,650	91
170m	1,530	58	890	75	66,600	110

This demonstrates that the impact of reducing panel width:

- Will reduce the Process Cycle Capacity due to the lesser proportion of time spent in the main cutting run;
- Will reduce the PRF marginally for the same reason;
- The combination of the above two will reduce the actual operating rate and (assuming no impact upon the weekly operating hours) will reduce the weekly production rate;
- Will increase the weekly retreat distance which will therefore require increased development.

The general consequences of the last two points will be an increased development ratio (more development required) and an increased LW move frequency. The annual impact of this can be determined by scheduling.

The ability of Tahmoor to reach these new targets cannot be commented on however by way of benchmarking, the following comments are made:

- Operating hours. The current 60 hours per week from 120 planned hours (50% operational availability) is towards the lower end of Australian practice with modern mines achieving over 95 hours per week from 140 planned hours (68% operational availability). Hence an improvement in operational availability from 50% to 60% is considered within current practice;
- Process Reduction Factor. The range of PRF measured in Australian mines is from 45% in difficult mines to approximately 80% in modern mines with good conditions and modern technology (automation). Hence an improvement in PRF from 55% to 60% is considered within current practice.

3.4.2 Development Productivity Improvements

It is assumed that Tahmoor are also predicting improvements in development productivity in order to match the improved longwall performance. This will assumedly come from a combination of new equipment, the simplified and updated coal clearance system and reduced travel times.

The current development performance is calculated at 0.3Mtpa, or 12km per year, 1,030m per month or 240m per week (source: NSW Coal Services). On the basis the LW improvement is of the order of a 33% improvement (2.4Mt to 3.2Mt), the equivalent development improvement target will equate to 16km per year, 1,333m per month or 310m per week.

On a benchmarking basis, the development performances at most Australian mines have lagged significantly behind the advances in LW productivity with most mines struggling to maintain development targets. While LW production has increased towards 10Mt per year, the best annual development performances remain around 22km to 24km per year. Many mines have increased their development fleets or engaged the use of Contractors to maintain the required development at a commensurate increase in cost.

In recognition of this, a development target of 16km per year for Tahmoor is considered within the Australian benchmark. The ability of Tahmoor to achieve this cannot be commented on however it is noted that development productivity improvements remain one of the LW industries key challenges and are not as simple as longwall productivity improvements. This is one of the main drivers for Australian (and International) mines to both widen and lengthen their LW panels.

3.5 Longwall Production Scheduling

Each panel width scenario was scheduled in order to determine key metrics. The scheduling assumptions are listed in Table 3.4. It is noted that these are assumptions adopted for the review and have been developed from historical production levels as outlined in Section 2.0. Tahmoor indicate the development start date will be around March 2021 and the LW start date around Q4 2022.

Table 3.4
Scheduling Assumptions

Parameter	Value
Development Rate	310m/week from 4 dev units (4 x CM's)
Main Headings Rate	45m/week
Gateroad Rate	110m/week
Install Road Rate	40m/week
Panel Flit Delay	2 weeks
Install Panel Belt Delay	4 weeks
Longwall Extraction Rate	As per Table 3.3
Longwall Relocation	6 weeks (includes bolt up and commissioning)
Bulli Seam Primary Yield	69.8% (from EIS Report)
Bulli Seam Secondary Yield	4.7% (from EIS Report)
Start date for Dev 1 & Dev 2 in LW101A main headings	1 March 2021
Start Date for Dev 3 in LW101A maingate	1 July 2021
Start Date for Dev 4 in LW102A maingate	1 Jan 2022
Start date for LW101A	1 November 2022

The following comments are made regarding the schedules:

- Each scenario was highly constrained by development to the extent LW production levels are constrained to approximately 95% of the rates indicated in Table 3.3;

- The maximum ROM production in any year matches SIMEC estimates of 3.6Mt;
- In order to have the first panel (LW101A) developed in time, the tailgate must be driven in advance of the adjacent main headings using super panel methods (two CM's);
- The SIMEC reported LW extraction sequence of extracting only LW101A to LW103A before progressing to the B series panels was not found to be possible in any scenario. It was not found to be possible to advance the main headings and bleeder roads sufficiently in advance to allow any early commencement of the B series panels. This means the LW extraction sequence is most likely to be LW101A – LW106A, then LW101B – LW108B;
- The required development rates are slightly in excess of the 16km per year discussed in section 3.4.2 and this will potentially pose the biggest challenge to Tahmoor;
- At these development rates, four development units are sufficient to maintain LW continuity in both the 283m and 220m layouts however a fifth CM unit is required for the 170m layout for a two year period from 2024;
- The mine plan requires the development of a new set of main headings to access the B series panels which is positioned at the inbye end of the A series panels. The A series gateroads are shown to connect into this new main headings assumedly to assist LW bleeder ventilation. However in all scenarios, development of the main headings does not occur prior to extraction of the A series panels. Hence use of this main headings as a back bleeder does not appear possible.

4.0 NON LONGWALL METHODS

Non longwall methods of underground coal extraction relate to one of three continuous miners methods:

- First Workings. Roadways are driven in the coal leaving sufficient coal pillars to maintain roof stability (typically 25% to 35% recovery);
- Partial Extraction. After roadways are formed, the pillars are stripped on retreat leaving remnant pillars sufficient to minimise the formation of a goaf (typically 45% to 55% recovery);
- Full or Panel Extraction. After roadways are formed, small panels are formed and progressively stripped leaving negligible pillars behind and allowing the roof to collapse forming small goaf areas (50% to 70% recovery).

Panel extraction was previously the most productive coal mining method prior to the advent of longwall mining. Certain areas of Tahmoor were extracted by this method in its early history. The study work scope includes a review of the application of first workings and partial extraction for Tahmoor South. Panel extraction by continuous miners is not included in the review as panel extraction is currently undertaken by longwall methods.

4.1 First Workings

In first workings, a panel is formed off a main headings and developed as a series of roadways linked by small sized pillars. Typically there would be five, seven or nine roadways with the conveyor located in the centre roadway. Pillar sizes are small, typically 20m x 20m, or 25m x 25m depending upon depth, allowing rapid transit of coal from the continuous miner (CM) to the conveyor boot end by shuttle car (SC). The design could be with angled cut throughs (herring bone) or square. The more roadways in the panel, the further some roadways are from the conveyor hence the productivity can decline. A seven heading layout is considered an efficient basis and is adopted for this example. The reason a panel is formed off the main headings is so it can be sealed off at some stage and a new panel started thus keeping the size of the open mine down to a manageable level.

Since the roadways do not collapse, there is negligible surface settlement. Over time (years), the remnant pillars may suffer some deterioration and hence a factor of safety is normally applied during their design to accommodate this. The orientation of the panel, roadways and cut throughs is important with respect to coal cleat and to a lesser extent, stress. Roadways should have an angle > 25° to cleat to minimise rib and roof falls.

A potential first working design for Tahmoor is shown in Figure 4.1 and Figure 4.2, featuring a seven heading pillar arrangement at 25m centres. This layout would provide a recovery of 31% within a panel.

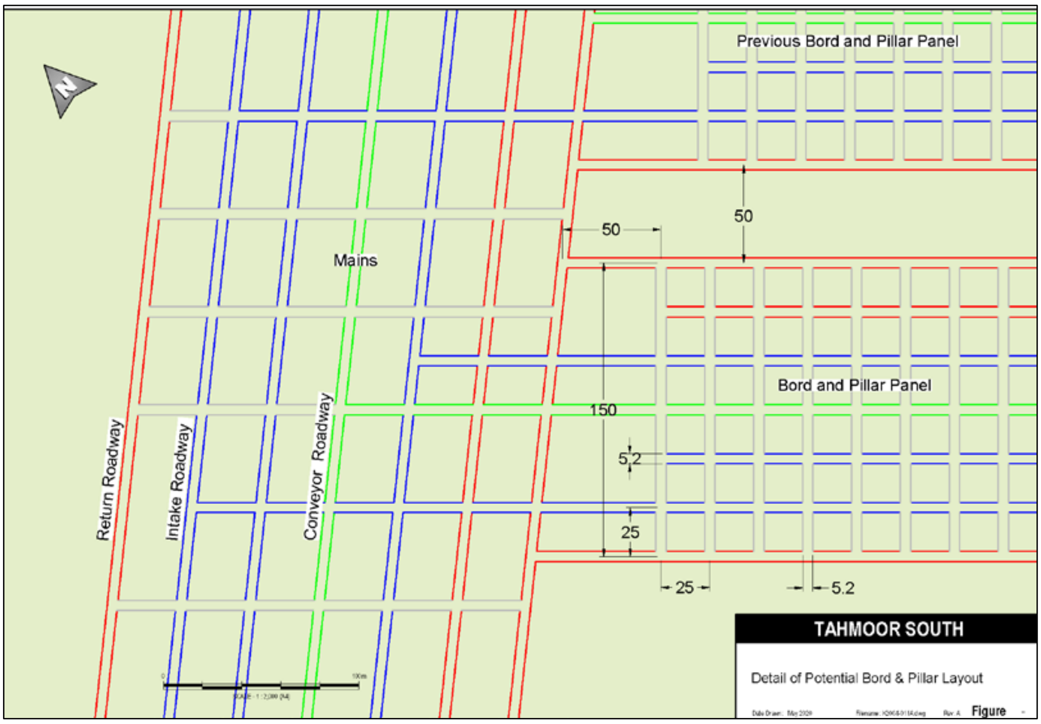

Figure 4.1
Seven Heading Bord and Pillar Design

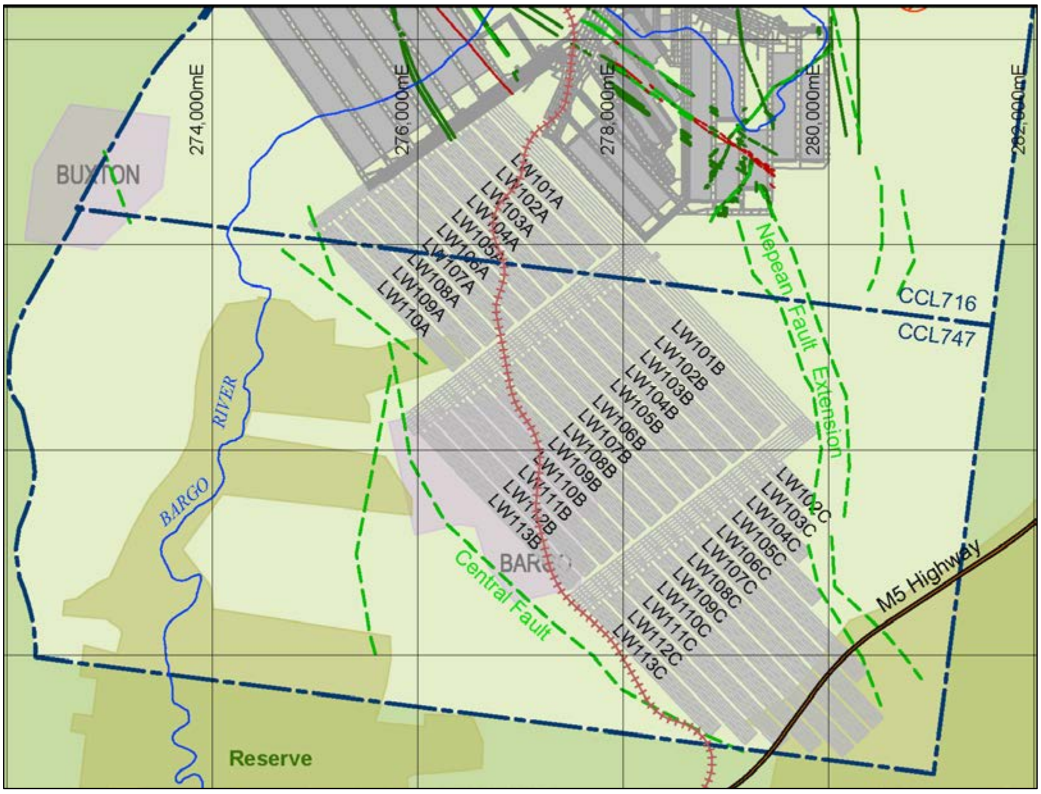

Figure 4.2
Potential Bord and Pillar Layout at Tahmoor South

4.1.1 First Workings Subsidence

It is noted that the work scope requires the first workings method to have less than 20mm of surface settlement. A specific geotechnical study would be required to confirm the design meets this requirement however for the purposes of this study reference is made to the proposed Hume Project which is proposing a first workings mining method with negligible surface disturbance and for which detailed geotechnical studies have been completed.

(source https://majorprojects.planningportal.nsw.gov.au). The proposed first workings method at Hume is shown in Figure 4.3 and consists of a series of plunges from a gateroad, each 4m in width, 120m in length and separated by a 6m pillar. Frequent barrier pillars are left in order to prevent collapse. This method would provide a comparatively high recovery of 36% at depths of around 170m. The geotechnical studies indicate surface settlement from this method of less than 20mm.

On this basis it is postulated that at Tahmoor, at depths of 400m, an extraction recovery of 31% would pose negligible surface impact (less than 20mm).

It is noted that the proposed Hume method is not applied to this study as the method is reliant on a new type of mining system which is in early trial stages.

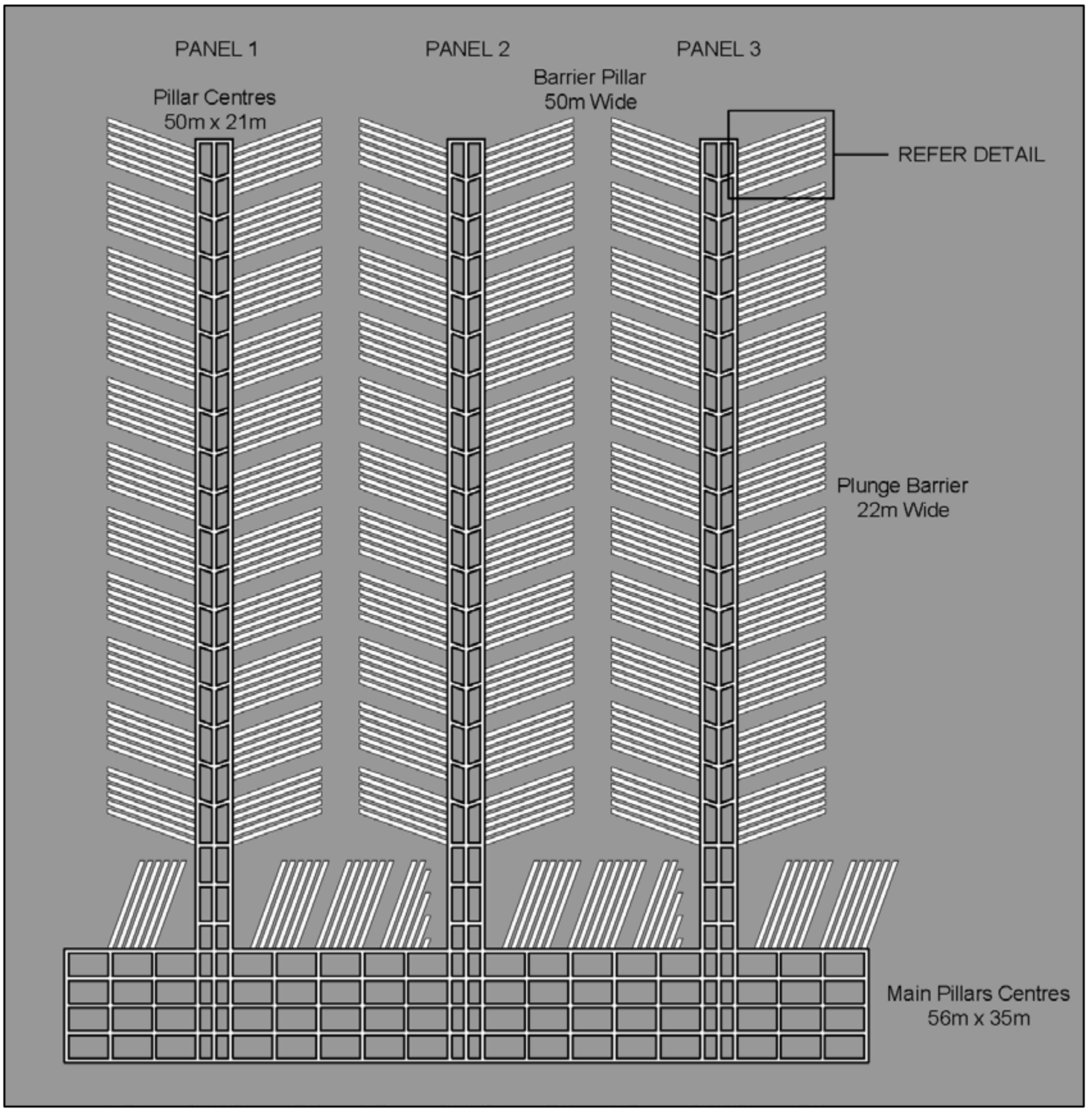

Figure 4.3
Hume Project First Workings Method

4.1.2 First Workings Productivity

First workings methods are the lowest productivity method as every roadway must be adequately supported on advance. Conditions conducive to high productivity include:

- Shallow depth – minimal roof support;
- Competent roof – deep plunges, minimal roof support;
- Thick seam – high tonnage per metre, ability to strip floor in second pass;
- Low gas – allow deep plunges;
- Hard floor – withstand rapid SC traffic.

Notable examples of first working mines in NSW include Myuna and Clarence (although they may each do some partial extraction at times). Narrabri has also recently introduced a first workings place changing unit to supplement their LW production. Myuna has very competent roof and produces approximately 1.9Mt per year. Clarence produces approximately 2.0Mtpa (source NSW Coal Services). Clarence utilise the Komatsu FCT (flexible conveyor train) in one panel to facilitate continuous coal clearance thus improving productivity. The FCT requires a minimum mining height in the order of 3.0m.

The place change or cut and flit method is commonly used in first workings whereby the CM is remotely plunged 12m to 14m into a heading (cut), then pulled back and moved to the next heading (flit). A mobile bolting machine is then moved into the newly cut roadway, and primary support and ventilation is installed. Productivity is reliant on deep plunges (> 10m), rapid SC cycles, rapid flits and the bolter keeping up with the CM. Ideally, pillar spacing is designed to be two plunge distances apart, e.g. 20m – 24m. In deep conditions where the roof is not as competent the plunge depth must be reduced to 10m or less and productivity declines with reducing plunge depth. Additionally a high gas environment, particularly methane can restrict plunge depths.

At Tahmoor, negative aspects to high productivity place changing would be the depth (400m) and the thin seam. A minimal extraction height would be considered necessary at say 2.6m for single pass bolting and ventilation requirements. At lower seam heights the floor would require excavation. While the gas environment will be high, the predominant seam gas is reportedly carbon dioxide which is likely to cause less of a plunge depth restriction than methane. However high ventilation quantities will be required to remove / dilute the gas.

Productivity is generally determined by metres advance (plunges per shift) hence the seam thickness has an influential impact upon the tonnage produced as the thicker the seam the more tonnes per metre. Ideally seam thickness would be in excess of 3.0m. This is shown graphically in Figure 4.4 as ROM tonnes per CM unit per annum for various weekly advances with the minimum extraction height of 2.4m.

World's best practise for first workings is around 550m advance per week per CM and this production has been observed in various USA coal mines. In Australia, various first workings place changing operations have achieved around 350m to 400m advance per week (e.g. Narrabri).

At Tahmoor, development advance rates are currently in the order of 100m per week or less. This is low in comparison to Australian benchmarks and is considered primarily due to the mining conditions (depth and ground support (bolting) requirements). Therefore this would be considered directly transferrable to first workings productivity with the consequence of a predicted low advance rate of 250m/week. This would equate to an annual production of between 250kt and 300kt per unit per annum. Assuming four production units in operation, an annual production of around 0.85Mt to 1.0Mt would be considered possible. Clearly the thicker seam areas should be targeted.

For this study, no further evaluation of the first workings method has been undertaken as this productivity level is considered too low to be economic. The following discussion on partial extraction supports this conclusion.

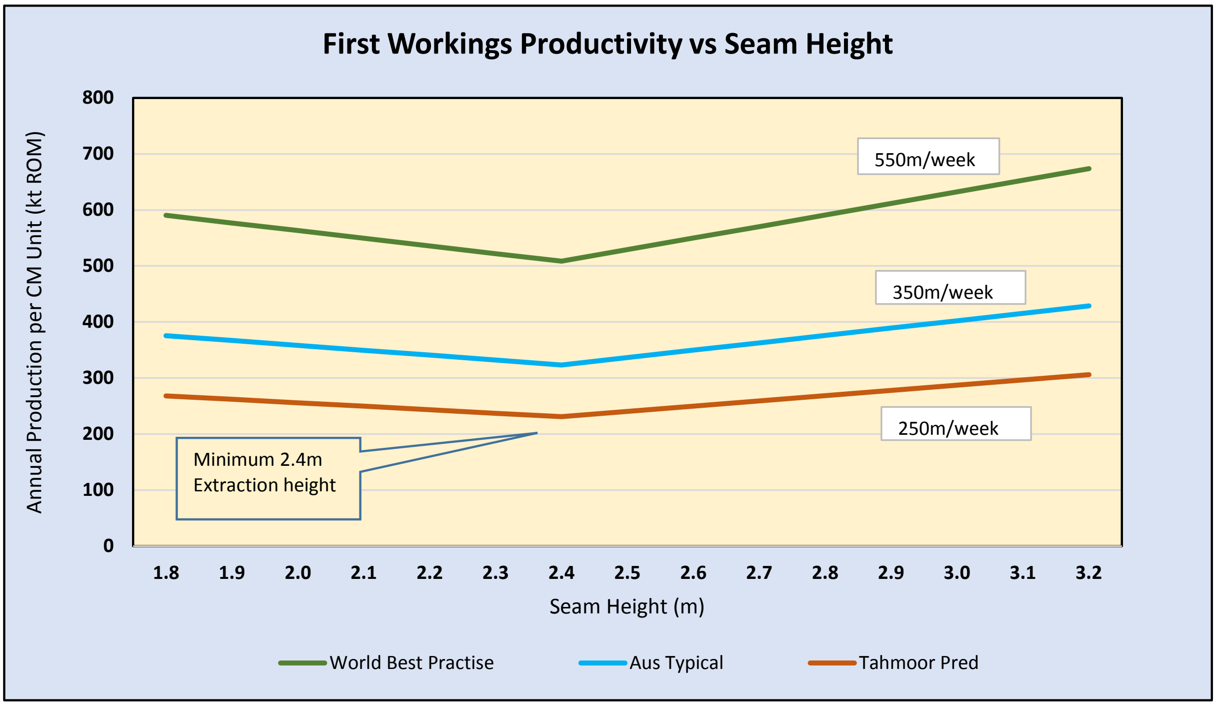

Figure 4.4
First Workings Productivity vs Seam Height

4.2 Partial Extraction Methods

In partial extraction, a panel is formed from a main headings and developed as a series of roadways linked by moderately sized pillars, spaced apart. Once the panel is developed to its limits, the CM would retreat back to the main headings stripping each pillar in a progressive method. Since the most productive part of this method is the pillar stripping, panels are generally confined in size (length and width). The intent is not to form large unsupported areas which could collapse and form a goaf hence the remnant pillar size must be designed to retain their general integrity and load bearing capability. The immediate roof could collapse between the remnant pillars however this would only be localised and be of minor areal extent so as to prevent large surface movement. Reference is made to NERDCC Report 1564, March 1993 which undertook a study of surface subsidence relating to panel extraction methods. This report concluded that any formation of a goaf by panel extraction methods would likely lead to subsidence > 100mm.

A potential design would be the method deployed at the now closed Tasman mine which was called the Modified Duncan method. This method is shown in Figure 4.5 and as a potential layout for Tahmoor South in Figure 4.6.

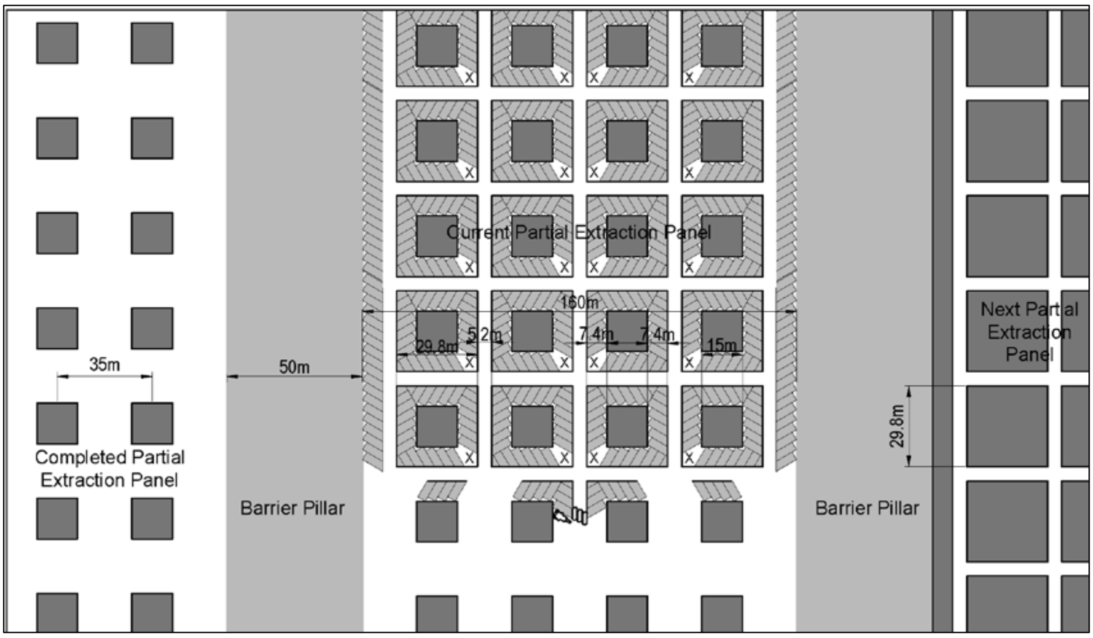

Figure 4.5
Partial Extraction Modified Duncan Method

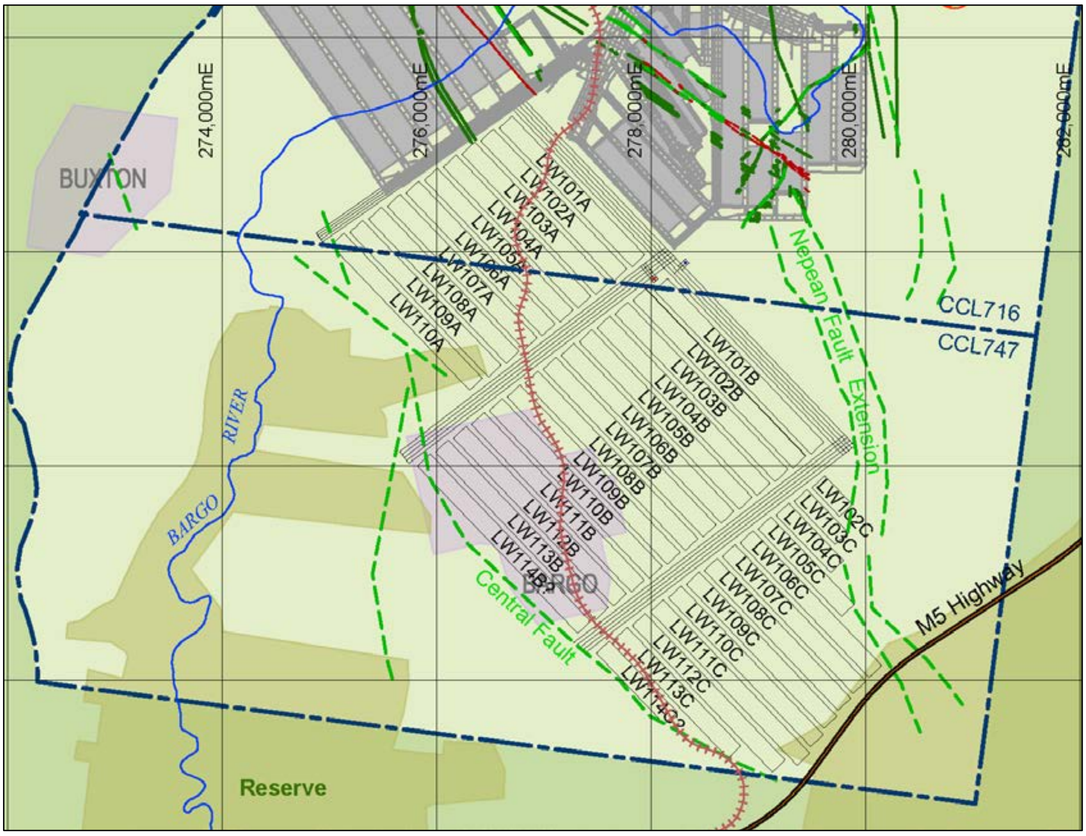

Figure 4.6
Partial Extraction Panel Layout For Tahmoor South

The design features a five heading panel with 35m pillar centres. Once developed each pillar would have a series of lifts removed each around 7.4m in length thus leaving remnant pillars 15m square. The mining recovery from this method would be around 50% depending upon how much of the pillar coal could be removed. Breaker Line Supports would be used to protect the CM during pillar lifting.

The exact impact to the surface from this method would require detailed study however since no large goaf areas are formed, surface settlement less than 100mm would be targeted. Depending upon modelling the pillar size could be increased or decreased accordingly.

4.2.1 Partial Extraction Productivity

Partial extraction productivity is greater than from just bord and pillar as no roof support installation is installed during pillar stripping. The CM operates from supported roadways and is remotely mined into the pillar with one side protected by the coal pillar and the other side by two or three Breaker Line Supports. The mining rate is then determined by the SC cycle times and the time taken to set up for each lift. The modified Duncan method only requires the CM to plunge in 7.4m, approximately three quarters of its length, before it is retracted and moved to the next lift position.

In practise, panel extraction achieves a productivity approximately 50% more than bord and pillar. So typically in Australia where bord and pillar may achieve 400kt per year, partial extraction would produce 600kt. However both methods are required as the panel is initially developed by bord and pillar prior to its extraction.

At Tahmoor, in the thicker area, if bord and pillar produced 300kt per annum and pillar extraction produced 450kt per annum, the use of four production units would be expected to produce in the order of 1.2Mtpa to 1.5Mtpa.

4.2.2 Partial Extraction at Tahmoor

A concept layout and analysis for the use of partial extraction in selected areas at Tahmoor South is discussed in detail in Section 6.4.4.

5.0 ECONOMIC EVALUATION

5.1 Operating Costs

In order to estimate the mine operating costs a generic underground operating cost model has been used. This model is an internal MineCraft model developed over the past twenty years and used for numerous projects. Costs are categorised by major cost and activity centres specific to underground longwall mining. Some costs are variable in nature (roof support consumables), some are fixed costs (e.g. staff labour) while many are a mixture of fixed and variable.

The model matches the various unit cost drivers to the annual production schedule to derive the annual operating cost. This includes offsite costs for transport, washing, port and marketing charges, and royalty payments. It is noted that the royalty payment is driven by the coal sale price.

The unit cost information is considered generic but reflective of the industry. Actual costs were not provided by SIMEC and reference was made to the Economic Report of the Amended Mine plan (Appendix L, Economic Impact Assessments) in order to reference available cost information. This report refers to NPV values rather than real cost data thus preventing a direct comparison. The report indicates the total revenue generated by the project is $5.8B and a NPV_7 value of $3.1B. The total operating costs is reported at NPV_7 $2.4B over 15 years. By back calculation this would approximate to $4.3B in real costs. The MineCraft cost model calculates a total cost of $4.1B over the 15 year period and hence the unit cost drivers and assumptions are considered sufficiently reflective of Tahmoor's costs for the purposes of this report.

An example of the operating cost breakdown for a typical year is shown in Table 5.1. This is for a 278m panel width, operating at the Tahmoor projected increased productivities (average 3.4Mtpa), with 1.3 longwall moves per year and a sale price assumption of USD110 or AUD169/t.

Table 5.1
Annual Operating Cost Estimate

Cost Centre	Annual Cost	Variable Cost
Development	$57.3	$3,500/m
Longwall	$26.4	
Longwall Moves and Overhauls	$22.1	
Mining General	$50.4	
Gas Management	$15.2	
Business Support Overheads	$77.5	
Total Pit Top Cost	$251.0	$93.5/t
Coal Washing	$17.9	
Rail Freight	$12.4	
Port, Marketing & Sampling	$12.6	
Royalties	$26.7	
Total FOB Cost	$320.5	$119.4/t
Development Advance	16,300m	
Total ROM Coal Production	3.4Mt	
Total Saleable Coal	2.7Mt	

5.2 Capital Costs

The Economic Impact Assessment report provides some information on capital costs, namely a graph indicating a project capex of $327M phased over five years and sustaining capex which averages approximately $15M per year. While the detail of the capital components are not specified it is assumed the capex is for new conveyors, new development fleet, two ventilation shafts and related infrastructure. It is likely the main headings to the new ventilation shafts are capitalised at an assumed cost of $80M. This capex is reproduced in the cash flow analysis. It is noted that depreciation of capital is not included in the cash flow analysis in this study.

5.3 Revenue

Revenue has been calculated by assuming a constant sale price for each year and each case. A base case hard coking coal price of USD110 has been applied with a conversion rate of 0.65 AUD/USD (AUD169). This reflects recent prices (May 2020) for Australian export coking coal and assumes all coal is exported or sold internally at export prices. This price includes a relativity factor of 94% which reflects the typical discount applied to Illawarra coal in comparison to the bench mark coal from Peak Downs. It is noted that this may not reflect actual prices realised by SIMEC however all cases are treated similarly. It is also noted that coking coal prices fluctuate over the years and this price represents a low price in the cycle. A small amount of thermal product is also produced and a price of USD65 (AUD100) is assumed.

5.4 Taxation

The cash flow assumes company tax is payable on positive cash flow at a rate of 30%. Also that negative cash flows are accumulated as losses and carried forward until a net positive cash flow is achieved before taxation is applied. A project evaluation is applied whereby only the cash flow from the project is evaluated hence the cash flow from ongoing operations at Tahmoor while the project is being constructed are kept separate. It is noted that this will not reflect reality however is applied for comparative purposes.

5.5 Net Present Value

A NPV calculation is applied to the annual cash flow after tax with a discount rate of 7% for each case. It is noted that the EIS used a discount rate of 7%. The results are shown in Table 5.2.

As shown, the reducing panel width for all panels in Tahmoor South would cause a considerable reduction in value. This is primarily driven by reduced revenue due to less annual production and higher total operating costs due to the extended mine life and increased development requirements.

Table 5.2
Net Present Value – Base Sales Price

Panel Width	NPV_7
278m	$360M
220m	$189M
170m	-$6M
Hybrid 278m / 220m	$345M
Hybrid 278m / 170m	$312M
278m – No LW107B / 108B	$231M

A sensitivity to coal sale pricing is shown in Table 5.3 where the NPV is calculated assuming a 115% price factor (coking price AUD195, thermal price AUD115), and a 87% price factor (coking price AUD147, thermal price AUD87). As shown, the project value is highly sensitive to price. The relativity between NPV values is around $170M – $190M for a 50m reduction in panel width.

Table 5.3
Net Present Value – Sensitivity to Pricing

Panel Width	Low Price	Base Price	High Price
Coking Sale Price AUD	$147/t	$169/t	$195/t
Thermal Sale Price AUD	$87/t	$100/t	$115/t
278m	$68M	$360M	$686M
220m	-$103M	$189M	$507M
170m	-$308M	-$6M	$308M
Hybrid 278m / 220m	$48M	$345M	$674M
Hybrid 278m / 170m	$22M	$312M	$635M
278m – No LW107B / 108B	-$21M	$232M	$509M

6.0 SPECIFIC WORK SCOPE QUESTIONS

The work scope included specific questions and while the preceding sections discuss many of these aspects, each question is discussed for completeness.

6.1 Review The Proposed Mine Plan

A description of the proposed mine plan is discussed in detail in Section 3.1. In summary, the amended layout would appear a more practical plan than that proposed in the EIS in that it is more practically suited to ongoing operations at Tahmoor and with a likely lower capital cost as it suits the current LW equipment. In terms of LW width and extraction height there is little difference from current practice.

6.2 Investigate the Suitability of Alternative Bord and Pillar Techniques

A discussion on bord and pillar methods is included in Section 4.1. The combination of thin seam, depth and high gas are not considered conducive to high productivity levels. Any bord and pillar operations would be best in the thick seam areas (> 2.6m), however a low productivity is predicted in the range 0.85Mt to 1.0Mt. Also it is considered that this method would provide a low resource recovery in the range of 30% to 35%.

6.3 Investigate the Suitability of Partial Extraction Techniques

A discussion on partial extraction methods is included in Section 4.2. A pillar stripping method which does not allow the formation of any goaf areas and leaves remnant stable pillars would be expected to minimise surface subsidence to less than 100mm. This could provide a resource recovery in the range 50% to 55% and a higher productivity than bord and pillar, ranging between 1.2Mtpa and 1.5Mtpa. Again the thicker seam areas should be targeted.

6.4 Comparative Revenue Generation Assessment

6.4.1 The Proposed Mine Plan

Economics are discussed in detail in Section 5.0. The comparative economics of the proposed mine plan and alternate panel width options are summarised in Table 6.1.

Table 6.1
LW Panel Width Comparative Metrics

Parameter	278m	220m	170m
Total ROM	43Mt	42Mt	41Mt
Total Product	34Mt	33Mt	32Mt
Total Cost of Sales	$3,815M	$4,088M	$4,328M
Total Capex	$398M	$413M	$424M
Total Revenue	$5,541M	$5,453M	$5,280M
Total Royalties	$334M	$329M	$319M
Total Corporate Tax Payable	$399M	$286M	$158
NPV_7	$360M	$189M	-$6M

6.4.2 Excluding LW107B and LW108B

The economic impact from removing LW107B and LW108B from the mine plan is approximately $129M NPV_7 (refer Table 6.2). The reason it is significant is these two panels contain 8.3Mt of ROM t (at 2.6m), or 21% of the total LW reserve. Additionally these are the two longest panels.

Table 6.2
Net Present Value – Without LW107B & LW108B

Scenario	NPV – Base Sale Price
Including LW107B & LW108B	$360M
Without LW107B & LW108B	$232M
Difference	$129M

6.4.3 Alternate Layout

An alternate layout designed to avoid the main part of Bargo Township is shown in Figure 6.1 and features an angled main headings, reduced length panels in the B series domain and extended length panels in the A series domain. It would also permit an additional short panel (LW109B) which would lie to the east of Bargo and add additional reserves to compensate for the shortening of panels in the B series domain. The contained ROM reserves in this alternate layout are shown in Table 6.3.

Table 6.3
Alternate Layout ROM Reserves

Parameter	278m Base Layout	278m Alternate Layout	278m Alternate Including LW109B
No of LW Panels	14	14	15
Longwall ROM (Mt)	38.8	32.9	34.4
Total ROM (Mt)	42.7	36.7	38.4

As shown, the revised layout reduces ROM reserves by 6Mt. The addition of a short panel adjacent to LW108B (LW109B) would add back 1.7Mt.

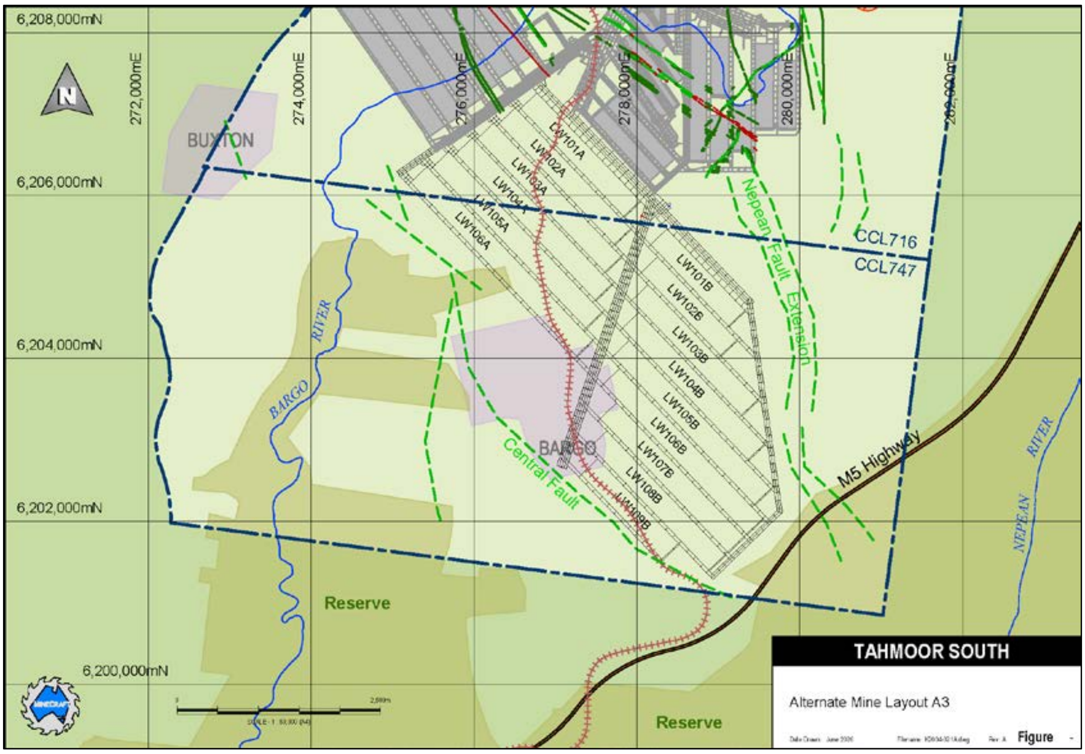

Figure 6.1
Alternate Mine Plan

Economic evaluation of the alternate layout (Table 6.4) indicates the alternate layout provides a similar economic return as the base layout without LW107B and LW108B. If an additional panel is added (LW109B), then a slightly improved return is indicated.

Table 6.4
Net Present Value – Alternate Layout

Scenario	NPV – Base Sale Price
Base layout Including LW107B & LW108B	$360.4M
Base Layout Without LW107B & LW108B	$231.6M
Alternate Layout up to LW108B	$231.0M
Alternate Layout Including LW109B	$255.9M

Therefore in summary. The alternate layout does not provide a better economic solution unless LW109B is added.

6.4.4 Bord and Pillar Mining Method

Only a high level analysis of the economics of bord and pillar mining at Tahmoor has been conducted in this study. A ROM production of 0.9Mtpa and corresponding sales of 685kt would provide revenue of approximately $113M at the base sale price. The corresponding operating costs are estimated around $200M hence providing a negative cash flow in the order of $87M per year not including capex. Hence this scenario would be uneconomic.

6.4.5 Partial Extraction Mining Method

A hybrid concept whereby the mining method reverts to partial extraction after extraction of LW106B has been drafted in concept, scheduled and modelled. In this concept, the strategy is for each development unit to change to partial extraction methods once their support activities for the LW becomes complete. This is around 2029 for completion of the main headings and then around 2031 for the gateroads. So at these points in time, the development units would commence developing the main headings towards the pillar panels, develop the pillar panels and then extract them. The LW would finish mid 2032 so over a two year period, the four continuous miners would revert to partial extraction. Total ROM production would temporarily increase from 3.5Mtpa under LW methods to 4.2Mtpa when both LW and partial extraction is occurring, then decrease to around 1.2Mtpa. The metrics over the transition period from 2028 to 2036 are shown in Table 6.5. This shows the mine cash flow reverting from positive to negative and hence the economic non-viability of this concept.

The net present value of this option calculates to $69M at the base sale price. Since the NPV of the LW operation prior to starting partial extraction is $232M, partial extraction is shown to significantly erode value. Sensitivity analysis indicates that a sale price around AUD225/t would be required for partial extraction in Tahmoor conditions to be cash positive (based on the assumptions made in this report).

Table 6.5
Hybrid LW & Partial Extraction Economics

Parameter	2028	2030	2032	2034	2036
ROM (Mt)	3.5	4.2	3.4	1.1	1.3
Product (Mt)	2.8	3.3	2.7	0.9	1.0
Opex ($M)	$322	$356	315	198	203
Capex ($M)	$15	$10	7	7	7
Revenue ($M)	$457	$545	447	148	165
Royalties ($M)	$28	$33	27	9	10
Cash Flow Before Tax ($M)	$120	$180	$124	-$57	-$45

Note: All units in Millions

6.4.6 Alternate Longwall Widths

The economic analysis of alternate LW panel widths of 220m and 170m (225m and 175m total void) indicates that reducing panel width would erode significant value at approximately $170 to $190M for every 50m reduction. Panels at 170m show a negative NPV at the base sale price.

Concepts whereby narrower panel widths are used in selected areas around LW107B and LW108B are shown in Figures 3.4 and 3.5. Economic analysis of these hybrid layouts indicates a much reduced economic impact in the order of $15M to $48M as shown in Table 6.6.

Table 6.6
Net Present Value – Alternate LW Widths, Base Price

Panel Width	NPV_7
278m	$360M
220m	$189M
170m	-$6M
Hybrid 278m / 220m	$345M
Hybrid 278m / 170m	$312M
278m – No LW107B / 108B	$231M

6.4.7 Alternate Extraction Heights

The LW extraction height is discussed in detail in Section 3.1 and 6.10. In summary, the LW extraction height is dictated by the physical parameters of the existing LW shields which have a maximum height of 2.6m.

6.5 Extent of Roadway Development and Associated Mining Costs

The extent of roadway development required for the proposed mine plan is considered high, particularly due to the requirement for main headings and back bleeder roads. Back bleeder roads are not commonly used in many underground coal mines due to their expense and alternate methods are commonly applied to manage the specific gas emissions. Most commonly surface goaf drainage wells are used where surface access is available and consist of large diameter, steel lined boreholes, drilled to just above the coal seam in front of the retreating LW face. As the roof collapses forming the goaf, suction is applied to the boreholes thus draining the gas from the goaf.

In the Southern Coalfields goaf drainage boreholes are drilled from within the mine into the roof or floor prior to goaf formation with suction applied to assist drain the gas from the goaf however this method is not as effective as surface wells. Therefore back bleeder roads are used in addition.

As shown in Table 3.1 the development ratio for the proposed mine plan is 4.2 (km per 1,000t of LW extraction) which compares to 3.6 for the proposed Dendrobium Expansion mine plan and increases up to 6.0 for narrow panels at 170m width.

The development cost at Tahmoor is relatively high due to the low development rates and is estimated at around $3,500/m excluding overheads. For comparative purposes Dendrobium development cost was estimated at $3,200/m, other mines can have costs as low as $2,500/m.

6.6 Any Additional Requirements for Management of Underground Gas

Section 3.2.4 of the Amendment Report describes the Tahmoor South resource as 'gassy' with the requirement to undertake both pre and post gas drainage as well as use the ventilation system in order to manage the gas levels in the mine. The seam gas at Tahmoor is a mix of predominantly carbon dioxide and methane (ratio of 90% to 40% CO_2). Seam gas contents range from $10m^3/t$ to $14m^3/t$ which while typical of the region, are high, and in need of specific mitigation and control measures. The Amendment Report indicates the gas in Tahmoor South will be managed by continued use of the existing methods and surface infrastructure which is considered valid. Pre-drainage drilling would typically be flanking holes drilled from the gateroad hence the main risk at Tahmoor would be the tight development float for the first panels within each domain i.e. panels LW101A and LW101B. The inbye ends of these panels will have a small timeframe to be drilled and drained hence posing a risk of restricted production at the start of these panels.

As mentioned in Section 3.5 of this report, the back bleeder roadways for the A series panels may not be developed in time thus increasing the reliance on post drainage for managing the LW gas emissions. Exceptions will be panel LW101A which is likely to be able to connect its tailgate to the back bleeder and this may compensate for the low pre-drainage time.

In any regard, the inability to effectively drain or dilute the gas emissions will directly impact LW productivity, which is no different to the current situation. Tahmoor North operations currently incorporate the high gas emissions into their roster by allowing idle weekend shifts to allow the gas to drain and incorporate planned non production shifts to undertake tailgate support activities. These practises are expected to continue into Tahmoor South.

6.7 Development Float, Mine Sequencing and Continuity of Mining

The Amendment Report provides little information on the issues of development float, sequencing and mining continuity however this has been analysed by running an independent production schedule. The findings from this schedule are discussed in Section 3.5 and summarised as follows:

- The production schedule is highly constrained by development to the extent LW production levels are constrained to approximately 72kt per week. This rate is an upside to the current rate of 56kt per week and matches the proposed maximum capacity at Tahmoor South of 3.6Mtpa;
- The scheduled development rates are approximately 16km per year which is an upside to the current 12km per year;
- Development float at these production levels is minimal, ranging between one and four months. Three months is considered an ideal float, one month is minimal;

- The inability to achieve these upside development rates will therefore directly impact longwall production as the float times are minimal;
- There appears little opportunity to undertake any different mining sequence to the sequence scheduled which is LW101A – LW106A, then LW101B – LW108B. SIMEC indicated they would prefer to extract up to LW103A before moving into the B series panels for coal quality reasons (and the thicker coal seam). However the check schedules prepared as part of this report found this would unlikely be possible due to the amount of development time required to establish the B series panels, particularly the tailgate for LW101B and the back bleeder system;
- The check schedule indicates continuity of mining is achieved at the scheduled production rates, which is typically 16km per year of development and 3.1Mt per year of longwall production (3.4Mt ROM);
- Mining continuity is also achieved for the other panel widths of 220m and 170m albeit at lower respective production rates and greater development requirements;
- At the scheduled development rates, four development units are sufficient to maintain LW continuity in both the 283m and 220m layouts however a fifth CM unit is required for the 170m layout for a two year period from 2024.

6.8 Total Coal Recovery

Coal recovery will vary according to the mining method and layout. Longwall recovers the most coal and for Tahmoor South would recover between 81% and 77% depending upon the panel width as shown in Table 6.7. Partial extraction could recover approximately 50%, first workings would recover around 30%.

Table 6.7
Hybrid LW & Partial Extraction Economics

Mining Method	Panel Size	Recovery
Longwall Retreat	278m	81%
Longwall Retreat	220m	80%
Longwall Retreat	170m	77%
Partial Extraction	150m	50 – 55%
First Workings	150m	30 - 36%

It is noted that the recovery percent stated is based around the outside perimeter area of the mining area and not the mining lease. Hence total recovery of the coal in the lease will be much less.

6.9 Income to the State of NSW

Appendix L of the Amendment Report contains an economic impact assessment report which outlines the cost benefit analysis undertaken for the amended project. The overall net benefit to the State of NSW is shown to be \$784M on an NPV_7 basis. This is calculated at average sales prices of \$187/t and $94/t for coking coal and thermal coal respectively. The overall benefit is comprised of $512M in indirect benefits and $272M in direct benefits. Direct benefits include royalties, payroll tax and Council rates ($191M) and Company tax (NSW apportionment of $81M).

In regard to the sensitivity of direct benefits to NSW:

- Royalties are impacted by sales price and production levels, and therefore can vary significantly;
- Payroll tax is impacted by employment numbers hence will generally be constant;
- Council rates will generally be constant;
- Company tax will vary with profitability and hence can vary significantly.

6.9.1 Sales Price Assumptions

The sale price assumptions used in this report are listed in Table 6.8.

Table 6.8
Coal Pricing

Sale Price	Dec 19	Base Price	Low Price	High Price
Source	Amendment Report Dec 2019	Platts May 2020	Platts June 2020	Base + 15%
Forex AUD/USD	0.75	0.65	0.70	-
Coking Coal	$187	$169	$148	$194
Thermal Coal	$94	$100	$86	$115

Note: Prices expressed as $/t in AUD

6.9.2 Royalties

Royalty payments to the State of NSW are related to coal price and saleable production. The calculated royalty payment for each case expressed in NPV_7 terms are shown in Table 6.9. This is based on a royalty rate of 6.2% less a discount for coal washing at $3.50/t.

Table 6.9
Royalty Sensitivity

Panel Width	Low Price	Base Price	High Price
278m	$169M	$195M	$226M
220m	$163M	$188M	$217M
170m	$156M	$180M	$107M
Hybrid 278m / 220m	$172M	$198M	$229M
Hybrid 278m / 170m	$168M	$194M	$223M
278m – No LW107B / 108B	$144M	$167M	$192M

6.9.3 Corporate Tax

The taxation assumptions used in the cash flow calculations assumes company tax is payable on positive cash flow at a rate of 30%. Also that negative cash flows are accumulated as losses and carried forward until a net positive cash flow is achieved before taxation is applied.

The calculated total tax payable on this basis for each LW option is shown in Table 6.10.

Table 6.10
Corporate Tax Comparison

Panel Width	Low Price	Base Price	High Price
278m	$196M	$399M	$632M
220m	$87M	$286M	$516M
170m	$0M	$158M	$381M
Hybrid 278m / 220m	$179M	$386M	$624M
Hybrid 278m / 170m	$148M	$348M	$578M
278m – No LW107B / 108B	$92M	$252M	$436M

6.10 Reduction in Longwall Extraction Height

The seam height at Tahmoor North ranges from 1.8m to 2.6m but is typically 2.0m to 2.2m. This suits the current LW shields which were specified for these conditions. The height range for LW shields are specified under four dimensions as shown in Table 6.11.

Table 6.11
LW Shield Dimensions

Term	Measurement	Comment
Minimum Closed	1.4m	This is the transport height
Minimum Operating	2.1m	This is the lowest the shield can operate without fouling
Maximum Operating	2.45m	This is the hydraulic limit less free board
Maximum Hydraulic	2.6m	This is the physical open limit

As shown there is a difference between the maximum hydraulic and maximum operating height is the amount of 'free board'. Free board is important as this covers situations where a small cavity may form in the roof or the operators may dig deeper into the floor by error. The shields can then extend into these cavities and provide effective support. Generally Tahmoor operate at 2.4m which leaves 200mm of 'free board' movement above the shields.

Therefore the current shields at 2.6m maximum hydraulic height are well suited to Tahmoor North.

The seam height at Tahmoor South ranges from 1.4m to 3.4m and is typically 1.8m to 2.0m over LW panels LW101A-LW106A, 2.2m to 2.6m over LW101B – LW104B, and 2.6m to 3.2m over LW105B - LW108B (refer Figure 6.2).

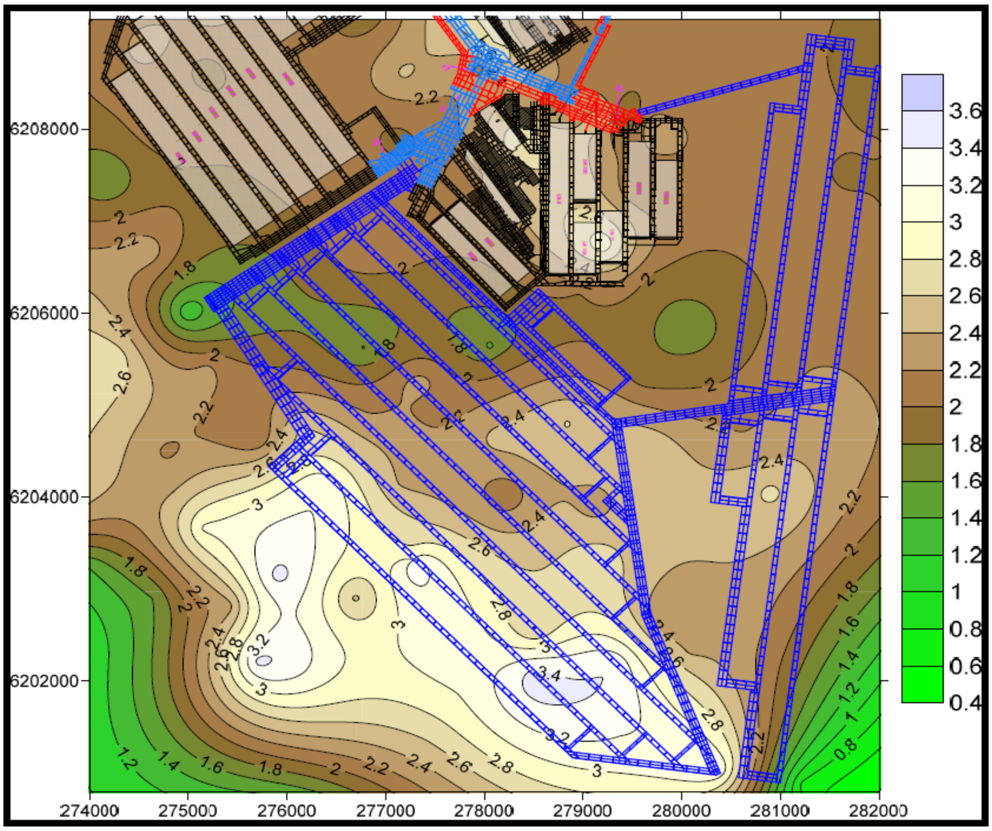

Figure 6.2
Bulli Seam Thickness Contours Provided by SIMEC

Therefore the current shields are well suited for the Tahmoor South ‘A’ series panels and half the ‘B’ series panels. However they are considered small for the remaining ‘B’ series panels and will require some careful operation to maintain a cutting height of 2.6m or less. It is likely that the operators will target say 2.50m to 2.55m cutting height to allow some free board and ensure the shields can always extend to the roof. If the shields cannot extend to the roof, lagging (ie timber) can be placed on the shield canopies however this can be a hazardous activity and only used in urgent situations.

So in summary, little margin is considered possible in the extraction height and an extraction height between 2.4m and 2.6m would be expected across the Tahmoor South mining area.

A better solution for Tahmoor would be to procure different, higher reaching shields for the latter ‘B’ series panels which would benefit in the following ways:

- Operationally easier and safer;
- Efficient extraction of the valuable resource.

The available options would be to purchase new shields, locate suitable second hand shields, or to modify the existing shields (e.g. fit spacers to the canopies).

If either of these options could be met, management of subsidence would need to be reconsidered and perhaps balanced by panel width reduction for these thicker seam panels.

6.11 Summarise The Comparative Review Outcomes

A summary of the study outcomes is contained both in Section 7.0 and the Executive Summary.

6.12 Recommendations For Additional Information

The work scope included recommendations for any additional information required to inform the comprehensive assessment of the projects' proposed mine plan. This was covered during the study process and no additional information is required.

7.0 SUMMARY AND FURTHER WORK

This study reviewed the Tahmoor South proposed mine plan as described in the EIS Amended Report, considered alternative LW panel widths of 225m and 175m, and considered alternative mining methods including first workings bord and pillar and partial extraction.

The proposed mine plan is essentially an extension of the existing Tahmoor North operations into Tahmoor South adopting the same panel dimensions, same extraction height and same equipment. The plan proposes a productivity increase from the current 2.4Mtpa to up to 3.6Mtpa which will require a commensurate increase in development productivity from the current 12km up to 16km per year.

Independent economic evaluation conducted as part of this study indicates the proposed plan to extract 14 LW panels at 283m total void width provides the best economic benefit measured as Project NPV. Reducing panel width by 50m erodes NPV_7 value in the order of $170M to $195M per 50m of panel width. Removing the last two panels (LW107B and LW108B) erodes $130M NPV_7 value.

An alternative option is to reduce the width of the last three panels to either 225m or 175m which reduces NPV_7 value by $15M and $48M respectively.

An alternative layout designed to avoid Bargo Township also erodes value in the order of $130M, or $105M if an additional small panel is added.

Bord and pillar or partial extraction was not found to be economic at Tahmoor South even if applied at the end of LW extraction. This was due to the projected low productivity and high operating costs.

In comparison to other Australian LW mines, Tahmoor is a low productivity, deep, gassy mine with limited upside capacity. Notwithstanding this, the proposed mine plan should enable the mine to continue operating and providing benefits to the State of NSW for the remaining mine life. However any significant restrictions in operating conditions (panel width, size of resource, etc) may negatively influence the investment decision by the owners.

It is noted that during the period of this review, Tahmoor Coal issued a further amendment to their mine plan in which the most westerly two longwall panels (LW107B and LW108B) were removed from the extraction plan in order to minimise subsidence impacts upon the Bargo township. As discussed above, this has a significant economic impact.

7.1 Further Work

Further detailed analysis could be directed to determine if a more productive and lower cost partial pillar method could be identified.

A larger resource base could provide additional value to the project. Further work could be directed at identifying any means to add additional resources to the plan.

8.0 REFERENCES

Tahmoor South Environmental Impact Statement, prepared by AECOM Australia Pty Ltd; December 2018 - https://majorprojects.planningportal.nsw.gov.au

Tahmoor South Project Amendment Report, prepared by AECOM Australia Pty Ltd; February 2020 - https://majorprojects.planningportal.nsw.gov.au

Optimal Mine Design to Accommodate Surface Subsidence Restriction; Edwards, McNabb, Swan & Wardell; NERDCC Report 1564, March 1993

Hume Coal Project Environmental Impact Statement, prepared by EMM Consulting Pty Ltd; March 2017 - https://majorprojects.planningportal.nsw.gov.au

Tahmoor South Project Second Amendment Report, prepared by EEM Consulting Pty Ltd; August 2020 - https://majorprojects.planningportal.nsw.gov.au

APPENDICES

Appendix No.	Description
A	Data Tables
B	Definitions

Appendix A

Data Tables

MINECRAFT CONSULTING PTY LTD
VALUATION MODEL - OPERATING COST
K2004 - Tahmoor South Mine Plan Review

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Output Tab	278m LW Panel Width																	
Dev m		9.2	16.5	15.7	16.4	16.2	16.1	16.7	16.4	14.4	9.6	8.7	6.3	2.2	0.0	0.0	0.0	164
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.0	4
LW t		0.0	0.6	3.2	2.7	3.2	3.2	2.7	3.2	3.2	3.2	3.2	3.2	3.2	3.6	0.6	0.0	39
LW Moves		0.0	0.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	0.0	14
ROM t		0.2	1.0	3.6	3.2	3.5	3.5	3.1	3.5	3.5	3.4	3.4	3.3	3.2	3.6	0.6	0.0	42.7
Product t		0.2	0.8	2.8	2.5	2.8	2.8	2.4	2.8	2.7	2.7	2.7	2.6	2.5	2.8	0.5	0.0	33.6
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.0	2.0	1.0	0.0	0.0	0.0	2.39
Opex		163	237	320	327	322	321	328	322	319	281	238	234	201	160	42	0	3,815
Revenue		30	133	465	410	460	457	402	457	453	440	439	432	420	466	78	0	5,541
Royalties		2	8	28	25	28	28	24	28	27	27	26	26	25	28	5	0	334
Capex		50	50	98	61	28	15	15	15	15	15	15	10	7	4	0	0	398
Cash Flow Before Tax		-182	-154	48	22	110	121	59	120	119	143	186	188	212	303	36	0	1,329
Cum Cash Flow		-182	-336	-288	-266	-156	-35	24	120	119	143	186	188	212	303	36	0	
Tax Payable	30%	0	0	0	0	0	0	7	36	36	43	56	56	63	91	11	0	399
Cash Flow After Tax		-182	-154	48	22	110	121	52	84	83	100	130	131	148	212	25	0	930
NPV before Tax	7%		**544**															
NPV after Tax	7%		**360**															

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Output Tab	220m LW Panel Width																	
Dev m		9.2	17.0	16.5	17.1	16.8	16.7	16.9	16.8	17.1	13.7	10.3	9.4	7.2	2.9	0.0	0.0	188
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.2	0.1	0.0	0.0	5
LW t		0.0	0.6	2.7	2.9	2.6	3.0	2.6	2.6	3.0	3.0	3.0	3.0	3.0	3.0	2.7	0.0	38
LW Moves		0.0	0.0	1.8	1.2	2.0	1.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	17
ROM t		0.2	1.0	3.1	3.4	3.0	3.4	3.0	3.0	3.4	3.3	3.2	3.2	3.2	3.1	2.7	0.0	42.1
Product t		0.2	0.8	2.4	2.6	2.4	2.6	2.3	2.3	2.6	2.6	2.5	2.5	2.5	2.4	2.1	0.0	33.0
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	2.0	2.0	1.0	0.0	0.0	2.61
Opex		163	237	324	321	328	321	327	327	321	315	266	237	233	193	175	0	4,088
Revenue		30	131	401	435	388	435	385	383	437	427	420	419	412	398	352	0	5,453
Royalties		2	8	24	26	23	26	23	23	26	26	25	25	25	24	21	0	329
Capex		50	50	98	61	28	15	15	15	15	15	15	15	10	7	4	0	413
Cash Flow Before Tax		-182	-157	-21	53	32	99	44	41	100	97	139	167	169	198	174	0	953
Cum Cash Flow		-182	-339	-360	-307	-275	-176	-132	-91	10	97	139	167	169	198	174	0	
Tax Payable	30%	0	0	0	0	0	0	0	0	3	29	42	50	51	59	52	0	286
Cash Flow After Tax		-182	-157	-21	53	32	99	44	41	98	68	97	117	118	139	122	0	667
NPV before Tax	7%		**310**															
NPV after Tax	7%		**189**															

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Output Tab — 170m LW Panel Width

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Dev m		9.2	17.4	17.2	18.6	19.2	17.9	17.1	17.3	18.5	17.7	18.5	11.3	8.3	4.8	0.2	0.0	213
Dev t		0.2	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.1	0.0	0.0	5
LW t		0.0	0.5	2.4	2.4	2.4	2.6	2.3	2.6	2.6	2.8	2.4	2.8	2.8	2.8	2.8	1.2	36
LW Moves		0.0	0.0	2.0	2.0	2.0	1.6	2.3	1.5	1.6	1.0	2.0	1.0	1.0	1.0	1.0	1.0	21
ROM t		0.2	1.0	2.9	2.9	2.9	3.0	2.7	3.0	3.0	3.2	2.8	3.1	3.0	2.9	2.8	1.2	40.7
Product t		0.2	0.8	2.3	2.3	2.3	2.4	2.1	2.4	2.3	2.5	2.2	2.4	2.4	2.3	2.2	0.9	32.0
No Dev Units		3.0	4.0	4.0	5.0	5.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	1.0	1.0	0.0	2.79
Opex		163	238	325	328	332	326	328	323	326	321	314	295	233	194	207	77	4,328
Revenue		31	127	375	377	377	390	350	390	387	415	369	400	393	381	366	153	5,280
Royalties		2	8	23	23	23	24	21	24	23	25	22	24	24	23	22	9	319
Capex		50	50	98	61	28	15	15	15	15	15	15	15	15	10	7	0	424
Cash Flow Before Tax		-182	-161	-48	-11	17	49	7	52	46	79	40	91	144	177	152	76	528
Cum Cash Flow		-182	-344	-392	-403	-386	-337	-330	-278	-232	-153	-113	-22	122	177	152	76	
Tax Payable	30%	0	0	0	0	0	0	0	0	0	0	0	0	37	53	46	23	158
Cash Flow After Tax		-182	-161	-48	-11	17	49	7	52	46	79	40	91	108	124	107	53	370
NPV before Tax	7%		**54**															
NPV after Tax	7%		**-6**															

Output Tab — 283m LW Panels Without LW107B & LW108B

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Dev m		9.2	16.5	15.7	16.4	16.2	16.1	16.7	14.7	10.2	5.0	1.2	0.0	0.0	0.0	0.0	0.0	138
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	3
LW t		0.0	0.6	3.2	2.7	3.2	3.2	2.7	3.2	3.2	3.2	3.2	2.2	0.0	0.0	0.0	0.0	30
LW Moves		0.0	0.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	12
ROM t		0.2	1.0	3.6	3.2	3.5	3.5	3.1	3.5	3.4	3.3	3.2	2.2	0.0	0.0	0.0	0.0	33.7
Product t		0.2	0.8	2.8	2.5	2.8	2.8	2.4	2.7	2.7	2.6	2.5	1.7	0.0	0.0	0.0	0.0	26.5
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	1.89
Opex		163	237	320	327	322	321	328	319	282	218	199	135	0	0	0	0	3,169
Revenue		30	133	465	410	460	457	402	452	440	425	415	285	0	0	0	0	4,375
Royalties		2	8	28	25	28	28	24	27	27	26	25	17	0	0	0	0	264
Capex		50	50	98	61	28	15	15	15	15	10	7	4	0	0	0	0	368
Cash Flow Before Tax		-182	-154	48	22	110	121	59	118	143	197	209	147	0	0	0	0	839
Cum Cash Flow		-182	-336	-288	-266	-156	-35	24	118	143	197	209	147	0	0	0	0	
Tax Payable	30%	0	0	0	0	0	0	7	36	43	59	63	44	0	0	0	0	252
Cash Flow After Tax		-182	-154	48	22	110	121	52	83	100	138	146	103	0	0	0	0	587
NPV before Tax	7%		**359**															
NPV after Tax	7%		**231**															

MINECRAFT CONSULTING PTY LTD
VALUATION MODEL - OPERATING COST
K2004 - Tahmoor South Mine Plan Review

Output Tab — 283m / 220m Hybrid LW

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Dev m		9.2	16.5	15.7	16.4	16.2	16.1	16.7	16.4	16.0	13.5	8.9	8.8	4.8	0.3	0.0	0.0	176
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.0	0.0	0.0	4
LW t		0.0	0.6	3.2	2.7	3.2	3.2	2.7	3.2	3.2	3.2	3.2	3.2	3.2	3.2	1.7	0.0	39
LW Moves		0.0	0.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	15
ROM t		0.2	1.0	3.6	3.2	3.5	3.5	3.1	3.5	3.5	3.5	3.4	3.4	3.3	3.2	1.7	0.0	43.6
Product t		0.2	0.8	2.8	2.5	2.8	2.8	2.4	2.8	2.8	2.7	2.7	2.7	2.6	2.5	1.3	0.0	34.3
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	2.0	2.0	1.0	0.0	0.0	2.19
Opex		163	237	320	327	322	321	328	322	322	318	238	239	230	191	88	0	3,964
Revenue		30	133	465	410	460	457	402	457	458	451	439	440	427	412	217	0	5,659
Royalties		2	8	28	25	28	28	24	28	28	27	26	27	26	25	13	0	341
Capex		50	50	98	61	28	15	15	15	15	15	15	15	10	4	3	0	408
Cash Flow Before Tax		-182	-154	48	22	110	121	59	120	121	118	186	187	187	217	127	0	1,286
Cum Cash Flow		-182	-336	-288	-266	-156	-35	24	120	121	118	186	187	187	217	127	0	
Tax Payable	30%	0	0	0	0	0	0	7	36	36	36	56	56	56	65	38	0	386
Cash Flow After Tax		-182	-154	48	22	110	121	52	84	84	83	130	131	131	152	89	0	900
NPV before Tax	7%		**522**															
NPV after Tax	7%		**345**															

Output Tab — 283m / 170m Hybrid LW

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Dev m		9.2	16.5	15.7	16.4	16.2	16.1	16.7	16.4	16.2	12.4	8.7	9.0	4.9	0.1	0.0	0.0	175
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.2	0.2	0.1	0.0	0.0	0.0	4
LW t		0.0	0.6	3.2	2.7	3.2	3.2	2.7	3.2	3.2	3.2	3.2	3.2	3.2	3.2	0.2	0.0	38
LW Moves		0.0	0.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	15
ROM t		0.2	1.0	3.6	3.2	3.5	3.5	3.1	3.5	3.5	3.5	3.4	3.4	3.3	3.2	0.2	0.0	42.2
Product t		0.2	0.8	2.8	2.5	2.8	2.8	2.4	2.8	2.8	2.7	2.7	2.7	2.6	2.5	0.2	0.0	33.1
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	2.0	2.0	1.0	0.0	0.0	2.19
Opex		163	237	320	327	322	321	328	322	322	316	238	239	230	191	26	0	3,901
Revenue		30	133	465	410	460	457	402	457	458	448	438	441	428	411	31	0	5,469
Royalties		2	8	28	25	28	28	24	28	28	27	26	27	26	25	2	0	330
Capex		50	50	98	61	28	15	15	15	15	15	15	15	10	7	0	0	409
Cash Flow Before Tax		-182	-154	48	22	110	121	59	120	121	117	186	187	187	213	5	0	1,160
Cum Cash Flow		-182	-336	-288	-266	-156	-35	24	120	121	117	186	187	187	213	5	0	
Tax Payable	30%	0	0	0	0	0	0	7	36	36	35	56	56	56	64	2	0	348
Cash Flow After Tax		-182	-154	48	22	110	121	52	84	85	82	130	131	131	149	4	0	812
NPV before Tax	7%		**475**															
NPV after Tax	7%		**312**															

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Output Tab — 283m LW With Partial Extraction

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Dev m		9.2	16.5	15.7	16.4	16.2	16.1	16.7	16.4	23.6	43.4	41.3	50.0	49.0	46.6	46.5	48.2	734
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	1.0	1.0	1.2	1.2	1.1	1.2	1.3	18
LW t		0.0	0.6	3.2	2.7	3.2	3.2	2.7	3.2	3.2	3.2	3.2	2.2	0.0	0.0	0.0	0.0	30
LW Moves		0.0	0.0	1.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	12
ROM t		0.2	1.0	3.6	3.2	3.5	3.5	3.1	3.5	3.7	4.2	4.2	3.4	1.2	1.1	1.2	1.3	48.5
Product t		0.2	0.8	2.8	2.5	2.8	2.8	2.4	2.8	2.9	3.3	3.3	2.7	1.0	0.9	0.9	1.0	38.1
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.65
Opex		163	237	320	327	322	321	328	322	331	356	329	316	202	198	199	203	5,527
Revenue		30	133	465	410	460	457	402	457	480	545	542	447	161	148	154	165	6,293
Royalties		2	8	28	25	28	28	24	28	29	33	33	27	10	9	9	10	380
Capex		50	50	98	61	28	15	15	15	15	10	7	7	7	7	7	7	431
Cash Flow Before Tax		-182	-154	48	22	110	121	59	120	135	180	206	124	-48	-57	-53	-45	336
Cum Cash Flow		-182	-336	-288	-266	-156	-35	24	120	135	180	206	124	-48	-105	-158	-203	
Tax Payable	30%	0	0	0	0	0	0	7	36	40	54	62	37	0	0	0	0	237
Cash Flow After Tax		-182	-154	48	22	110	121	52	84	94	126	144	87	-48	-57	-53	-45	99
NPV before Tax	7%		**190**															
NPV after Tax	7%		**69**															

Output Tab — 283m Alternate Layout Including LW109B LW

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Dev m		9.2	16.6	16.5	16.5	16.2	16.3	16.1	15.7	16.6	12.4	8.1	3.5	0.0	0.0	0.0	0.0	164
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.2	0.1	0.0	0.0	0.0	0.0	4
LW t		0.0	0.3	3.2	3.2	3.2	3.0	2.9	2.9	3.0	3.2	3.2	2.8	3.2	0.6	0.0	0.0	34
LW Moves		0.0	0.0	1.0	1.0	1.0	1.3	1.6	1.6	1.5	1.0	1.0	2.0	1.0	1.0	0.0	0.0	15
ROM t		0.2	0.7	3.6	3.6	3.5	3.4	3.3	3.3	3.3	3.5	3.4	2.8	3.2	0.6	0.0	0.0	38.4
Product t		0.2	0.6	2.8	2.8	2.8	2.7	2.6	2.6	2.6	2.7	2.7	2.2	2.5	0.5	0.0	0.0	30.2
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	1.0	0.0	0.0	0.0	0.0	1.83
Opex		163	229	322	322	323	324	325	325	327	317	238	209	170	42	0	0	3,636
Revenue		30	95	467	466	460	439	422	423	433	451	439	368	409	78	0	0	4,980
Royalties		2	6	28	28	28	27	25	26	26	27	26	22	25	5	0	0	300
Capex		50	50	98	61	28	15	15	15	15	15	7	7	4	0	0	0	380
Cash Flow Before Tax		-182	-185	47	84	109	100	81	83	91	118	194	152	236	35	0	0	964
Cum Cash Flow		-182	-367	-320	-236	-127	-27	54	83	91	118	194	152	236	35	0	0	
Tax Payable	30%	0	0	0	0	0	0	16	25	27	35	58	46	71	11	0	0	289
Cash Flow After Tax		-182	-185	47	84	109	100	65	58	64	83	136	106	165	25	0	0	675
NPV before Tax	7%		**395**															
NPV after Tax	7%		**256**															

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		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	TOTAL
Output Tab	283m Alternate Layout Excluding LW109B LW																	
Dev m		9.2	16.6	16.5	16.5	16.2	16.3	16.1	15.7	16.6	10.4	7.2	0.0	0.0	0.0	0.0	0.0	157
Dev t		0.2	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	4
LW t		0.0	0.3	3.2	3.2	3.2	3.0	2.9	2.9	3.0	3.2	3.2	2.8	2.2	0.0	0.0	0.0	33
LW Moves		0.0	0.0	1.0	1.0	1.0	1.3	1.6	1.6	1.5	1.0	1.0	2.0	1.0	0.0	0.0	0.0	14
ROM t		0.2	0.7	3.6	3.6	3.5	3.4	3.3	3.3	3.3	3.4	3.4	2.8	2.2	0.0	0.0	0.0	36.7
Product t		0.2	0.6	2.8	2.8	2.8	2.7	2.6	2.6	2.6	2.7	2.6	2.2	1.7	0.0	0.0	0.0	28.8
No Dev Units		3.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	0.0	0.0	0.0	0.0	0.0	1.78
Opex		163	229	322	322	323	324	325	325	327	314	237	178	122	0	0	0	3,510
Revenue		30	95	467	466	460	439	422	423	433	445	436	357	289	0	0	0	4,761
Royalties		2	6	28	28	28	27	25	26	26	27	26	22	17	0	0	0	287
Capex		50	50	98	61	28	15	15	15	15	12	7	7	4	0	0	0	377
Cash Flow Before Tax		-182	-185	47	84	109	100	81	83	91	119	193	172	163	0	0	0	874
Cum Cash Flow		-182	-367	-320	-236	-127	-27	54	83	91	119	193	172	163	0	0	0	
Tax Payable	30%	0	0	0	0	0	0	16	25	27	36	58	51	49	0	0	0	262
Cash Flow After Tax		-182	-185	47	84	109	100	65	58	64	83	135	120	114	0	0	0	612
NPV before Tax	7%	**359**																
NPV after Tax	7%	**231**																

Appendix B

Definitions

Actual Operating Rate	LW output in tph measured as an average
AFC	Longwall Armoured Face Conveyor – Chain conveyor
AUD	Australian dollars
Average Capacity	The average tonnes per hour rate as measured over an extended period (shifts, weeks, months, etc) of longwall operating time.
Bi Di	Bi directional cut. Refers to LW cutting mode where the entire seam is cut during each run from gate end to gate end. Most common mode of operation in Australia
Cleat	Natural joints in coal. Coal will favourably break along the cleat.
Breaker Line Support	Self powered, moveable roof support, similar to a LW shield used in pillar extraction
CM	Continuous Miner. Electro hydraulic coal cutting machine
EIS	Environmental Impact Statement
Goaf	Waste area of the mine where the coal has been extracted and the roof has collapsed
Inbye	Coal mining term referring to towards the working face relative to your position in the mine (opposite of Outbye)
Kpi's	Key performance indicators
LW	Longwall
Longwall Nameplate Capacity	The average tonnes per hour rate discharged from the longwall armoured face conveyor whilst the shearer is producing at its design capacity. Measured during the period when the shearer is traversing 80% of the longwall face length on the main cutting run. (Between snakes)
Longwall Process Cycle Capacity	The average tonnes per hour rate discharged from the armoured face conveyor as measured over a complete shearer cutting cycle.
Outbye	Coal mining term referring to away from the working face relative to your position in the mine (opposite of Inbye)
PRF	Process Reduction Factor. Measure of efficiency and reflects the percentage that the LW is operated at its Process Cycle Capacity.
ROM Reserves	The calculated tonnage of ROM coal contained within the mine plan. This is not the same as JORC Reserves for which a strict definition and reporting method is required.
ROM	Run of Mine. Refers to the coal mined and conveyed out of the mine and will be a blend of coal, stone dilution and moisture.
Snake	Describes the method of advancing the AFC at the gate ends. The AFC is routinely pushed forward behind the shearer forming a 'snake' at the gate end (curve in the AFC) which requires a double shuffle movement of the shearer in order to straighten out. This is results in lower productivity during this activity.
Stress Relief Road	Where a roadway is driven parallel and close to another proposed road and then encouraged to fail thus relieving the ground stresses in the immediate area. The proposed road can then be developed in a stress relieved environment thus minimising the risk of roadway failure. Method used for longwall installation roads in deep, high stress mines.
tph	Capacity - Tonnes per Hour
Uni Di	Uni directional cut. Refers to LW cutting mode where only a portion of the entire seam is cut during each run from gate end to gate end, hence takes two runs to extract the full seam height. This cutting mode commonly used in difficult conditions.
USD	United States dollars
Web	Thickness of coal cut by one pass of the LW shearer. Generally between 0.8m and 1.0m
$	Australian dollars