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Optimisation of Waste-Dump Lift Heights for Pre-strip Operations

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ABSTRACT: The optimisation of waste dump design parameters is a vital aspect that has the potential to significantly influence operational costs within mining operations. This research study investigates the effects waste dump lift height has on a truck-shovel coal mining operation. The analysis focusses upon simulating various dump lift heights in a truck-shovel operation in order to determine the optimal overall dump lift height. The dump lift height is the height to which each dump level or lift is constructed. The optimal height will therefore be determined by plotting the simulated cost results for each height and undergoing a comparative study. Additional factors incorporated within the simulation results include the cost of haulage, and ancillary equipment works (dozers, graders and water cartsto maintain the dump and construct haul roads to each new dump lift. Generating results from the research analysis to closely resemble real world applications, current mine data is incorporated within each simulation, including dig, dump and equipment data obtained from King 2 North pit of the Meandu mine located in Queensland.

INTRODUCTION

Surface coal mining is a well-known mining method heavily utilised in Australia, most commonly implemented in Queensland and New South Wales as an abundance of coal deposits are located near to the surface. Queensland accommodates approximately 38% of Australian coal exploitation and New South Wales approximately 42% (Mitra and Saydam, 2012); these surface mining coal deposits contribute approximately 65% of Australia's total coal production (Scott, *et al.*, 2010). The implementation of truck-shovel operations within an Australian surface coal mining context is an extremely popular material extraction method. The truck-shovel mining operation generally constitutes approximately 50% to 60% of the total surface mining cost (Nel, *et al.*, 2011). The typical truck-shovel operation encompasses a loading unit which extracts/handles material, and a haulage unit for material transport. The truck-shovel mining method is popular due to increased flexibility and is capable of consistent high productivity in surface mining operations. The continual improvements and technological development of truck-shovel operations has resulted in increased utilisation of this extraction method within the Australian mining industry. The main benefit of running a truck-shovel operation is the improved flexibility of the mining system, resulting in better suitability and selective mining of complex ore deposits, varying ore depths, varying overburden thicknesses and is not restricted to ore deposit size. An additional benefit is that the initial capital investment required to employ a truck-shovel operation can be lower compared to other methods depending on operational scale, however truck-shovel includes higher operating costs per bank cubic m (Mitra and Saydam, 2012).

The transport and dumping of waste material is a substantial cost component of truck-shovel operations. Therefore a significant amount of research has been conducted regarding the optimisation of waste dump design standards and implementation aspects. However, the time constraints associated with the rapid expansion of surface mining operations does not allow for target waste dump design optimisation at specific locations. Hence a risk factor or compromise is generally associated with the development and costs of waste dump implementation. The ideal mining operation consists of optimal fleet productivity, utilisation and availability, along with the lowest attainable mining cost. The target mine for this research case study is the open cut coal mine, Meandu mine, located in Queensland. The mentioned factors are all influenced by incorrect design and staging of waste-dumps. Therefore indicating that analysing and optimisation of Meandu mine's dumps could improve potential for substantial operational cost savings within the King 2 North truck-shovel operation.

WASTE DUMP DESIGN

Waste rock dumps, otherwise known as spoil piles are an integral part of surface mining. The waste rock dump is an area where surface mining operations dispose of low grade or barren material that has been

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extracted from the pit in order to reach high grade ore (Kennedy, 1990). The construction of waste dumps in surface mining is unavoidable, whether they are built via haul truck or piled from dragline passes.

The overall aim of correct waste dump design is to plan a series of waste disposal stages that will effectively minimise the vertical and horizontal distances between the pit and potential waste dump site (Kennedy, 1990). The waste transport and dumping aspect of surface mining operations is one of the largest cost components of the mining cost constituting approximately 25-50% of mining operational costs (Adam and Bertinshaw, 1992). Therefore the designing and staging of waste dumps can significantly affect the total operational expenses.   The two major parameters that dictate the overall design and staging of waste dumps are pit mining sequence and the production schedule, as these parameters influence the waste dump starting location, advancing rate and the ultimate dump volume (Kennedy, 1990).

There are various methods of waste disposal in surface mining operations, depending upon economics and safety. In-pit dumping is a common practice, as it is a practical method of waste disposal, especially when haul roads require establishment to new dump sites or new pit areas (Kennedy, 1990).   However, waste dumps are often located outside the pit limits. As this minimises material rehandle, the waste material located at higher elevations must be hauled the longest distance in the dump design, whilst the lower elevated material must be hauled the shortest to improve the economics of truck-shovel productivity (Kennedy, 1990). Several external dump designs can be incorporated into surface mining including; valley fills, cross-valley fills, hillside wedges, fan and terrace dumps, ridge dumps and heaped dumps (Kennedy, 1990).

CASE STUDY- MEANDU MINE

The Meandu coal mining operation commenced in 1978; 34 years later in January 2012 an approximate annual production of 7.6 million tonnes was extracted from the coal strip mining operation (Stanwell, 2013). The primary beneficiary for Meandu Mine is the Tarong power station which burns the majority of the thermal coal produced per annum. The later construction of Tarong North power station resulted in Meandu mine increasing the coal exploitation and productivity requirements in order to feed the new coal requirements of the combined Tarong power stations. The mine currently has five operational pits and geological surveys have identified six gently dipping coal seams of varying thicknesses on the project lease (Stanwell, 2013). Meandu Mine is owned by the Stanwell Corporation, an energy company that owns the Tarong power stations.

The King 2 pit operating at Meandu Mine is the primary focus of the research project, where equipment consists of a hydraulic excavator, and fleets of electric drive haul trucks. The primary equipment incorporated within the research case study includes a Hitachi EX8000 hydraulic excavator production unit, combined with a haul fleet of Komatsu 830E electric drive haul trucks. The additional ancillary equipment considered in the investigation includes the caterpillar D11T dozer, Caterpillar 777 water cart and 24M motor grader.

DETAILED HAULAGE ANALYSIS

The analysis of the waste dump lift height influence on total operational costs at the Meandu mine truck-shovel operation contains several design factors that could influence the end results. Therefore to ensure sufficient realistic designs were modelled and simulated to closely resemble the operation, a detailed haulage analysis was conducted in the software packages *Minescape Dragline Module, Deswik CAD* and *Deswik Landform and Haulage Scheduler*.

The implementation of these software packages enabled realistic modelling of the truck-shovel operation by incorporating collected site data including surveyed topography files, pit and dump shells, current void profiles, planned haul routes, equipment specifications and accurate volume estimation. Therefore the detailed dumping reports generated via *Deswik Landform and Haulage Scheduler* conformed to the expected King 2 North truck-shovel operation. The detailed dumping report was generated for various lift height options to analyse the affect different lift construction heights have on operational costs. Therefore a range of scenarios are required to simulate the dump being constructed at different lift height increments.

Scenarios

The modelling of the truck-shovel operation requires creation of various scenarios to differentiate between the different dump lift height options. However several key parameters are consistent between each scenario including utilisation of a single dig unit (Hitachi EX8000 excavator), unlimited trucking units (Komatsu 830E-AC), a single in-dump dozer unit (Caterpillar D11T), and a single haulage and dump route.

The purpose behind incorporating unlimited trucking units is that the case study operates under the assumption that the dig unit is fully trucked, thus avoiding any idle time. The reason behind this is that the exact trucking number for the King 2 North operation is unknown, and the optimal truck-shovel operation consists of a fully trucked digger to maximise productivity. The primary differing factor separating each scenario within the detailed haulage analysis is the pre-determined dump lift construction height (Figure 1), lift heights range from 2 to 24 m increasing in height by 2 m increments.
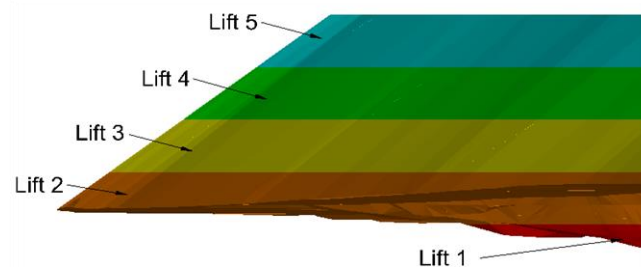

Figure 1 - Dump lift heights

Scenario dependencies

The final conclusions of this study could potentially be implemented within surface mining operations. Therefore the importance of generating realistic and accurate results mimicking real world truck-shovel operations is an important aspect of the research project. Hence each scenario contains realistic dependencies designed to limit the haulage simulation within *Deswik Landform and Haulage Scheduler*.

The primary aspects of the haulage simulation that require dependency input are the truck and dump sections. Therefore the trucking dependencies input to limit the haulage model simulation include:

- Downhill speed limit of 15 kiloms per hour for grades -5% or more;
- Loaded rolling resistance factor of 3.4%;
- Unloaded rolling resistance factor of 2%;
- Truck spot and load time of approximately 2.83 minutes; and
- Truck spot and dump time of approximately 1 minute.

Dump dependencies are generated to limit the haulage model simulation to conform to realistic dump building practices incorporated in live surface mining operations, such as dump face angle and construction method. The dependencies and rules input into the dump design include:

- Vertical overlap of approximately 37° (angle of repose);
- Material swell factor of 25%;
- A unique dump lift height option ranging from 2 to 24 m;
- Dump limiting boundary (footprint);
- Maximum dump height (dump-shell);
- Single dump ramp at constant angle (haul road string); and
- Rule dictating the dump must be constructed at the minimum RL and minimum distance prior to proceeding.

RESULTS AND DISCUSSION

Dozer push analysis

The operational costs regarding the construction of waste dumps are commonly influenced by how effectively the ancillary and trucking resources are utilised. The most important ancillary equipment aspect of the research case study is the implementation of in-dump dozer push operations. The percentage of in-dump dozer push required for an operation is dictated by the dumping technique undertaken by the haul trucks. The two dumping methods commonly used include short and edge dumping.

The Meandu mine King 2 North operation intends to incorporate edge dumping as the waste material has proven in the past to contain geotechnical competency allowing this technique to be safely utilised. The basic process of edge dumping requires the truck to simply reverse to the edge of the dump and tip the waste material over the edge. Next an in-dump dozer unit pushes the remaining material that did not self-fall over the dump edge.

The safe performance of edge dumping limits the truck to dump away from the dump edge. Considering the haul unit implemented within the haulage analysis (Komatsu 830E-AC), the truck tray tipping point is estimated to be approximately 2 ms from the dump edge. The dumped waste material volume is dictated by the haul unit. Therefore the dumped volume is limited to the heaped tray capacity of approximately 126 cubic ms. The reason for fully loaded tray capacities is that realistically truck-shovel operations will fully load the haul units to maximise haulage and production.

The dozer push percentage is estimated for each lift height option via modelling the dumped material for each lift in *Minescape Dragline Module*, to determine how much dumped material volume is remaining above the dump level after freely flowing over the dump edge at an angle of 37 degrees, angle of repose. The material remaining above the dump lift is the waste material requiring dozer push (Figure 2).
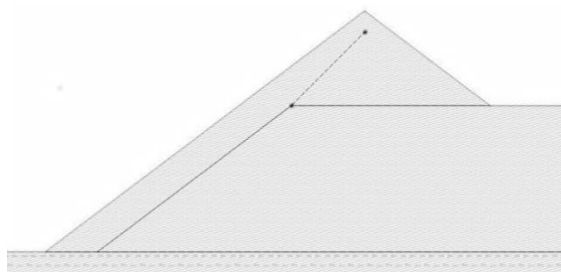

Figure 2 - Edge dumped waste material

The dozer push operations require a dozer to push the remaining dumped material over the dump edge (Figure 3). Therefore in the lower lift options the material requiring dozer push is much greater than high lift options.

The dozer push percentage results for each lift height (Figure 4) identifies that a 2 m lift requires approximately 85-90% dozer push, whereas a 20 m lift only requires approximately 30% dozer push. Therefore, a difference of 55-60% in dozer costs can be saved simply by incorporating a more optimal dump lift height into the final design. Furthermore the total dozer cost for each lift option is estimated within the cost model via multiplication of total hauled volume by dozer push percentage, the result is divided by the dozer production rate and finally multiplied by the hourly dozer operating cost.
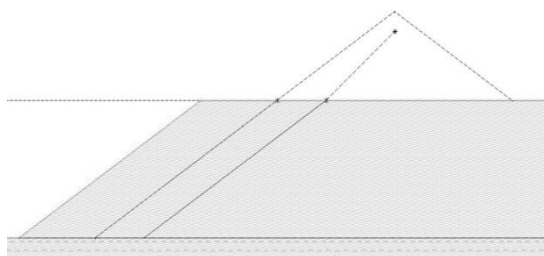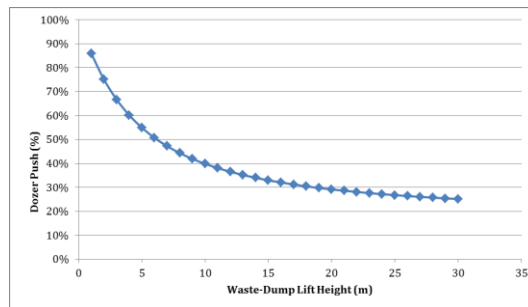

Figure 3 - Dozed dump material

Figure 4 - Dozer push percentage Vs. lift height

Haul road analysis

The haul road cost section is a combination of two vital components to truck-shovel operations, the construction and maintenance of the waste transportation roads. Therefore, an additional ancillary cost to consider is the construction and regular maintenance works required for each lift haul road. The assumptions incorporated into the haul road cost estimation include:

- Approximate haul road length of 250 ms per lift;

- Haul road width of 30 ms;

- Dozer blade width of 6.3 ms;

- Grader blade width of 7.3 ms; and

- Two cost components, construction and maintenance.

The equipment to construct and maintain the haul roads include a dozer (Caterpillar D11T), grader (Caterpillar 24M), and a water cart (Caterpillar 777). Analysing the detailed dumping report for each scenario, the number of lifts required to reach the maximum dump RL is determined for each individual lift height option.

Road construction cost

The construction of waste transport roads is a key component to a successful truck-shovel mining operation, and estimation of haul road construction costs will assist in developing realistic and usable recommendations regarding optimal lift height for the King 2 dump. Hence as each dump lift requires a primary haul road and with each scenario the number of lifts change, an approximate cost per m of haul road construction is estimated. An assumption regarding the cost of haul road construction materials such as gravel (hardstand) and engineered fill. is made to keep a simplistic and generic construction cost. Therefore the material cost is not included in the analysis.

The estimation of machine cost per m of haul road construction (Equation 4) is calculated through a combination of various equations. The number of machine passes per m (Equation 1) requires calculation to determine how many passes are required to construct a 30 m width road based upon the machine blade or spray width.

$$No. passes\ per\ metre = \frac{Road\ width}{Blade\ or\ spray\ width} \qquad (1)$$

The following stage is to calculate the total machine operation time per m (Equation 2), where the previously calculated number of passes per m is multiplied by the estimated time taken to complete each individual pass.

$$Total\ time\ per\ metre = No. passes\ per\ m * time\ per\ pass \qquad (2)$$

The amount of time required for each machine to conduct a m of haul road construction is only a fraction of an hour. Therefore the hourly percentage taken to construct one m of haul road requires calculation (Equation 3). The calculation of the machine hourly percentage is simply the total time per m divided by 3,600 seconds.

$$Hour\ Percentage\ (\%) = \frac{Total\ time\ per\ metre\ (s)}{3600} \tag{3}$$

Calculating the estimated machine cost per m (Equation 4) is simply the multiplication of the machines hourly operating percentage by the individual machine rate of cost. Furthermore the estimated total haul road construction cost per m is the summarisation of each individual machines cost per m. The calculated total machine cost per m for the Caterpillar D11T dozer, 24M grader and Caterpillar 777 water cart is approximately $16 per m.

$$Machine\ cost\ per\ metre = Rate\ \left(\frac{\$}{h}\right) * Hour\ \% \tag{4}$$

Road maintenance cost

The regular maintenance of surface mine haul roads is a vital aspect in keeping productivity and costs at optimal levels. Without clean and well graded haul roads the trucking efficiencies and therefore productivity would considerably suffer. The cleanliness of haul roads also dictates the life of truck tyres, rolling resistance and safe speeds of the haulage units. Another factor to consider is how often road maintenance should be performed, as too often would suggest problems with the road construction material and increase the ancillary costs, and too few will result in road debris from overflowing trucks and increased rolling resistances due to road deterioration.

The estimation of machine cost per hour of road maintenance is calculated via Equation 7, however several additional parameters require calculation. The equipment considered for road maintenance includes the Caterpillar 24M motor grader and the 777 water cart. The initial parameter to estimate is the machine factor, which is an estimation of how much the machine is anticipated to work in an hour. The 24M grader is assumed to work 0.65 of an hour and the 777 water cart 0.5 of an hour. The total machinery operating hours can be determined using Equation 5, where the estimated machinery factor is multiplied via the total dig hours. The total dig hours limit the scheduled maintenance as the dig hours are simply the length of time taken to completely pre-strip King 2 North pit with the Hitachi EX8000 excavator.

$$Machine\ hours = Machine\ factor * Total\ dig\ hours \tag{5}$$

The machinery cost is the next parameter calculated through inputting the determined total machine hours for each piece of equipment into Equation 6, which is multiplied by the machines rate of cost.

$$Total\ machine\ cost\ = Machine\ hours * Rate\ \left(\frac{\$}{h}\right) \tag{6}$$

The total cost per hour of haul road maintenance (Equation 7) is estimated through the division of the calculated total machine cost by the estimated total dig hours for the King 2 North pre-strip. The calculated total cost per hour for the Caterpillar 24M grader and 777 water cart is approximately $291 per hour of haul road maintenance.

$$Total\ cost\ per\ hour = \frac{Total\ machine\ cost\ (\$)}{Total\ dig\ hours\ (h)} \tag{7}$$

Trucking fuel consumption

The transport and dumping of waste material is one of the largest cost components in a surface mining operation, in particular waste transport costs are significantly influenced by the efficient utilisation of trucking resources. Therefore when trucks are not efficiently utilised, the operational costs increase through aspects such as fuel consumption. Hence, the realistic modelling of a truck-shovel operation requires consideration of particular variables that could influence the final optimal lift height. The trucking aspect of fuel consumption is analysed via *Deswik CAD* detailed haulage reports generated from each scenario simulation to identify how the fuel consumption and cost changes with lift height. The detailed dumping reports contain a fuel algorithm per cycle. This combined with the number of cycles enables the litres of fuel consumed per trucking cycle to be estimated. The sum of the litres per cycle for the entire dump construction is multiplied using an assumed fuel cost of $0.90 per litre to determine a total fuel consumption cost for each lift height option.

The plotted results (Figure 5) confirm that as greater lift heights are implemented within the dump design, additional fuel is consumed by the trucks through working harder when loaded and losing run-up

momentum whilst trying to reach the higher lift heights. The estimated difference solely in fuel consumption between the 2 and 24 m lift height is approximately $180,000 (Figure 5). Therefore the optimisation of lift heights can provide a cost saving simply by reducing the amount of fuel consumed through waste transportation.
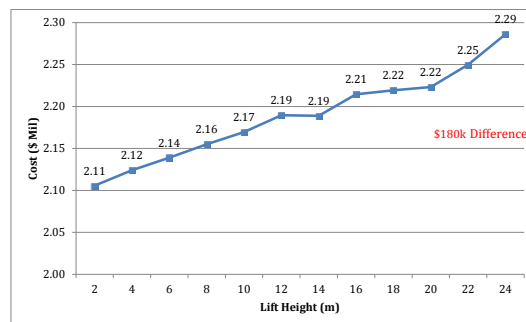

Figure 5 - Truck fuel consumption Vs. lift height

Cost modelling

The process of cost estimation modelling is a common aspect associated within the mining industry, allowing easy estimation of project costs through mathematical algorithms and equations. The importance of cost modelling to the mining industry is to provide a realistic detailed result for budgets and financial planning in order to obtain approval for new designs or operational plans. Therefore the cost modelling stage of the research project will estimate the optimal waste dump lift height for the Meandu mine King 2 North operation. The estimate will be calculated through the collation of detailed dumping reports for each lift height option generated from *Deswik Landform and Haulage Scheduler.*
The cost modelling process involves inputting mining cost rates. For the purpose of the research project, generic mining cost rates are adopted as site specific rates are unavailable. Furthermore the main benefit from utilising generic rates is the cost model, which is more applicable to the surface mining industry as opposed to being site specific. Concerns may arise through utilising generic costs to determine an optimal lift height for a specific mine site. However it is estimated that the difference in generic and Meandu mine rates is not great enough to significantly influence the total operational cost results or optimal waste dump lift height. Therefore the mining rates input into the cost model include:

- Digger cost per hour = $1,370/h;

- Trucking cost per hour = $270/h (ex. fuel);

- Trucking fuel cost per litre = $0.9/L;

- Dozer cost per hour = $340/h;

- Road construction cost   = $16.07/m;

- Road maintenance cost = $291.25/h; and

- Prime (*in situ*) overburden blasting = $1.15/bcm.

The cost model detailed dumping report input allows the estimation of equipment operating hours and costs, truck fuel consumption cost, haul road construction cost, haul road maintenance cost and the cost of prime (*in situ*) material requiring blasting for each waste dump lift height option. Therefore the total operational expenditure is simply the sum of these individual mining cost components.

Operational cost results

The individual cost results determined from the cost modelling for each of the key components of the Meandu mine King 2 North truck-shovel operation identifies how each cost component trends with the various lift height increments (Figure 6). The trends provide valuable insight into which cost components are most susceptible to change resulting from lift height implementation and how it affects the total operational cost.
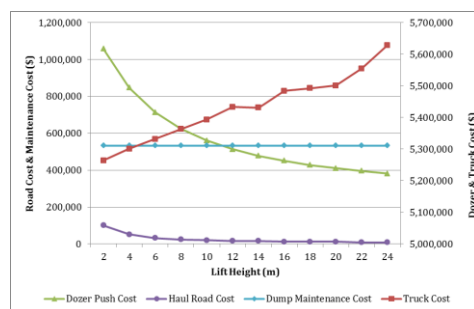
Figure 6 - Operational cost results

The major cost component in a truck-shovel surface mining operation is the cost of transporting and dumping the waste material. Hence the trucking costs in Figure 6 displays how as the lift height increases the cost of trucking will also increase. The reason behind why the trucking costs drastically increase as larger lift options are implemented is due to the extra trucking required, fuel consumption and longer cycle times. The trucking cost component is one of the more significant results that will affect the final optimal lift height selection.

The ancillary work is another major cost component influencing the optimal lift height for dump construction, specifically dozer push operations. Figure 6 displays how the dozer push costs are significantly higher in the lower lift heights, as more material requires dozing. Analysing the dozer push cost trend, the observation that the dozer cost closely resembles the previously estimated dozer push percentage plot, which indicates the resulting costing is estimated correctly. Through observing the plot it can be estimated that the optimal lift height is above the 10 m lift option as the dozer push costs plateau.

The construction and maintenance of haul roads is not a major cost component that will significantly influence the final optimal lift height. However including the trended costing for these additional ancillary operations provides more realistic results applicable to the Meandu mine King 2 North operation. As Figure 6 displays, the haul road construction cost is greater in the lower lift options due to the additional length of haul road requiring construction. However the haul road maintenance cost is uniform because it is calculated solely from hourly scheduled intervals. Therefore, as the amount of time taken to remove and transport the waste material does not significantly differ with lift height change, the haul road maintenance cost will not change.

Total cost results

The total operational cost results output (Figure 7) from the cost modelling process identifies the cheapest lift height option for the Meandu mine truck-shovel operation and the optimal lift height. As modelling result generated within various software packages and between software versions is unpredictable a margin for error should be considered. Therefore the optimal lift height range for the Meandu mine is between 14 to 20 m. If a lift height option is implemented within the Meandu mine operation a potential saving of approximately $500,000 is possible. This enables a significant operational cost saving for a single dump design aspect.

The optimal range is also applicable to most mining operations as the cost input within the cost model is the generic equipment rates. Furthermore if an operation incorporates a dump lift height of 8 m or less, or greater than 20 m the total operational cost will increase due to either an increase in ancillary equipment hours or trucking hours.

Sensitivity analysis

The identification of what changes are expected when certain variables are modified is undertaken through a sensitivity analysis. Completing a sensitivity analysis is a vital aspect for determining the uncertainty of results generated from the modelling process via systematically manipulating specific scenario inputs. The scenario inputs manipulated within the cost modelling include the dozer push volume, dozer push production rates and the price of fuel regarding trucking.

An aspect influential to the total operational costs that is variable with different operations is the implementation of haulage units containing different capacities. Therefore a sensitivity analysis is

conducted targeting the dozer push volumes, basically identifying how the total operational cost will change in respect to different truck capacities.

The Figure 8 graph displays the trend of total operational cost dependent upon lift height. The results identify the lower lift height options are most susceptible to cost change when larger haul units are implemented. These results are accurate as logically an increase in truck capacity will result in less dumped waste volume, hence less dozer push hours are required, lowering the dozer push ancillary costs. The optimal lift height range reduces due to the dozed volume effect.
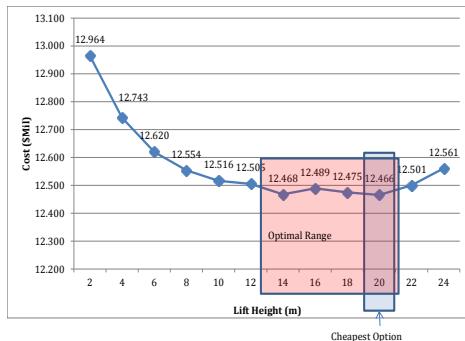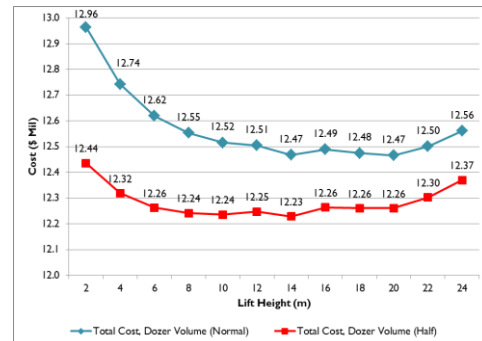

Figure 7 - Total cost results   **Figure 8 - Dozer volume sensitivity analysis**

The selection of in-dump dozers is an operational aspect that can significantly influence the total operational costs of a surface mining operation. Hence a sensitivity analysis is conducted targeting the dozer push production rates predicting the changes expected when implementing dozers with different push production rates.

The Figure 9 graph displays the change in total operational cost with respect to an increase or decrease in dozer production rates. The change in production rates influences the total cost via increasing or decreasing the amount of hours required to perform dozer push operational in each lift. As the dozer push is a significant cost aspect the change in dozer hours can dramatically affect the total operational cost. As expected the lower lift height options are most susceptible to cost change when the dozer production rates are modified. If a larger dozer unit is implemented the optimal lift range reduces, however if a smaller dozer unit is selected the optimal lift height increases as more time is required to complete dozing operations.

An important aspect affecting the total operational cost of a truck-shovel mining operation that cannot be controlled is the fluctuation in fuel price. The trucking cost of waste transport is a significant contributor to the total operational cost. Therefore as fuel price fluctuates the cost of truck fuel consumption will also fluctuate.

Figure 10 identifies that the lift height options most susceptible to a fluctuation in fuel price are the higher value options. The reason for this is as the lift height increase, the trucks are required to work harder and burn additional fuel to reach the greater elevations. Unfortunately the fuel price cannot be controlled and fluctuates with the petroleum market. Hence it is important to predict what may occur if the price changes in order to compensate by implementing a different lift height during dump construction.
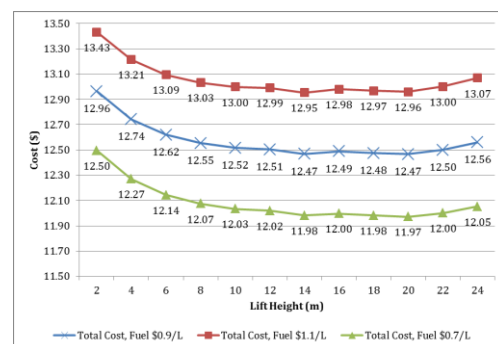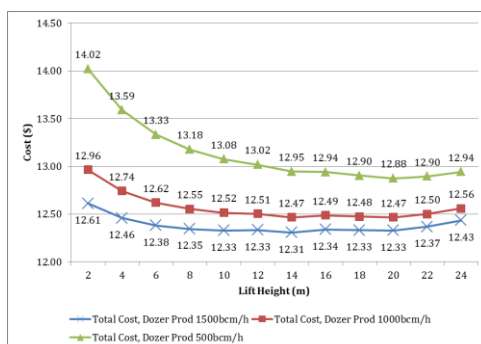

Figure 9 - Dozer production sensitivity analysis Figure 10 - Fuel price sensitivity analysis

CONCLUSIONS

The research project aimed to optimise the fleet efficiency and utilisation through a detailed haulage analysis, and to identify any potential cost savings available within the Meandu mine King 2 truck-shovel operation. The detailed haulage analysis and cost modelling identified that by optimising the waste dump lift height design, cost savings of potentially $500,000 is achievable. The two main contributing cost factors within the truck-shovel operation were identified as the trucking unit and the dozer push unit, with haul road costs being a minor contributor. Conducting a comparative study on the total operational expenses for each lift option, the cheapest lift option for the King 2 North works is identified as a 20 m lift height construction increment. However, due to the modelling methods utilised to determine this result, a margin for error within the modelling process should be considered. Hence the 'optimal' range for waste dump lift heights at King 2 North lies between 14 and 20 mlift height increments.

The main benefiting factors toward the mining industry that the research case study conveys, are dumps constructed at lift heights lower than 8 m, or greater than 20 m will see an unnecessary increase in operational costs due to inefficient utilisation of trucking and ancillary resources.

Aspects of the research project that could be researched in greater depth, thus improving the usability of results include more detailed dozer push analysis, consideration of trucking aspects such as tire consumption and maintenance costs, set number of trucks, truck queuing, bunching and digger idle times. Furthermore, as the research project primarily focused upon the Meandu Mine King 2 North pre-strip operation, future studies could be conducted targeting more generic data to produce a generic cost model applicable to general dump construction producing a ballpark cost estimate targeting any operation.

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