EIS 723

AB019429

Mount Arthur North Coal Project CA150 Mine Planning Study

3.5 M.T.P.A. Product Case. Volume 1

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ELECTRICITY COMMISSION OF NEW SOUTH WALES

MOUNT ARTHUR NORTH COAL PROJECT

MINE PLANNING STUDY

3.5 M.T.P.A. PRODUCT

PREPARED BY

RUNGE AND ASSOCIATES PTY. LTD.

AND

MINCOM MINING CONSULTANTS PTY. LTD.

BRISBANE, QUEENSLAND

AUSTRALIA

AUGUST 1984

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MOUNT ARTHUR NORTH COAL PROJECT

CA150 MINE PLANNING STUDY
3.5 M.T.P.A. Product Case

Volume I

Prepared for:

ELECTRICITY COMMISSION OF NEW SOUTH WALES

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Brisbane, Queensland,
Australia.

Report Number 151a
September, 1984.

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RA-151-ME-04	Excavation and Refill Production Schedule, 3.5 M.P.T.A. (PRODUCT), Year 20
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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

1.1 Study Background and Scope

In January 1982, the Electricity Commission of New South Wales (ECNSW) appointed a mine planning team comprising Mincom Mining Consultants Pty. Ltd. (MMC), Runge and Associates Pty. Ltd. (RAPL) and Mincom Pty. Ltd. to undertake detailed mine planning for the Mount Arthur North coal deposit.

This study included a re-assessment of the conceptual mine plan in the light of additional data from geological and geotechnical programmes undertaken in 1980 and 1981.

This report presents the major findings of both the conceptual planning part of the study and subsequent detailed planning and scheduling of these concepts, to achieve an annual production rate of 3.5 million tonnes of product coal.

The starting point for the mine planning study was the ECNSW's previous Environmental Impact Statement (Jan. 1981) [Reference 1].

1.2 Report Organisation

This report is divided into three parts.

a. PART A - INTRODUCTION and SUMMARY, in which the major findings of both the conceptual planning and the detailed planning and scheduling phases of the study are summarised.

b. PART B - CONCEPTUAL PLANNING, in which the geological, geotechnical and environmental implications for mine planning are described, and the evolution of the conceptual mine plan is discussed.

c. PART C - DETAILED PLANNING and SCHEDULING, in which the development of the detailed mine design and mining method, the generation of production schedules, and the determination of equipment and manning requirements are presented.

Volume 2 of this report contains plans and drawings to accompany the text in this volume.

1.3 Overview of Conclusions

A detailed mine plan for the production of 3.5 million tonnes per annum of product coal from the Mount Arthur North deposit has been developed. This plan incorporates the numerous environmental constraints imposed on the project by virtue of its location and size.

The most significant outcome of the study was the development of the single pit concept to enable coal in the major fault zone in the centre of the deposit to be mined. This concept maximises resource recovery, extends the ultimate life of the project and results in a significant reduction in the annual truck/shovel waste removal requirements over the previous 3 pit concept, for a given coal production level. A major environmental benefit of this approach is that mining operations are restricted to a single confined area, facilitating the implementation of environmental control measures and monitoring procedures.

The workability of the mining method at the designated production rate was demonstrated by the scheduling of production and major equipment over the initial 20 year mine life.

INTRODUCTION 4

The deposit is strategically important as a coal source for electricity generation, since large annual production rates can be sustained over a long period with only minimal increases in the real cost of coal produced.

CHAPTER 2

SUMMARY

2

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2. SUMMARY

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2. SUMMARY

2.1 Major Mining Constraints

A fundamental feature of this project is that mining operations will be constrained by a variety of environmental, geological, and geotechnical factors. The superimposition of these influences tends to exacerbate the effect on mining operations caused by any single influencing factor. For instance, the drilling and blasting of relatively thin interburden benches is dictated by the comparatively hard nature of the material. The efficiency of drilling such thin benches is low due to the large proportion of time spent moving from hole to hole and setting up. In addition, in order to protect nearby historical buildings from the vibrations caused by blasting, there is a limit on the amount of explosives that can be placed in each blasthole. Yet, the powder factor required is relatively high, given the hardness of the interburden. The net result is that the environmental constraints can only be satisfied by drilling more blastholes at a closer spacing, thereby compounding the inefficiency of the drilling operation, increasing the number of drills required and the number of drillers required to operate them.

The mine planning undertaken in this study incorporates the constraints imposed by the individual or collective influence of these various factors.

Environmental considerations were a major element in the progressive review of the mine plan development by the Commission engineers. All aspects of the mine planning study were undertaken with a multiple objective approach - to maximise mining efficiency and to minimise environmental impacts. Where these objectives conflicted, the mine plan was amended to ensure that the environmental standards outlined in the project's previous Environmental Impact Statement (Jan. 1981) [Reference 1] were maintained.

2.2 Review of Mining Concepts

The mining concept for Mount Arthur North at the commencement of this study is outlined in the previous Environmental Impact Statement. (Jan. 1981) [Reference 1]

That concept involved three distinct pits (or mines) - Ramrod Creek, Whites Creek and Glen Munro, and a production rate of 11 million tonnes of run-of-mine coal per annum. It was envisaged that two large draglines and a supporting truck/shovel fleet would be used in Ramrod Creek pit for the first half of the mine life and then transferred to the Glen Munro pit. The Whites Creek pit would be mined using truck/shovel methods exclusively over the life of the mine.

Given the relatively high waste:coal ratios in the Glen Munro area and the lower annual output now proposed, it was decided to exclude the Glen Munro area from current mine plans. An environmental advantage of this concept is that all mining operations are confined to a smaller area.

A geotechnical study of the fault zone by Golder Associates, (March 1981) [Reference 2] concluded that there was minimal ground disturbance associated with the major faults, despite vertical throws of up to 100 metres, and that the coal seams within the fault zone were essentially intact. There was therefore a prima facie case for discounting the previously held assumption that the faults represented a barrier to mining. As a consequence, it was proposed that the mine could be developed as a single pit extending from near the Denman Road in the north to the lower slopes of Mount Arthur in the south.

It was also established that the waste:coal ratios in the western portion of the Ramrod Creek zone remained constant at about 5 cubic metres/tonne, and the future extension of mining in this area was therefore preferable to opening up the Glen Munro area.

2.3 Current Mining Concepts

Whilst the northern end of the Ramrod Creek pit was defined by its proximity to the realigned Denman Road and the southern end of the Whites Creek pit by the rising topography of the slopes of Mount Arthur, both the northern end of Whites Creek pit and the southern end of Ramrod Creek pit had no precise boundary, but were controlled by the major fault zone. Both end walls intersected the major fault zone near the centre of the deposit. An assessment of the waste:coal ratios of incremental extensions to the southern end of the Ramrod Creek pit into the fault zone indicated that as the ratios were comparable with those for the major portion of the pit (viz. 4.5 cubic metres/tonne), then the southern end of the pit should be extended as far south as possible. A similar analysis of the northern end of the Whites Creek pit indicated that its northern wall should be extended as far north as possible.

A major advantage of this concept was that the coal seams in the fault zone could be extracted simultaneously with the seams in the other pits. If the two pit concept had been retained, this fault zone coal would have been sterilised under the refill in those pits. Thus, the single pit concept provides for maximum recovery of the coal resource and a consequent extension of the ultimate working life of the deposit.

Contemporaneous mine planning revealed that it was feasible to extract coal in the fault zone down to and including the basal seam (Lower Ramrod Creek), and that small temporary cross-pit bridges could be constructed at the southern end of the fault zone to facilitate the haulage of both overburden and coal. An added feature of the concept was that it was feasible for a dragline to walk across the fault zone benches between the Ramrod Creek pit and the Whites Creek pit, thereby enhancing scheduling flexibility.

The single pit concept yielded a major environmental benefit in that all operations were restricted to a single confined area, facilitating the implementation of environmental control measures and monitoring procedures.

In order to identify the various zones within the single pit, the names previously given to individual pits or mines have been retained. Thus, the area at the north of the single pit is referred to as the Ramrod Creek zone, and the area at the south as the Whites Creek zone. The faulted area between these zones is referred to as the Basil zone, and the small mining area near the trial pits as the Edinglassie zone.

The alternatives of mining only one of either the Ramrod Creek pit or the Whites Creek pit were considered, but were considered to be less favourable in that -

1. refill waste would be placed on the fault zone, either sterilising some of the coal resource in this area, or imposing a major waste rehandling cost on future operations aimed at extracting coal in this zone.

2. the pit length in either Whites Creek pit or Ramrod Creek pit is relatively small, imposing major scheduling difficulties on the dragline operation and increasing the risk of the dragline operations becoming coal-bound. By contrast, the large single pit concept or a concept involving the mining of both Ramrod Creek pit and Whites Creek pit enables the dragline to be alternatively scheduled in

Ramrod Creek pit/zone and Whites Creek pit/zone, whilst coal is extracted from the pit/zone in which the dragline is not currently working. The alternative of using truck-shovel methods exclusively was rejected on the basis of increased costs and increased environmental impacts over the dragline method.

3. the end walls of either Ramrod Creek pit or Whites Creek pit would intersect the major faults, with the risk of ground instability. The single pit concept obviates this risk by eliminating end walls in the fault zone.

2.4 Mining Layout and Design

A detailed mine layout for the single pit concept was prepared in accordance with geotechnical recommendations and parameters developed during the conceptual planning phase.

A fundamental feature of the design is that the deeper Basil zone will be advanced ahead of the Ramrod Creek zone and the Whites Creek zone. In this way, the in-pit refill in the Basil zone will prevent dragline spoil from the other zones from spilling over the fault into the base of the Basil zone, thereby ensuring the safety of personnel and equipment at the base of the Basil zone.

The pit is bounded on the north by a surface limit line 200 metres south of the deviated Denman Road, thereby preserving the Hunter River alluvial plain and providing a corridor for screening the mining operation. The southern limit of the pit is based on mining ratio considerations, with the surface limit extending to the lower slopes of Mount Arthur.

The eastern limit of the pit is the subcrop line of the basal seam, the Ramrod Creek seam. This limit is not a continuous line due to the presence of the major faults. Because the seams are downthrown in the fault zone, the subcrop of the Ramrod Creek seam is further east in the Basil zone than in the Ramrod Creek or Whites Creek zones.

The western limit of the pit is determined only by the rate of mining progress. This limit can be extended well beyond the initial 20 year period before it reaches the Edderton road.

The depth of the pit is controlled by the position of the basal seam (Ramrod Creek seam) or, where it exists, its lower split (the Lower Ramrod Creek seam). This seam dips towards the west and hence the depth of mining increases as the pit progresses towards the west.

2.5 Mining Methods

The mining method adopted is a conventional terrace mining technique with progressive backfilling of the pit. The dragline will work in the base of the pit, whilst the remaining waste benches will be removed by truck/shovel methods. An exception to this is the Basil zone, where truck/shovel methods will be used exclusively since the dragline cannot access the downthrown lower benches.

2.5.1 Clearing and Topsoil Removal

Clearing of scattered timber will be carried out by bulldozers and topsoil will be stripped by scrapers. Topsoil will be initially stockpiled for later rehabilitation but at a later stage will be transferred directly to the rehabilitation area. Prevention of erosion and dust generation will be achieved by establishing an early grass cover on the topsoil stockpiles and rehabilitation area. Depending on suitability, subsoil material will be ripped and respread on the overburden spoil or may be mixed with the overburden.

2.5.2 Drilling and Blasting

Most of the waste material and the coal in excess of 1 metre thick will require drilling and blasting prior to excavation. The interburden is typically relatively hard, requiring medium to high powder factors for satisfactory fragmentation. The previous EIS imposes strict limitations on the permissable levels of blasting vibration and noise, resulting in the need for specially designed blast patterns for each vibration level area and burden thickness. These designs are outlined in the Drill and Blast Study [Reference 7] The net effect of this combination of design influences is that the requirement for drills and drillers is higher than it might otherwise be. Vibration levels will be monitored from the commencement of operations so that blasting designs can be refined on an ongoing basis.

2.5.3 Truck/Shovel Operation

All overburden and interburden down to a nominal level of 15 metres above the Edinglassie seam will be removed by a truck/shovel operation, with the exception of the Basil zone, where the truck/shovel operation will be used down to the basal seam. The waste will be hauled from the excavation faces to the inpit refill faces via haul roads in the end walls of the pit and a central cross pit road.

The average annual volume of waste removed by this method will be 14.1 million cubic metres.

2.5.4 Dragline Operations

The dragline method has been designed to overcome the scheduling difficulties inherent in relatively short pit lengths. The working method involves a single dragline uncovering two interburdens in a single pass along the strip, using conventional underhand digging techniques more suited to the hard interburden material.

The dragline will alternate between the Ramrod Creek and Whites Creek zones.

2.5.5 Coal Extraction

After blasting, coal seams greater than 1 metre thick will be loaded by either front end loader or hydraulic shovel into 108 tonne rear dump haulers and transported to the dump station via the haulroads in the pit end walls and the central cross-pit bridge.

Coal seams less than 1 metre thick will be ripped by bulldozer prior to loading.

INSUFFICIENT DESCRIPTION.

DISPOSAL OF REJECT ?

SEE P. 61
Summary longer than original.

2.5.6 Rehabilitation

The external slopes of the waste dumps will be reshaped and contoured prior to the placement of topsoil. The reshaping and revegetation activity will be undertaken progressively throughout the life of the mine.

Since the deposit represents an economically attractive coal source well beyond the initial 20 year period, it is envisaged that the pit will progress towards the west for one or more additional 20 year periods. Under these circumstances, the pit will be left in operational condition at the end of the initial 20 year period.

In the highly unlikely event that it is decided to wind down the operation from, say, year 15, it is proposed to discontinue operations in the Whites Creek and Basil zones from that time, and place waste from the Ramrod Creek zone into the final void of those zones. The inpit refill face will be simultaneously dozed into the void.

The waste haulage method allows for selective placement of any toxic layers in the overburden at all stages of the mining operation; such material will be buried at depth.

2.6 Mining Reserves

Mining reserves within the designated mine area have been estimated to be 334 million tonnes of run-of-mine coal covered by 1,611 million cubic metres of waste. Of the total amount of reserves delineated, only 23 percent has been scheduled over the initial 20 year mine life, the balance being planned for extraction after this time.

Consequently, the mine design provides for continuation of the operation at the nominated production rate beyond year 20.

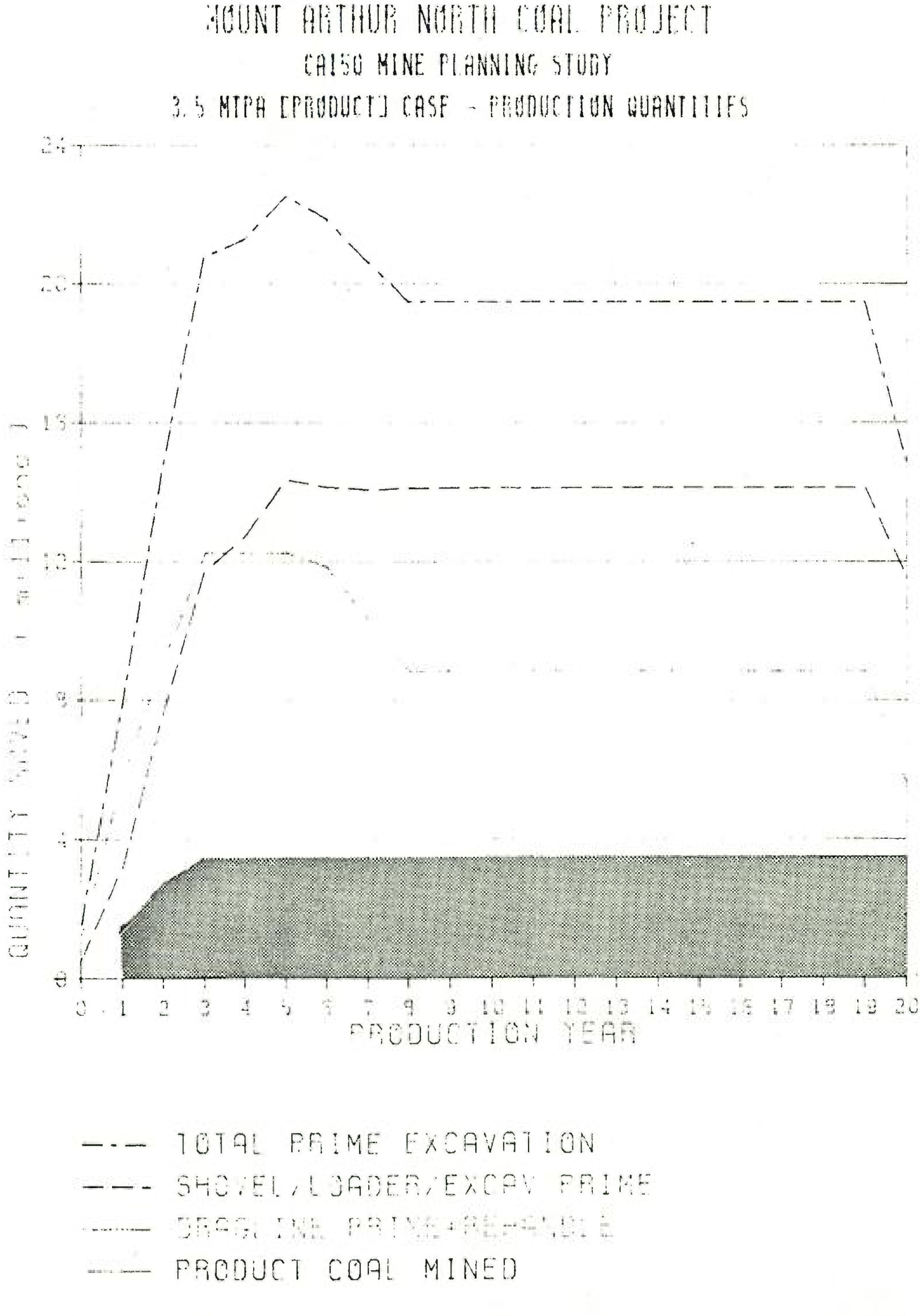
Over the first 20 years of mine life, the average ratio of the mining reserves is 5.0 cubic metres of overburden per tonne of run-of-mine coal, compared to the average ratio of 4.8 cubic metres/tonne for the total designated mine area.

As well as the delineated reserves available after year 20, substantial additional coal may be available to be mined from the Authorisation but has not been delineated in this study.

2.7 Production Schedules

The annual coal production and waste removal quantities are presented in Figure 2.1. Coal production is gradually built up to reach the full production rate of 3.5 million tonnes (product)

Figure 2.1


MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY
3.5 MTPA [PRODUCT] CASE - PRODUCTION QUANTITIES
QUANTITY MOVED [MILLIONS]
24
20
16
12
8
4
0
0 . 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
PRODUCTION YEAR
TOTAL PRIME EXCAVATION
SHOVEL/LOADER/EXCAV PRIME
DRAGLINE PRIME+REHANDLE
PRODUCT COAL MINED

per annum by year 3 accompanied by an increase in truck/shovel waste removal requirements to about 14 million bank cubic metres per annum by year 5.

Two features of the annual waste removal requirements for the dragline are highlighted. Firstly, the amount of waste removed by the dragline, which is a significant proportion in the early years, decreases gradually after Year 6. As the mine advances to the west, more coal seams are encountered to contribute to the 3.5 million tonne coal production target. The waste above these upper seams is removed by truck/shovel methods and, as a consequence, it is not possible to fully utilise the draglines beyond Year 7 at this coal production rate. Secondly, the absolute value of the bank cubic metres of waste removed annually by the draglines reflects the relatively high rehandle associated with the adopted dragline working method.

Over the life of the mine, some 54 percent of the overburden is removed by large rope shovels loading into 154 tonne rear dump haul trucks. In addition, 14 percent of the overburden is hauled in 108 tonne rear dump trucks loaded by either large hydraulic excavators or large front-end loaders.

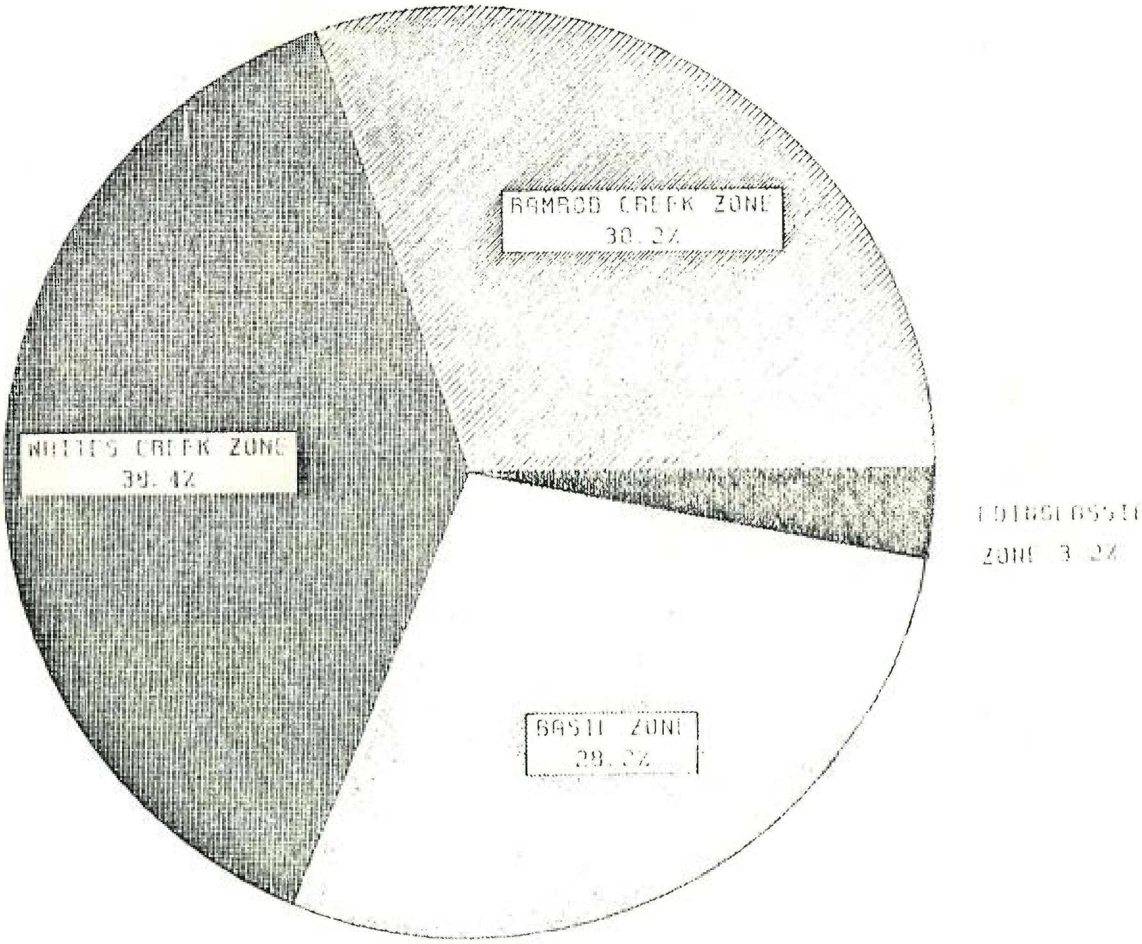
The balance of the overburden - 32 percent - is spoiled directly by the large walking dragline. Since the annual waste removal task of the truck/shovel fleet remains relatively constant over the life of the mine, the total annual waste removal quantities decrease gradually beyond year 6 reflecting the trend in the dragline task.

Figure 2.2 shows that, over the life of the mine, 38 percent of the coal mined is sourced from Whites Creek zone and 30 percent from Ramrod Creek zone. Only 3 percent of the total is mined from the small zone near the existing test pits (designated Edinglassie zone).

The proportion of coal mined from the Basil zone (29 percent) is significant in that, without the single pit concept, this amount of coal would have been sourced from the other major zones. This coal sourcing balance highlights the role played by Basil zone in extending the ultimate life of the deposit.

Figure 2.2

MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY
3.5 MTPA [PRODUCT] CASE - ROM COAL BY ZONE



2.8 Operating Basis

The general operating basis throughout the mine shall be -

215 operating days per annum
3 shifts per day
7 hours per shift.

Exceptions to this are the dragline operations prior to Year 8 and the topsoil removal and rehabilitation operations.

The dragline operation prior to Year 8 will be based on a 3 shift, 5 panel continuous roster, operating 7 days per week including 1 shift per week for scheduled maintenance. It is expected that the dragline will operate for 315 days per annum.

The topsoil removal operation will be 1 shift per day (7 hours), whilst the rehabilitation operation will be undertaken on 2 x 7 hour shifts per day.

2.9 Major Equipment Requirements

In a typical full production year (Year 8) the major equipment includes:-

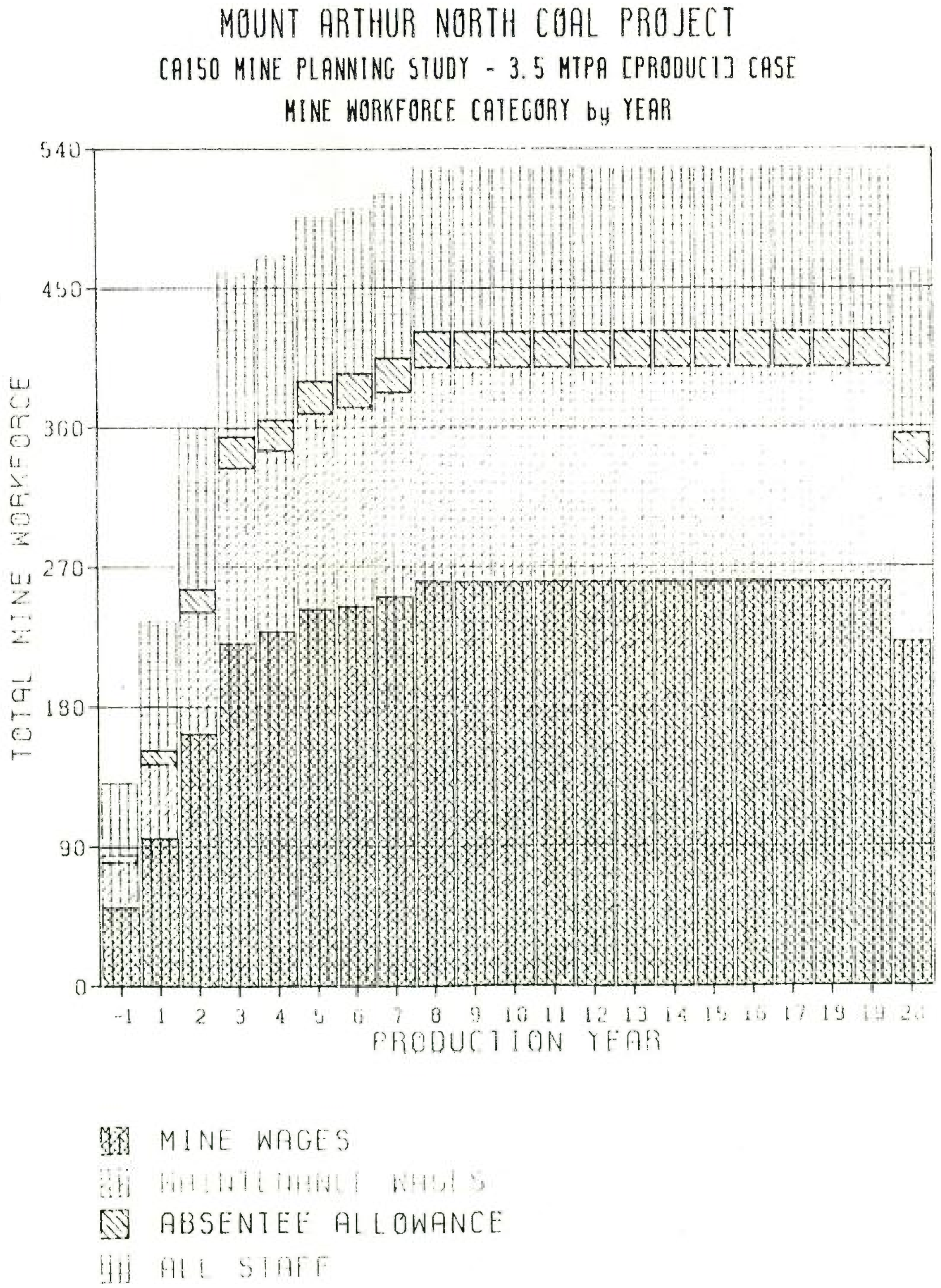
1 Dragline (B-E 1570-W)
4 Rope Shovels (P & H 2800 class)
2 Hydraulic Excavators (Demag H-241 class)
25 154 Tonne Haul Trucks
10 108 Tonne Haul Trucks
11 108 Tonne Coal Trucks
11 Overburden Drills (various sizes)
2 Coal drills (various sizes)

The usual range of mining support equipment will be required, including dozers, graders, water trucks and scrapers.

2.10 Manning Levels

Once full production is reached, the manning levels for the project (excluding the coal handling and preparation plant operating and maintenance personnel) will increase from 460 in Year 3 to 529 in Year 8, as shown in Figure 2.3. This gradual increase reflects the trend in haul truck and drill requirements and the need for personnel to operate, maintain and service these units.

Figure 2.3


MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY - 3.5 MTPA [PRODUCT] CASE
MINE WORKFORCE CATEGORY by YEAR

Major contributors to the manning levels are operating and maintenance personnel for overburden drills and waste haul trucks. Overburden drill numbers are a function of the hard overburden material and vibration limits imposed on blasting. Increased knowledge of both factors gained through operational experience could result in a reduction in the requirement for overburden drillers and associated maintenance personnel. The manning levels are higher than shown in the previous EIS due to fewer planned overburden removal shifts per week. (15 vs. 17)

2.11 Strategic Importance of the Deposit

As the life of a typical open cut mine progresses, the costs of producing coal generally tend to increase (in real terms) due to two major factors.

1. The increasing depth of the mine and the increasing height to which waste is hauled for dumping result in lower truck productivities and the consequent need for more trucks to accomplish a given overburden removal task, and

2. An increase in waste to coal ratio. This increasing ratio is fully explained by the mine planning processes - the lowest ratio coal is invariably mined first to achieve the best cash flow.

This second factor - increasing ratio - serves to exacerbate and compound the effect of the first factor, with the result that operating costs per tonne of coal tend to increase in a curvilinear trend over time.

A special characteristic of the Mount Arthur North deposit is that the effective overburden ratio remains relatively constant over the mine life, and it is neither possible nor desirable for any operator to influence this greatly in the long term.

The deposit therefore represents a coal source with minimal increases in the real cost of coal production over the mine life, as opposed to many competitive sources of supply which would exhibit cost increases of 30 percent or more during the same period.

Whilst a small number of other coal deposits in Australia are amenable to mining at a relatively low and constant ratio over the mine life (notably Vickery, Tarong and Blair Athol), Mount Arthur North has yet another advantage in that the reserves of coal available to be mined at this ratio are large. The deposit can therefore be mined at a high production rate over a period of time commensurate with the economic life of a power station.

SUMMARY

Mount Arthur North represents an ideal source of coal for electrcity generation, given the Commission's philosophy of minimising the real cost of electricity production over a long period of time.

CHAPTER 3

PROJECT LOCATION AND BACKGROUND

3. PROJECT LOCATION AND BACKGROUND

The Electricity Commission of New South Wales has initiated the development of the Mount Arthur North Coal Project on the site of Authorisation No. 168 near Muswellbrook, in the Upper Hunter Valley of New South Wales, as shown in Figure 3.1.

Authorisation No. 168 is close to other existing and planned coal mining developments, as shown in Figure 3.2.

The Commission has already undertaken a number of steps in the development of the project, including:

1. Publication and release of an Environmental Impact Statement (E.I.S.) in January, 1981.

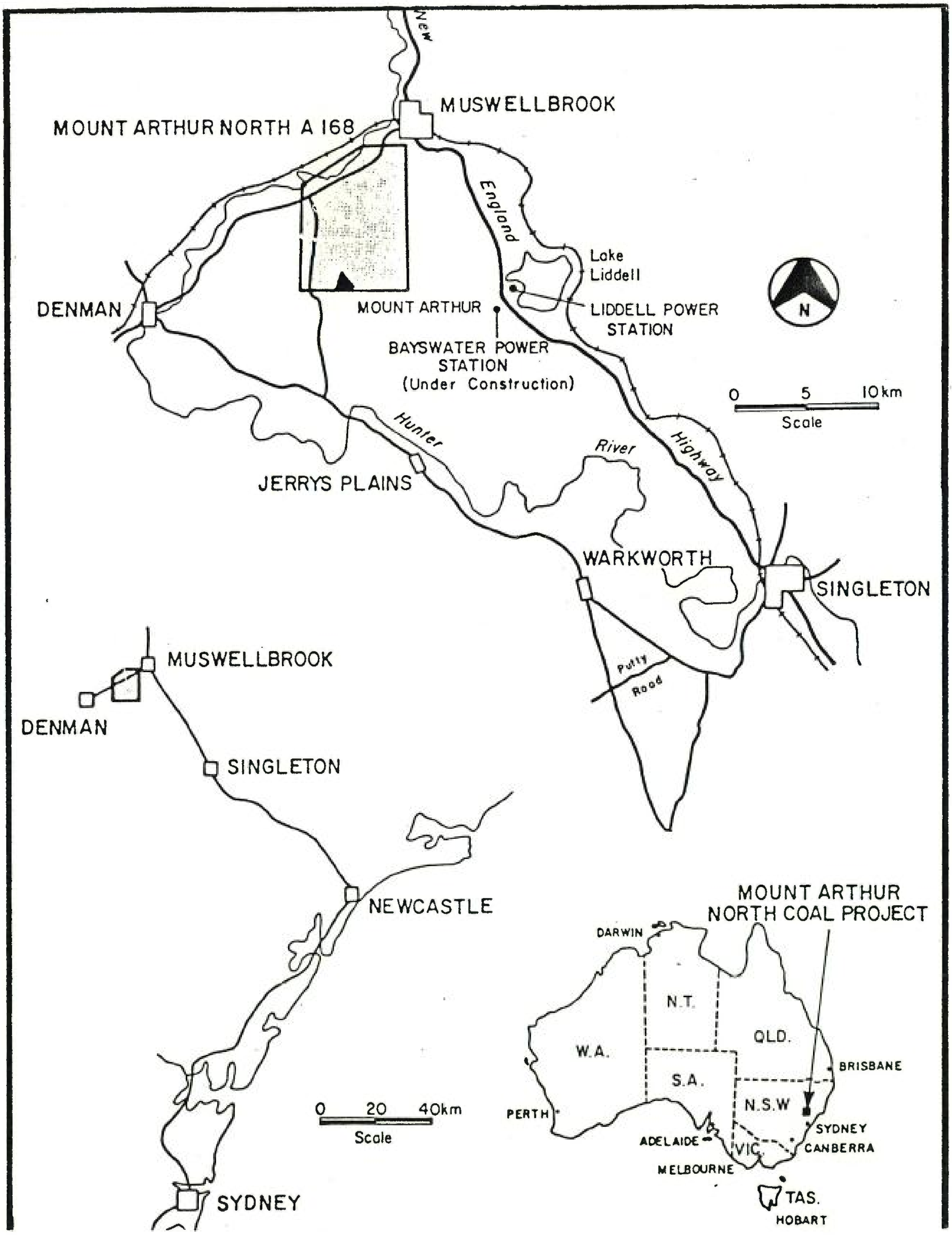
2. Detailed design of minesite facilities and infrastructure.

3. The decision to use a Bucyrus-Erie 1570-W electric walking dragline.

4. Construction of a dragline erection pad.

5. Planting of screen trees (preliminary).

Figure 3.1

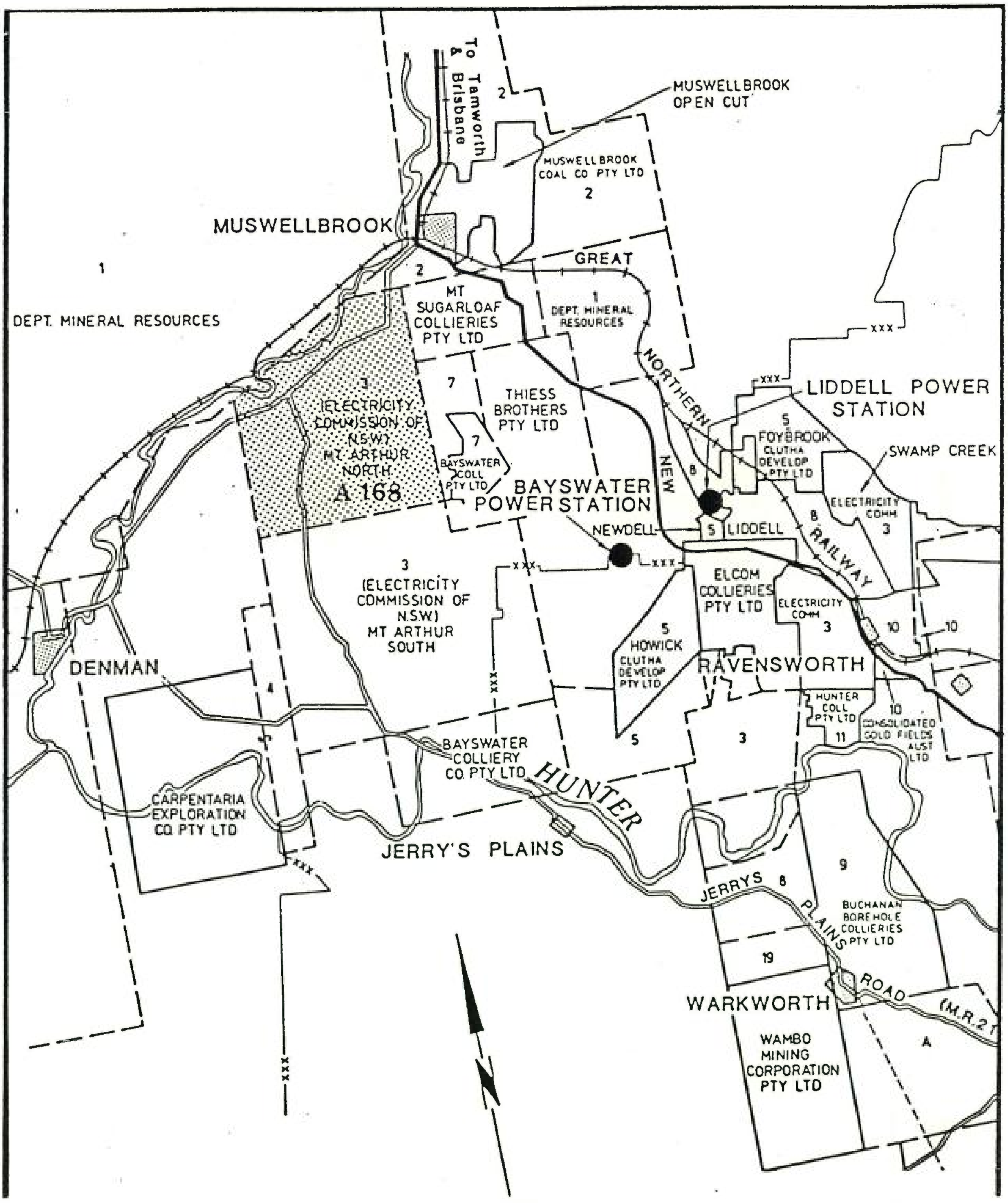

New
MUSWELLBROOK
MOUNT ARTHUR NORTH A 168
England
Lake Liddell
LIDDELL POWER STATION
DENMAN
MOUNT ARTHUR
BAYSWATER POWER STATION (Under Construction)
N
0 5 10km
Scale
Hunter
River
Highway
JERRYS PLAINS
WARKWORTH
SINGLETON
Putty Road
MUSWELLBROOK
DENMAN
SINGLETON
NEWCASTLE
SYDNEY
0 20 40km
Scale
MOUNT ARTHUR NORTH COAL PROJECT
DARWIN
N.T.
QLD.
W.A.
S.A.
BRISBANE
N.S.W
PERTH
SYDNEY
ADELAIDE
VIC.
CANBERRA
MELBOURNE
TAS.
HOBART

MOUNT ARTHUR NORTH COAL PROJECT
CA150 Mine Planning Study

3.5 M.T.P.A. Product

EXISTING AND PLANNED COAL DEVELOPMENTS

Figure 3.2



6. Acquisition of minesite land.

7. Detailed investigation of mining concepts and methods.

8. Preliminary monitoring of environmental parameters, including air quality.

The planning for this study provides for a peak production of 3.5 million tonnes of product coal per annum after washing at an on-site preparation plant, prior to transport by overland conveyor to the nearby Bayswater and Liddell power stations.

CHAPTER 4

GEOLOGICAL IMPLICATIONS FOR MINE PLANNING

4. GEOLOGICAL IMPLICATIONS FOR MINE PLANNING

This section of the report outlines briefly the geological factors pertinent to mine planning. A more detailed account of the deposit geology is presented in the Commission's geology report (Feb, 1984). [Reference 2]

4.1 Geological Setting

The coal seams in the Mount Arthur North area, Authorisation No. 168, are contained within the Wittingham and Greta Coal Measures.

Coal seams of the Wittingham Coal Measures subcrop sequentially over the central and western parts of the area. The Greta Coal Measures occur below the Maitland Group and are at depths in excess of 200 metres where they are known within the Authorisation.

The area is located to the west of the Muswellbrook Anticline and the strata dip generally to the west with a shallow syncline plunging gently south in the western part of the area. A major fault zone strikes generally east-west across the central part of the area.

4.2 Exploration Status

Exploration has consisted mainly of slim core drilling with non-cored drilling used to define faults and the oxidation limits of the Edinglassie and Ramrod Creek seams. In addition, large diameter (200 millimetre) boreholes have been drilled at 14 locations and 2 trial pits have been excavated to allow detailed testing of bulk coal samples.

Cored drilling at 250 metre grid centres has been completed for most of the proposed mine area with the non-cored and some additional cored drilling providing closer spaced coverage.

4.3 Coal Seams and the Computer-Based Geological Model

All geological data for the Ramrod Creek, Whites Creek, Basil and Edinglassie zones of the pit were coded and modelled using a computer-based method. This computer-based model was completed in August 1982, with the data for the Ramrod Creek zone extending as far west as the Edderton Road.

The input to the model comprised both seam intersection data and the associated analytical data.

Correlation of seams and the selection of working sections for computer modelling was carried out by Commission geologists.

Within the modelled area 20 discrete seams have been identified. These split and in some cases coalesce with other splits to produce 59 unique splits or combinations of splits.

The names of these seams and splits are listed in Table 4.1. In the context of the computer model, the term "Uncorrelated" is a misnomer - all seams and splits have been correlated by the Commission geologists.

Borehole intersections of the individual splits vary in thickness within the ranges shown in Table 4.2.

Weathered coal has been excluded from the selected working sections in the database and a 0.01 metre thickness has been assigned to completely weathered seams to provide additional control for the computer model.

In addition, a 15 metre weathering horizon has been added to the model to limit the seams whose oxidation lines have not been well defined by drilling.

The analytical database is comprehensive and contains most of the available slim core analyses, but only selected properties have been modelled. These properties are:

Raw Coal (at 8% moisture)
Ash
Specific energy
Total Sulphur
Ash fusion temperature (hemisphere)
Volatile matter

Clean Coal F1.60 (at 10% moisture)
Ash
Specific energy
Total sulphur
Yield

Table 4.1

MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY

3.5 M.T.P.A. Product Coal

LIST OF SEAMS AND SPLITS IN COMPUTER-BASED GEOLOGICAL MODEL

Glen Munro
Glen Munro lower split
Woodlands Hill middle split
Woodlands Hill lower split
Uncorrelated U
Uncorrelated V
Uncorrelated V lower split
Uncorrelated W
Uncorrelated W lower split
Uncorrelated X
Uncorrelated Y upper split
Uncorrelated Y
Uncorrelated Z
Upper Mt. Arthur upper split
Upper Mt. Arthur
Middle Mt. Arthur upper split
Middle Mt. Arthur
Mt. Arthur
Lower Mt. Arthur
Uncorrelated G
Upper Piercefield
Piercefield
Lower Piercefield
Vaux top split
Vaux
Middle Vaux
Middle Vaux lower split
Lower Vaux upper split
Lower Vaux
Upper Broonie
Broonie
Middle Broonie
Lower Broonie
Broonie/Bayswater coalesced
Bayswater upper split
Bayswater
Bayswater middle split
Bayswater lower split
Wynn
Middle Wynn
Lower Wynn
Edderton upper split
Edderton
Clanricard upper split
Clanricard
Bengalla
Bengalla A upper split
Bengalla A
Bengalla B
Bengalla A/Bengalla B coalesced
Bengalla C
Bengalla B/Bengalla C coalesced
Edinglassie
Transition
Edinglassie/Transition coalesced
Ramrod Creek upper split
Ramrod Creek middle split
Ramrod Creek
Lower Ramrod Creek

Table 4.2

MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY

3.5 M.T.P.A. Product Coal

SEAM THICKNESS RANGES

Seam	Thickness (metres) Minimum	 Maximum	 Average	Number of Intersections
Glen Munro	3.55	3.55	3.55	1
Glen Munro lower split	0.45	0.45	0.45	1
Woodlands Hill middle split	0.96	3.30	2.13	2
Woodlands Hill lower split	0.26	0.41	0.34	2
Uncorrelated V	0.77	3.32	2.04	2
Uncorrelated V	0.99	2.88	1.79	14
Uncorrelated V lower split	0.37	0.59	0.46	4
Uncorrelated W	0.10	1.56	0.90	21
Uncorrelated W lower split	0.32	0.52	0.41	12
Uncorrelated X	0.01	1.36	0.86	27
Uncorrelated Y lower split	0.21	0.31	0.27	4
Uncorrelated Y	0.07	0.88	0.36	38
Uncorrelated Z	0.18	1.19	0.61	46
Upper Mt. Arthur upper split	0.10	0.86	0.35	58
Upper Mt. Arthur	0.12	2.28	1.16	87
Middle Mt. Arthur upper split	0.71	0.71	0.71	1
Middle Mt. Arthur	0.01	2.99	2.08	26

Table 4.2 continued ...

	Thickness (metres)			Number of
Seam	Minimum	Maximum	Average	Intersections
Mt. Arthur	0.01	5.45	3.41	96
Lower Mt. Arthur	0.09	0.88	0.25	14
Uncorrelated 6	0.01	1.32	0.53	104
Upper Piercefield	0.34	0.34	0.34	1
Piercefield	0.01	4.16	2.42	129
Lower Piercefield	0.01	1.39	0.41	104
Vaux top split	0.06	0.49	0.26	19
Vaux	0.01	7.23	3.27	151
Middle Vaux	0.08	1.87	0.75	82
Middle Vaux lower split	0.28	0.51	0.37	14
Lower Vaux upper split	0.46	0.62	0.54	2
Lower Vaux	0.01	3.12	1.42	117
Upper Broonie	0.34	0.64	0.51	4
Broonie	0.01	3.16	1.15	121
Middle Broonie	0.26	0.46	0.36	2
Lower Broonie	0.01	2.13	0.83	56
Broonie/Bayswater coalesced	0.40	5.32	3.97	30
Bayswater upper split	0.01	2.10	0.69	46
Bayswater	0.01	5.88	3.62	81
Bayswater middle split	0.43	0.97	0.63	6
Bayswater lower split	0.01	3.78	1.16	55
Wynn	0.07	3.43	1.20	97
Middle Wynn	0.11	1.20	0.33	44
Lower Wynn	0.08	1.15	0.57	126
Edderton upper split	0.07	0.69	0.31	57
Edderton	0.01	2.50	1.45	164

Table 4.2 continued ...

Seam	Thickness (metres)			Number of Intersections
	Minimum	Maximum	Average	
Clanricard	0.21	0.69	0.37	3
Clanricard	0.01	2.17	1.27	186
Bengalla	0.77	3.66	2.82	5
Bengalla A upper split	0.10	1.06	0.24	14
Bengalla A	0.01	1.88	1.14	173
Bengalla B	0.01	1.64	1.04	134
Bengalla A/Bengella B coalesced	0.01	2.90	2.27	17
Bengalla C	0.09	1.83	0.47	146
Bengalla B/Bengalla C coalesced	1.41	2.64	1.92	46
Edinglassie	0.01	5.01	3.33	405
Transition	0.01	1.20	0.60	211
Edinglassie/Transition coalesced	-	-	-	-
Ramrod Creek upper split	0.01	0.73	0.52	28
Ramrod Creek middle split	0.01	2.06	1.12	17
Ramrod Creek	0.01	9.22	4.63	543
Lower Ramrod Creek	0.01	1.99	1.52	106

4.4 Seam Dips

Seam dips generally vary between zero and ten degrees. To the north of the fault zone, the seams dip generally to the west, whereas south of the fault zone seams dip to the south-west.

There are some areas where seam dips approximate ten degrees, notably the eastern edge of the Ramrod Creek zone, the central part of the Ramrod Creek zone and the south-eastern corner of the Whites Creek zone.

Dips greater than ten degrees may be encountered adjacent to the faults, but these areas are of limited extent.

2. The southern boundary of the graben consists of two en echelon faults (Huon and Huon East Faults). Vertical displacement on the Huon Fault ranges from 35 metres in the west, increasing to 90 metres and then decreasing to zero. The Huon East Fault is en echelon and vertical displacement increases from zero to 70 metres in the east.

3. The northern boundary of the graben consists of a single fault (Fairford Fault) with vertical displacement of 35 metres in the west increasing to 100 metres in the central part, and then decreasing to 25 metres in the east.

4. The boundary faults appear to be relatively simple planar structures dipping at 40 degrees to 70 degrees. On some sections, it is necessary to interpret two separate fault planes, or planes with variable dip, to explain the borehole intersections. However, such variations are minor complexities superimposed on a basically simple overall structure.

5. North of, and parallel to, the Fairford Fault, are two lesser faults (unnamed and Fairford East faults) which form a subsidiary graben structure. This graben has a maximum vertical displacement of about 30 metres but occurs only in the eastern part of the deposit.

4.5 Faulting

A major fault zone trending east-west occurs between the Ramrod Creek and Whites Creek zones. A considerable amount of close spaced drilling has been carried out to obtain better definition of the faults. This drilling includes cored holes to intersect the faults, and non-cored drilling to locate oxidation limits at the eastern end of the fault zone. In addition, two programmes of non-cored/geophysically logged boreholes have been undertaken to determine fault details. These have been reported by Golder Associates [References 2 and 4].

1. The drilling programme has confirmed the presence of a major graben type fault zone trending east-west across the central part of the Mount Arthur North coal deposit. The width of the zone varies from 800 metres in the west to 200 metres in the east and the maximum vertical displacement within the zone is over 100 metres.

2. The southern boundary of the graben consists of two en echelon faults (Huon and Huon East Faults). Vertical displacement on the Huon Fault ranges from 35 metres in the west, increasing to 90 metres and then decreasing to zero. The Huon East Fault is en echelon and vertical displacement increases from zero to 70 metres in the east.

3. The northern boundary of the graben consists of a single fault (Fairford Fault) with vertical displacement of 35 metres in the west increasing to 100 metres in the central part, and then decreasing to 25 metres in the east.

4. The boundary faults appear to be relatively simple planar structures dipping at 40 degrees to 70 degrees. On some sections, it is necessary to interpret two separate fault planes, or planes with variable dip, to explain the borehole intersections. However, such variations are minor complexities superimposed on a basically simple overall structure.

5. North of, and parallel to, the Fairford Fault, are two lesser faults (unnamed and Fairford East faults) which form a subsidiary graben structure. This graben has a maximum vertical displacement of about 30 metres but occurs only in the eastern part of the deposit.

6. The en echelon nature of the Huon East and Huon Faults, and the decreasing displacement on the Fault Zone to the west, suggest that further en echelon faulting could occur to the south-west. However, any such faulting would be substantially outside the planned mining area.

7. The coal seams within the Fault Zone appear to be substantially undisturbed, except in the immediate vicinity of the fault planes. There is therefore no reason why the coal in this area should not be included in mineable reserves, provided that the geometric constraints of the Fault Zone are recognised.

8. There could be stability problems in the vicinity of the fault planes, depending on the mining configuration adopted. However, such problems would be localised to the immediate vicinity of the fault planes. Stability problems will be minimal if the Fault Zone is mined simultaneously with the remainder of the deposit, as proposed in the "single pit" concept.

Several other localised normal faults with throws of up to 20 metres have been identified in the Ramrod Creek zone, particularly near the subcrop.

4.6 Mining Reserves

The reserves of **run-of-mine** (R.O.M.) coal by zone and by seam (or seam group) are presented in Table 4.3. These reserves are contained in the areas in which mining strips have been designed.

Only 34 coal seams or splits were included in the reserves on the basis that these splits exceeded the minimum mineable thickness of 0.50 metres and generally had raw coal ash values less than 35 percent. Coal seams shallower than 15 metres below the surface have been excluded.

Geological reserves for the Wittingham Coal Measures in the whole of Authorisation No. 168 are presented in the Commission's Geology Report. [Reference 3]

CHAPTER 5

GEOTECHNICAL IMPLICATIONS FOR MINE PLANNING

Table 4.3

MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY

3·5 M.T.P.A. PRODUCT CASE

MINING RESERVES
R.O.M. Coal Quantities by Seam/Seam Group

	Ramrod Creek Pit		Whites Creek Pit		Edinglassie Pit		Basil Pit		Total Reserve	
	tonnes	%	tonnes	%	tonnes	%	tonnes	%	tonnes	%
Uncorrelated V Seam	-	-	1,008,312	0.6	-	-	638,438	1.1	1,646,750	0.5
Uncorrelated W Seam	-	-	506,872	0.3	-	-	209,449	0.4	716,321	0.2
Uncorrelated X Seam	-	-	740,750	0.5	-	-	466,814	0.8	1,207,564	0.4
Uncorrelated Z Seam	27,110	0.02	577,677	0.4	-	-	78,820	0.1	683,607	0.2
Mount Arthur Group	6,175,332	5.3	16,673,046	10.6	-	-	8,261,177	14.5	31,109,555	9.3
Uncorrelated G Seam	317,753	0.3	349,066	0.2	-	-	701,139	1.2	1,367,958	0.4
Piercefield Seam	3,195,660	2.7	9,503,234	6.0	-	-	5,791,336	10.1	18,490,230	5.5
Vaux Group	13,469,262	11.5	17,003,508	10.8	-	-	8,665,500	15.2	39,138,270	11.7
Bayswater/Broonie Group	13,801,378	11.8	17,772,452	11.3	-	-	8,352,997	14.6	39,926,827	11.9
Wynn Group	4,835,059	4.1	2,390,565	1.5	-	-	1,624,226	2.9	8,849,850	2.7
Edderton Seam	4,902,668	4.2	6,518,289	4.1	-	-	2,749,051	4.8	14,170,008	4.2
Clanricard Seam	3,617,049	3.1	6,221,872	3.9	-	-	1,685,102	3.0	11,524,023	3.5
Bengalla Group	8,805,050	7.6	10,584,338	6.7	-	-	3,730,995	6.5	23,120,383	6.9
Edinglassie Seam	21,029,740	18.0	23,372,940	14.8	4,795	0.002	5,594,792	9.8	50,002,267	15.0
Transition Seam	1,312,451	1.1	1,592,077	1.0	-	-	509,785	0.9	3,414,313	1.0
Ramrod Creek Group	35,342,528	30.3	43,178,864	27.3	2,406,981	100.0	8,022,697	14.1	88,951,070	26.6
TOTAL	116,831,040	100.0	157,993,862	100.0	2,411,776	100.0	57,082,318	100.0	334,318,996	100.0

All quantities expressed in tonnes.

5. GEOTECHNICAL IMPLICATIONS FOR MINE PLANNING

Preliminary geotechnical investigations for open pit mining, undertaken by Golder Associates, were reported in September 1979. [Reference 5]

Golder Associates subsequently conducted a geological study of the major fault zone between the Ramrod Creek and White Creek zones.

Golder's geotechnical evaluation in 1979 was limited to the Ramrod Creek zone and to the northernmost portion of the Whites Creek zone. A subsequent programme of drilling and testing of 11 partly core boreholes located throughout the proposed mining areas was undertaken in 1982. [Reference 6]

The following comments, extracted from the reports of the above studies, represent the significant implications for open pit mine planning.

5.1 Nature of Overburden and Interburden

Considering the general uniformity of the coal seams in the area, there is a surprising variability in both the thickness and the nature of inter-seam strata. A significant feature is the presence of hard, massive sandstone layers with bed thickness exceeding one or two metres. These sandstones are prominent in the following intervals.

- Above Mount Arthur seam
- Bayswater - Wynn
- Clanricard - Bengalla A
- Bengalla B - Edinglassie
- Edinglassie - Ramrod Creek
- Ramrod Creek - Ramrod Creek Lower

Some of these hard layers are evident in the test pits.

This feature has significant implications for drilling and blasting, excavation techniques (particularly for draglines) and pit wall stability. Specific comments on all inter-seam profiles are presented in Section 3.2 of the Golder geotechnical report, (1979). [Reference 5]

5.2 Groundwater Conditions

The piezometric surface in the area appears to be relatively flat at about RL140. [Reference 4] The coal seams are the main aquifers in the area and the inter-seam strata are relatively impermeable. Mining will be carried out below the water table, except in the initial dragline stripping area along the eastern subcrop zone. There is no evidence of aquifers beneath the basal coal seam, which could lead to floor heave problems in the open pit.

5.3 Drilling and Blasting

The coal seams at Mount Arthur North occur within a hard rock sequence with a high proportion of sandstone. Drilling and blasting will be required prior to excavation of virtually all the non-coal strata. Because of the occurrence of massive sandstone, blasthole diameters and spacings should be restricted to ensure adequate fragmentation is achieved. Golder Associates recommend that the blasthole diameter should not be greater than 300 millimetres and predicted average powder factors range from 0.35 to 0.45 kilogram/cubic metre, depending on the type of loading and transport equipment in use.

A specific problem will be the excavation of the thinner partings which occur particularly in the upper part of the sequence. Most of these partings will not be rippable and drilling and blasting efficiencies decrease rapidly as parting thickness decreases. Further studies are required to determine the optimum methods for excavation of partings less than two metres in thickness.

5.4 Stability

Wall stability conditions will be generally favourable and the following recommendations are made by Golder Associates.

- Dragline high walls 60 - 65 degrees
- Shovel faces 70 - 75 degrees
- Overall wall slopes 45 - 50 degrees

Angle drilling is highly recommended for high faces, e.g. dragline highwalls, and smooth blasting techniques will be required to achieve the steep overall wall slopes. Stability of the low wall along the Ramrod Creek subcrop could be a problem because of rock strength reduction by weathering and the steep seam dips (up to ten degrees) in this area. It is recommended that low-wall slope be restricted to 45 degrees and placement of waste dumps in close vicinity to the low wall will require further consideration.

Waste dump stability is a potential problem because of steep floor dips over most of the deposit and a variable thickness of weaker material immediately underlying the Ramrod Creek and Ramrod Creek Lower seams. Stability conditions will be most demanding for dragline spoil piles because of the inflexible nature of their location and geometry.

Potential instability of end-walls could result if such walls intersect the major faults. However, the proposal to adopt the single pit concept will avoid this possibility by eliminating the need for end-walls in the fault zone.

5.5 Seam Dips and Pit Floor

Each part of the mine will require specific study in relation to floor dip and thickness of weak floor material. However, for mine planning purposes, the following recommendations are made for dragline spoil pile design.

1. Angle of repose of spoil should be assumed to be 38 degrees.

2. Where floor dip is less then 5 degrees, assume 0.5 metres of floor must be removed over half the foundation area.

3. Where floor dip is greater than 5 degrees, assume 0.5 metres of floor must be removed over total foundation area.

4. Foundation area must be adequately drained and cleaned of any wet or moist material immediately before placing spoil.

5. Stripping must be scheduled to ensure that, as far as possible, hard blocky sandstone is placed in the layer of spoil immediately above the foundation.

6. Draglines should not be scheduled to operate from the spoil side in the early years of mining, in the subcrop zones; depending on experience obtained this procedure may be acceptable further down dip where floor conditions appear to improve.

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The above recommendations must be considered as guidelines and some degree of experimentation will be required to optimise spoil placement procedures when mining operations commence. Waste from higher levels in the mine will be placed on top of the dragline spoil. This waste should be placed in layers with maximum thickness 60 metres and the overall slope of the waste dump from the toe of the dragline spoil should not exceed:

. 30 degrees for floor dips up to 5 degrees
. 25 degrees for floor dips greater than 5 degrees

CHAPTER 6

ENVIRONMENTAL IMPLICATIONS FOR MINE PLANNING

A review of the previous Environmental Impact Statement (1981), [Reference 1] highlighted several areas where environmental controls must be superimposed on the mine planning and design process.

6.1 Vibration from Blasting

The environmental effects related to mine blasting are ground vibration and overpressure (air pressure waves) carried by the blast. Some of the air vibration effects manifest themselves as noise, being within the audible frequency range. Both these effects have the potential for creating disturbance to nearby residents and, at higher levels, superficial or even structural damage to buildings.

6.1.1 Location of Nearby Residences

The nearest occupied residences to the Whites Creek zone are Balmoral, some 3,000 metres to the north, and Windmill, some 4,000 metres to the north-west.

In the case of the Ramrod Creek zone, although Balmoral is the nearest occupied residence (some 1,200 metres to the north-east), there are two buildings closer - Edinglassie (700 metres) and

Rous-Lench (400 metres). These buildings, together with Balmoral, have been given "classified listing" status by the National Trust. The Commission has acquired Edinglassie and Rous-Lench and will ensure that they are maintained.

6.1.2 Investigations

A blasting investigation for the previous E.I.S. was undertaken by Wilkinson-Murray Consulting and involved carrying out a series of test blasts as well as a large scale bench blast in order to measure the effects. From an analysis of the results and an analysis of the proposed blasting methods, a prediction of vibration and overpressure levels at nearby residences was made by extrapolation, and guidelines prepared for the necessary controls.

6.1.3 Recommended Ground Vibration Limits

The best criteria for assessing the damage potential of ground vibrations is peak particle velocity Vp.

Recommended Vp limits for the various buildings are:

. Balmoral	2 millimetre/second
. Residences in general	7 millimetre/second
. Industrial area	20 millimetre/second
. Edinglassie, Rous-Lench	30 millimetre/second

These limits compare with the USBM recommended standard of 50 millimetre/second and the Australian Standard (AS 2187 Part 2 - 1979) of 200 millimetre/second for structurally sound buildings. The minimum perceptible Vp is 0.5 millimetre/second. The seven millimetre/second limit for "Residences in general" is typical of that applying to other open cut operations in the Hunter Valley.

6.1.4 Recommended Overpressure Limits

The recommended overpressure limits are:

. Residences in general	115 dB Linear
. Edinglassie & Rous-Lench	128 dB Linear
. Industrial areas	128 dB Linear

6.1.5 Blasting Design

The recommended limits on vibration and overpressure have been used to calculate maximum instantaneous charges (MIC) per delay, assuming 40 millisecond delays between holes.

The MIC levels vary with distance from residences, and range from a minimum of 120 kilograms at the north-east corner of the Ramrod Creek zone to over 2,000 kilograms at the southern end of the Whites Creek zone.

A blasthole diameter of 229 millimetres has been recommended in the E.I.S. although this is likely to be too large for the lowest MIC, unless deck-charging is adopted.

Detailed blasting designs for each MIC zone are presented in a Drill and Blast study prepared by Runge and Associates Pty. Ltd. in 1982. [Reference 7] These designs incorporate environmental considerations and material type.

6.2 Noise

The operation of haulage vehicles and earthmoving equipment will give rise to noise that could be heard at nearby residences. Consequently, a number of possible noise control measures may need to be implemented to comply with the noise level limits outlined in the previous E.I.S.

Such measures include the strategic placement of bunds to shield noise and selective location of certain operations at night time.

6.3 Drainage

The major catchments in the Authorisation are Ramrod Creek, Whites Creek and Quarry Creek, which flow into the Hunter River at the north of the Authorisation; and Saddlers Creek which flows south to join the Hunter River near Jerrys Plains. All creeks are intermittent and cease to flow for long periods of the year.

The upper part of the area of the Whites Creek catchment encompasses all of the Whites Creek zone. During mining operations, levee banks around the advancing highwall will serve to divert any flows around the proposed mining areas.

The water management proposals affect the conceptual mine plan in that a raw water storage is to be incorporated in the out-of-pit waste dump for the Whites Creek zone.

Conceptual mine planning work indicates that the water management proposals do not represent a major restriction on waste dumping.

MORE DETAIL

Protection of the mine workings from the effects of flooding of the Hunter River will be provided by the increasing surface level contours away from the river, to the south of the Denman Road realignment. This alignment will be a minimum of 2 metres higher than the 1 in 100 year Hunter River flood, and the bunding between the road and the Ramrod Creek zone will afford additional protection.

6.4 Road Deviations

Deviation of the Denman to Muswellbrook Road will be required over a distance of approximately 2 kilometres.

The realigned road provides the limit to the northern extent of the Ramrod Creek zone - it is proposed that the surface excavation will be generally no closer to the road than a distance of 200 metres.

A previous proposal to divert the Edderton Road has lapsed under the current `single pit' mining concept.

6.5 Groundwater

The coal seams represent the major aquifers in the deposit. Particular attention has been given to the possibility of an interconnection between the Ramrod Creek zone and the Hunter River alluvium through the coal seams. Most of the coal seams in the end wall will be covered by the advancing refill, and the possibility of sealing the lower seams with a clay cut-off zone will be investigated.

No quantitative evaluation of water make to be handled. ?

6.6 Dust

A study of dust generation and control carried out as part of the previous E.I.S. indicated that

1. most of the dust generated will be deposited within two kilometres of the source, and

2. due to prevailing wind patterns, areas most affected will be those to the south and east of the mining area.

Apart from watering haul roads and prestrip areas, controls proposed include

1. the use of dust collection equipment attached to drillings rigs,

2. the suspension of major blasts, if adversely located, during periods of high winds, and

3. a similar curtailment of dragline operations during periods of high winds, if the dragline is adversely located at the time.

6.7 Overburden Disposal

A substantial volume of the waste material excavated over the 20 year life will be required to be placed above existing ground levels. Some of this will be placed in dumps outside the limits of the surface excavation of the mining areas.

An overall site landscape plan will be developed to combine the need to dispose waste from the mining operation with the creation of landforms that will shield continuing mine operations, and, at the end of the mine life, blend with the existing character of the area.

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It should be noted that the waste dumping limit in the central section of the Ramrod Creek zone corresponds to the excavation limit of the pit. This precludes waste from being dumped on an area where the existing slope is relatively steep and where a group of trees provides significant screening of the operations.

Consequently, this portion of the boxcut cannot be excavated by dragline methods.

6.8 Surface Rehabilitation

The rehabilitation plan for the site will involve, inter alia,

1, The stripping of topsoil and subsoil on a selective basis, and the respreading of this soil on reshaped spoil areas either directly or after a period of stockpiling.

2. Regrading, reshaping and contouring of spoil areas to conform with the landform requirements.

3. Seeding, fertilising, planting and subsequent watering.

Surface reshaping and rehabilitation is required to be undertaken as soon as possible after spoil placement in an area is complete, in accordance with the landform design.

CHAPTER 7

IMPLICATIONS OF DEVELOPMENT DECISIONS ALREADY TAKEN

7. IMPLICATIONS OF DEVELOPMENT DECISIONS ALREADY TAKEN

As project development has already commenced, some decisions have already been made. These provide constraints within which the ongoing mine planning process must be conducted.

7.1 Surface Facilities Layout

The proposed layout for surface facilities is outlined in the report by Gutteridge, Haskins and Davey Pty. Ltd. [Reference 8]

For mine planning purposes, the most important of these fixed facilities are:-

1. The tailings dam reserve, which limits the spoil dumping area for the Ramrod Creek zone.
2. The coal preparation plant area, which limits the spoil dumping area for the Whites Creek zone.
3. The Denman Road deviation which limits the northern extent of surface disturbance for the Ramrod Creek zone.

4. The location and design of the coal receival station. Haul road locations are thereby largely defined and the dump station has been designed for rear dump haulers rather than the bottom dump haulers envisaged in the E.I.S. (1981)

5. The various dams, ponds and diversion channels required for water management.

7.2 Mining Equipment

7.2.1 Draglines

The conceptual mine plan includes the use of a BE1570W dragline to remove waste material.

A key objective of current mine planning is to utilise this dragline as much as possible whilst employing working methods best suited to the nature of the deposit and the envisaged production rate.

7.2.2 Other Mine Equipment

The Commission has prepared specifications to enable tenders to be called for other items of mining equipment such as drills, shovels and trucks. Whilst these specifications do not rigidly restrict the mining equipment that can be used, the general type and size of such equipment is largely defined by the scale of the project, and the nature of the deposit.

CHAPTER 8

CONCEPTUAL MINE PLAN

8. CONCEPTUAL MINE PLAN

The conceptual mine plan has gradually evolved over recent years under the influence of different mine planners using progressively better information.

8.1 Historical Development

The initial mining proposals concentrated on the northern end of the Authorisation. A dragline mine was to be developed in the area between Ramrod Creek zone and Whites Creek zone whilst a combined truck/shovel and dragline operation was proposed for the Ramrod Creek zone. This proposal involved the dragline proceeding eastwards (up dip) whilst the truck/shovel operations proceeded down dip from a centrally located boxcut.

It was found that this proposal required a large central working area which would create problems of overburden disposal in the initial stages and delays in rehabilitation.

The mining proposals were subsequently amended to dragline operations in the Ramrod Creek zone with later introduction of truck/shovel methods in the western part of the area as the pit got deeper and more coal seams appeared.

However, this dragline operation could not satisfy the total production requirement (as dictated primarily by the feed requirements of the Bayswater power station) and it was necessary to develop a second pit with a production capacity of about 7 million tonnes per annum.

The only area with sufficient reserves to support this production, over an economic equipment life of about 20 years, was the Whites Creek zone. This zone was initially planned as a truck-shovel operation.

The limit of dragline operation in the Ramrod Creek zone was estimated to be reached after nine years of mining due to increasing overburden thickness and more numerous coal seams. Continued usage of major plant items, such as the draglines, was found in the Glen Munro pit. Although the overburden is thicker than in Ramrod Creek pit, two major seams (Blakefield and Glen Munro) could be recovered.

Development of a dragline operation in the Glen Munro pit thereby provided continuity of dragline production over the initial 20 year mine life.

These concepts formed the basis of the mining methods described in the previous E.I.S., although the production details presented in that E.I.S were a combination of several studies undertaken by consultants and consolidated by the Commission.

8.2 Evolution of the Current Conceptual Plan

In view of the enhanced resource definition available since 1980, it was decided to re-assess the conceptual mine plan.

8.2.1 Single Pit Concept

The single pit concept involves the mining of the fault zone between the Ramrod Creek and Whites Creek zones simultaneously with the mining of those zones, thereby forming a large pit, extending from near the Denman Road in the north to the slopes of Mount Arthur in the south.

The adoption of this concept is based on the favourable waste to coal ratios characteristic of the fault zone and the results of exploration studies of the zone by Golder Associates. [Reference 4] These studies indicated minimal disturbance associated with the faults. It had previously been decided not to mine the fault zone, in the belief that such large displacement faults would be likely to give rise to significant areas of disturbance and associated losses of mineable reserves.

The major advantage of the single pit concept is that it allows maximum recovery of the coal resources in the fault zone, and at a much more attractive waste:coal ratio than if this coal were to be recovered after the Ramrod Creek and Whites Creek zones had been mined and refilled.

By extending the Ramrod Creek zone west towards the Edderton Road, coal could continue to be extracted from this zone in preference to the much higher waste to coal ratio reserves in the Glen Munro pit. Consequently, the Glen Munro pit was excluded from the initial 20 year mine life and there was no longer a need for a transporation and service corridor across the fault zone to the Glen Munro area. This strategy effectively removed any constraints from mining the fault zone simultaneously with the other pits.

Even with the adoption of the single pit concept, the previously established pit names have continued to be used to describe the various portions of the large pit. Thus, the area to the north of the Fairford Fault is known as the Ramrod Creek zone, and the area to the south of the Huon Fault is the Whites Creek zone.

The area between the Huon and Fairford Faults is known as the Fault zone or Basil zone, whilst the area near the test pits has been designated the Edinglassie zone.

Conceptual planning on the single pit design was undertaken to establish

1. that the dragline could be walked in the pit across the fault zone between the Ramrod Creek and Whites Creek zones, with a minimum of temporary walk road construction.

2. that the use of a central cross-pit bridge at the dragline operating level resulted in significant improvements in truck productivity for hauling both waste and coal from some benches and

3. that a central haul road through the waste resulted in improved truck productivities for coal haulage from some seams at the expense of in-pit waste dumping flexibility.

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9. ADOPTED PLANNING APPROACH

All the environmental, geological and geotechnical constraints outlined previously in this report were incorporated into the detailed mine plan.

Detailed mine planning commenced with a re-assessment of the basic mine design parameters in the light of the conceptual mine planning recommendations and preparation of a three dimensional pit limit plan. A particular use of this plan was to examine the constraints imposed by mining of the coal in the base of the Basil zone between the major faults. The relative advance of the Basil zone was examined and the mining bench layout, strip width and orientation for the various zones were determined.

After confirmation of the proposed dragline working scheme, optimum pit widths were determined as the seam geometry changed across the mine. Because this involved varying pit widths, overlying truck/shovel benches were laid out in such a manner as to provide for consistent operation of the dragline in the bottom of the pit. Volumes and quality data associated with these mining blocks were calculated from the geological model and transferred into the mine modelling system.

CHAPTER 9

ADOPTED PLANNING APPROACH

9

After transfer of data into the mine modelling system, adjustments were made for basic mine design parameters such as mining recovery, dilution and contamination. The volumes of waste to be disposed on a strip-by-strip basis were calculated. The allocation of waste volumes to dumping areas was undertaken and production rates for all equipment calculated.

In order to study a large number of potential extraction alternatives, the blocks in the mine were combined into large strips to represent, on a broad scale, the progress of the mine from east to west. Information from this aggregated data set was then scheduled at various production rates to filter out the best scheduling scheme prior to detailed scheduling of the extraction sequence. After the optimum broad scheduling scheme was determined, further detailed information about truck production rates and drilling rates on a block-by-block basis was calculated and the entire mine was scheduled for extraction at 3.5 million tonnes per annum product coal using the previously determined mining strategy. Major equipment requirements were calculated from this schedule.

Using information from the detailed schedule, tabulations of the major annual waste volumes, coal tonnages and associated coal quality parameters were prepared. The annual requirements for other major equipment such as drills and haul trucks were determined as were the requirements for support equipment. In accordance with the expected working life of equipment, a replacement schedule was prepared for all major and minor items for 20 years of mine life.

In order to demonstrate the workability of such a detailed mine plan, four large scale excavation and refill plans were prepared to illustrate the excavation at progressive stages in the mine life. (years 2, 3, 10, and 20). The plans highlighted the position of the excavation faces and both in-pit and out-of-pit refill dump faces.

A mine manpower schedule was prepared based on requirements for the number of operators for major equipment and for maintenance and servicing of this equipment. Labour requirements for supervision, technical and administrative staff were prepared in accordance with normal industry practice after discussion with Commission personnel.

This final report was prepared and supporting documentation collated and presented to the Commission.

CHAPTER 10

MINE LAYOUT AND SELECTION OF MINING METHOD

10. MINE LAYOUT AND SELECTION OF MINING METHOD

10.1 Mining Constraints

Both the nature of the deposit and the proximity of the project to the town of Muswellbrook impose major constraints on the mine planning. The most important of these constraints are:

1. The environmental implications associated with operating a mine of this size close to a centre of population.

2. Environmental constraints of blasting and general mine operations within close proximity of the historic homesteads of Balmoral, Rous-Lench and Edinglassie.

3. A designated peak annual production rate of 3.5 million tonnes of product coal per annum.

4. Deployment of the major overburden removal equipment - the large walking dragline was constrained to working in the lower waste benches with truck and shovel overburden removal equipment allocated to the upper benches.

10.2 Mining Limits

The following major lateral limits on the extent of mining have been used for the study.

1. The northern surface limit of the Ramrod Creek zone has been drawn 200 metres from the (diverted) Denman Road. It should be noted that the Authorisation boundaries extend further north than this road but no plans have been made for extraction of the coal to the north of the currently planned northern pit wall.

2. The eastern extent of the mine excavation is fixed by the subcrop of the Ramrod Creek seam. This subcrop line generally trends in a north-north-west to south-south-east direction and is offset approximately six times along the length of the deposit by east-west trending faults.

3. The southern extent of the Whites Creek zone is determined by the rising topography associated with the slopes of Mount Arthur. A small region of steeply dipping coal, known as the Eastern Extension area, has been excluded from the initial mining area to allow for surface water storage. Mine planning decisions undertaken in this study will not prohibit easy access for future mining of this coal reserve.

4. A limit to the open cut reserves has not been determined on the western side of the Authorisation since reserve blocks have been designed to extend well beyond the initial 20 year mine life. If mine planning is subsequently required to be undertaken past the western limit of the proposed 20 year mine, these mining blocks can be utilised. The mine has been designed so that operations can be continued beyond Year 20 by advancing towards the west. For the purposes of this study, the western surface limit of the proposed excavation is well to the east of the Edderton Road.

10.3 Depth of Excavation

Based on geotechnical information, the excavation could be designed to enable extraction of the basal seam of the Wittingham Coal Measures (viz the Lower Ramrod Creek seam). In the case of the Ramrod Creek zone, it appears that the economics of extraction of the coal with increasing depth are relatively consistent. It is not believed that the economics of extraction at any depths currently encountered within the existing plan area are sufficiently high to form a realistic limit of mining.

Since the Greta Coal Measures on the Authorisation occur at depths in excess of 200 metres, the extraction of coal to the base of the Wittingham Measures by open cut methods is consistent with maximum recovery of the resource.

10.4 Excavation Batters

Whilst the broad limits for excavation in a lateral direction have been determined using the abovementioned criteria, the actual lateral dimensions on a seam-by-seam basis are dependent on the depth of the seam and the intersection of the seam with the end batters of the pit. These end batters have been developed at a slope of 63 degrees based on geotechnical advice with appropriate adjustments and allowances for safety berms and major haulage roads, and are discussed more fully in Section 10.6.3.

10.5 Single Pit Concept

Since conceptual planning indicated that the large faulted region in the centre of the deposit did not constitute a limit of mining, a separate analysis was undertaken to evaluate alternative layouts of this zone with respect to the adjacent Ramrod Creek and Whites Creek zones.

The adoption of the single pit concept required the analysis of the constraints and limits associated with mining of the faulted region between the Huon and Fairfield Faults down to the base of the Lower Ramrod Creek seam. Satisfactory mining design for extraction of this coal required that the end batters be developed at an overall angle substantially less than the dip of either of the two faults. Hence the zone developed within this region, the Basil zone, also encompasses substantial quantities of waste and coal which were previously associated with the southern end of Ramrod Creek zone and the northern end of Whites Creek zone. The following logic was used to determine the major limits and constraints on mining for extraction of coal from this zone.

1. The depth of excavation did not allow the dragline to be manoeuvred into position for operation on the lower waste benches in the zone. The design was therefore fixed as a wholly truck/shovel operation.

2. Because this zone is developed to a much greater depth than either of the adjacent zones, it is not possible for both the refill faces and the excavation faces to be consistent with the corresponding faces in the adjacent zones. A choice must therefore be made as to which of the two alternatives will prove the

most efficient in practice - either consistent excavation development or consistent refill development.

3. Because the mining benches within the Basil zone were developed on distinctly different seam horizons to the mining benches in the adjacent Ramrod Creek and Whites Creek zones there was no necessity to have continuity of excavation faces between adjacent zones.

4. Substantial advantages are obtainable by designing for a continuous refill face between the adjacent Ramrod Creek zone and refill into Basil zone. In particular, the dumping of dragline spoil on the edge of the Huon Fault must be arranged in such a way that any waste material flowing over the fault is not likely to endanger men or equipment working in the base of Basil zone. Accordingly, Basil zone design was established on the criterion of a consistent refill face between the spoil disposal in the Basil zone and spoil disposal in the Ramrod Creek zone.

5. Because of the greater depth of the Basil zone and the adoption of a consistent refill face, the excavation faces in the Basil zone must of necessity be in advance of the excavation faces in the Ramrod Creek zone. Accordingly,

the excavation of the Basil zone can always be considered as a unique zone. The southern extent of the Ramrod Creek zone can then be always fixed by the intersection of the benches in this zone with the already established excavation face at the northern end of the Basil zone. Similarly, the northern end of the benches in the Whites Creek zone is limited by the established excavation at the southern end of the Basil zone.

6. Since the Basil zone is designed to be excavated in advance of the other zones and is generally much deeper than the other zones, the volume of material in the batters of the Basil zone is a significant influence on mining costs. Furthermore, the zone is planned to be excavated exclusively by the higher unit cost truck/shovel method. There is, therefore, considerable incentive to restrict the advance of the Basil zone relative to the other zones to the minimum necessary to ensure working safety in the bottom of the pit.

7. Mining benches in the Basil zone were designed to traverse both of the major faults and to allow for recovery of coal in the different seams on the other side of the fault corresponding to the major bench developed in the Basil zone. As the throw of the faults varies with progress of the mine down dip, the equivalent coal seam on the opposite side of the fault changed, so that on any particular bench in the Basil zone, a large number of different seams were extracted over the life of the mine.

8. The orientation of mining strips in the Basil zone was determined by the relative dip of the seams in the region giving due consideration to the need for dead-heading of the dragline from the Ramrod Creek zone to the Whites Creek zone via the Basil zone benches.

9. All roads were established in the southern wall of the Basil zone to provide for waste removal via a bridge established at the dragline working bench level at the northern end of the Whites Creek zone. This bridge was also used for coal removal to the Run-of-Mine dump station.

Once the arrangement for the Basil zone was fixed, the method of transportation of material and equipment through the entire central region of the mine was similarly fixed. The flow of material and equipment on both the northern end of the Ramrod Creek zone and the southern end of the Whites Creek zone was arranged in a conventional manner with establishment of ten percent gradient haul roads in the end wall batters. These haul roads lead the major equipment either directly on to the appropriate in-pit dumping bench level in the spoil or on to the main haul road leading to the Run-of-Mine dump station (in the case of coal haulage).

10.6 General Mine Design Parameters

10.6.1 Bench Width

Selection of the optimum bench width is a difficult choice in a complex mining operation with greatly varying overburden thicknesses, seam depths and equipment types. Accordingly, the bench widths selected for this study at the appropriate mining horizon involved a compromise between many factors, the principal ones being the volume of material needed to be disposed in the outside dump and the productivity of equipment working within the pit. Whilst a bench width of 50 metres was used wherever possible, the actual width used varies substantially over the mine due to variations in the operating conditions, particularly floor dip, for the dragline.

Narrow Benches (less than 40 metres). The advantages of narrow benches are:-

1. Minimum initial development work and reduced outside dump storage requirements.

2. Larger number of strips excavated per year (because of smaller volume per strip) and, therefore, greater diversity in the number and quality of coal seams delivered to the dump station. Blending may be improved.

3. In steeply dipping areas (e.g. base of the Basil zone), the operation may be easier to work due to substantially less dozing and support equipment requirements.

Wide Benches (greater than 40 metres). The advantages of wide benches are:-

1. Greater room for manoeuvring equipment.

2. Improved dragline scheduling due to slower linear rate of advance.

3. Improved dragline productivity due to reduced proportion of rehandle (limited by ability of dragline to dispose of waste material in steeply dipping areas).

4. Higher shovel productivity due to

    a. less lost time for clean-up,
    b. less walking between faces,
    c. greater percentage of double-sided loading of trucks, and
    d. less interference with trailing cable.

5. Improved scheduling of shovel operations due to slower advance of faces.

6. Improved blasting because greater blasting volumes can be handled at any one time.

7. Greater range of truck sizes can be accommodated due to greater manoeuvring room.

8. More room to allow for drainage of mining faces without interruption of loading operations.

Because of the overwhelming operating advantages of working with a wider bench, this overall approach was adopted subject to the following two constraints.

1. Maximum width applicable for operation of the dragline on the lower waste benches.

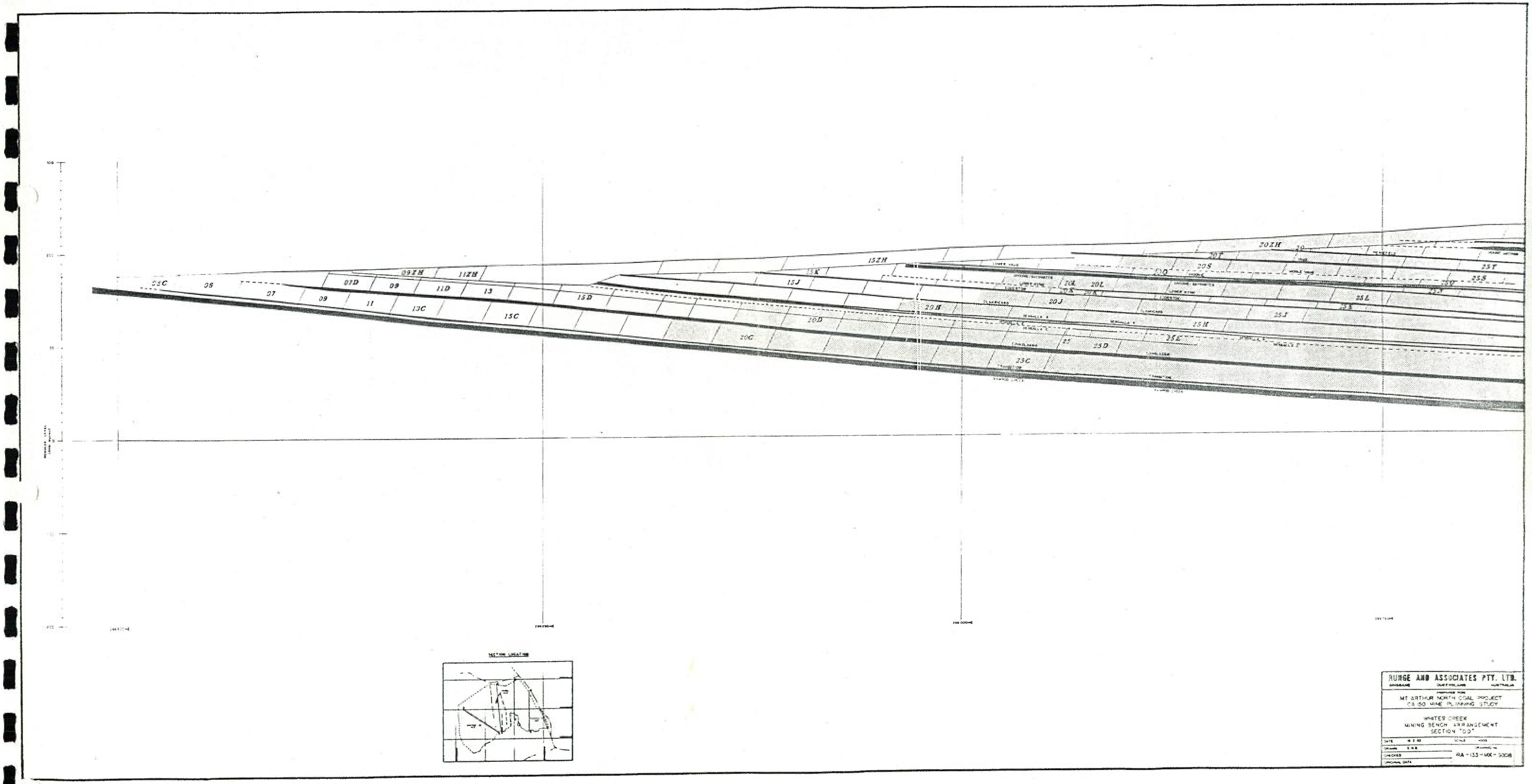
2. Overall slope of the mining bench arrangement determined by scheduling requirements. (With wider benches, a reduced number of active benches are required and, correspondingly, the number of sequential operations between active benches is increased. This reduces scheduling flexibility.)

An example of the overall bench arrangement is shown in Figure 10.1.

The actual mining bench width used varies substantially over the mine due to the changing conditions for dragline operation. Although many of the decisions on bench width were fixed by the optimum situation for the dragline this is expected to result in no loss of productivity of the shovels since invariably ample working room is available for operation of this equipment. A large number of benches planned to be mined by front-end loader or hydraulic excavator allows the possibilities of working more than one item of equipment on the same bench at the same time. This will provide for greater operational flexibility and if found to be advantageous, could result in a steeper overall working face angle and consequent reductions in outside dump volumes.

Figure 10.1

OVERALL MINING BENCH ARRANGEMENT



The actual operation of the excavation faces can be optimised as the mine is put into operation and none of the decisions made in this study would be highly constraining on operating personnel.

10.6.2 Bench Offsets and Layout

The overall mining bench layout and excavation slope is based on scheduling flexibility, safety of equipment operation, and geotechnical considerations. An overall excavation face slope which is very shallow provides for very safe working conditions, large areas for working of equipment, and scheduling at high production rates - but has a very high cost in terms of advance waste removal expenditure and outside dump volumes. Conversely, a steep overall excavation face provides for the maximum amount of in-pit refill and minimum advance waste removal expenditure but constrains the mining operation quite critically in terms of efficient scheduling and safety of operation of equipment.

The effective angle of the excavation face which must be used for the production rate can only be determined after detailed scheduling. However, this cannot take place until the volumes of the various mining blocks have been calculated. Calculation of mining blocks firstly requires the layout of the mine plan which can only be undertaken when the overall angle of the excavation face is known. To overcome this (circular) problem, empirical design criteria have been developed which allow reliable layout of mining faces that will not constrain subsequent scheduling operations. The criteria used for the layout of the Mount Arthur design are outlined in Reference 9.

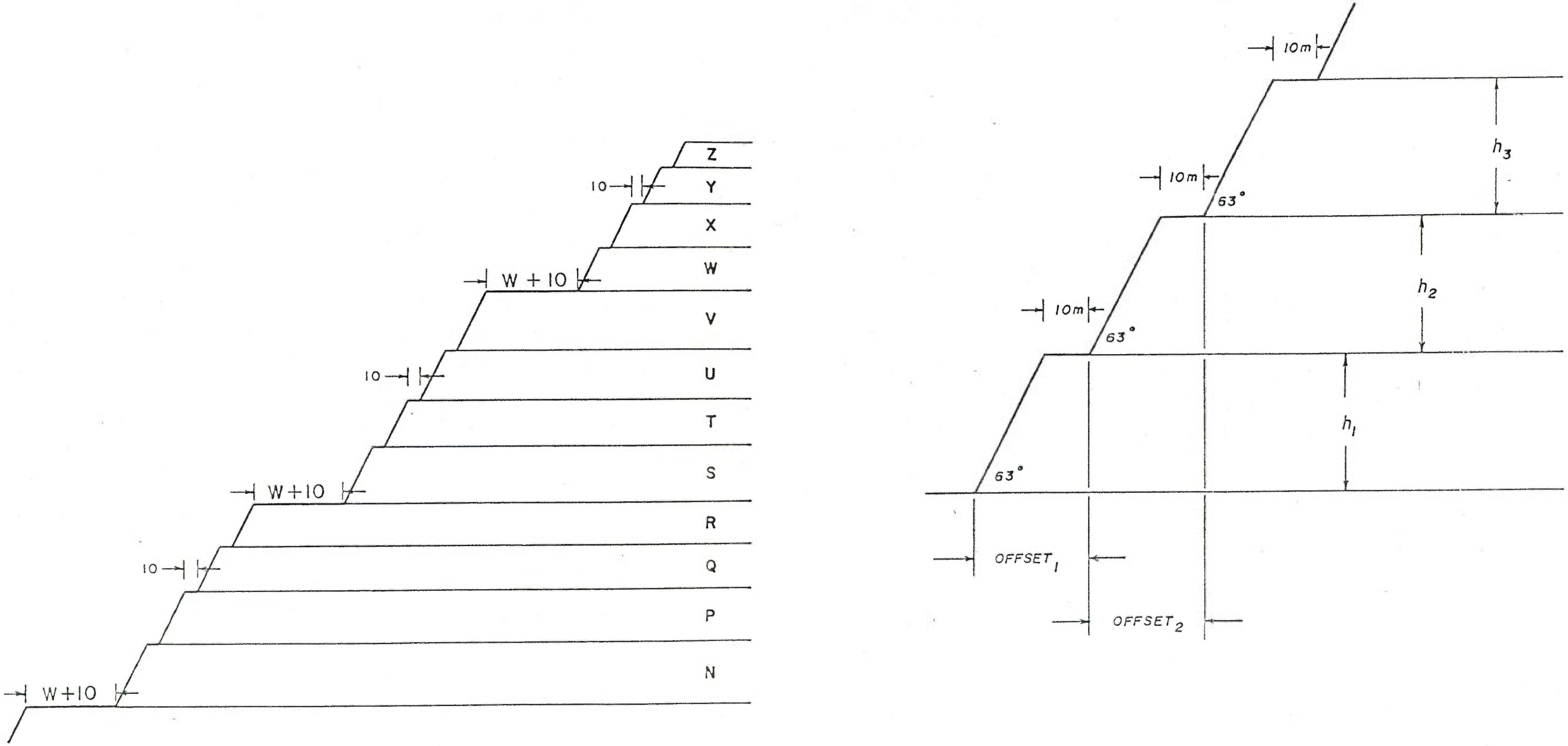
As indicated in Figure 10.1, the overall horizontal offset is made up of the following four components.

Working Bench Width Bench widths were determined as discussed in Section 10.6.1.

Safety Offset As shown in Figure 10.2, this safety offset is determined at either 3 metres in the case of thin coal and interburden benches, or 10 metres in the case of adjacent thick overburden or coal benches.

Figure 10.2

MINING BENCH ARRANGEMENTS



FULL PIT WIDTH OFFSET EVERY FOURTH BENCH

4th. Bench Offset = Pit Width + Standard Offset
= W+10

$$\text{OFFSET}_1 = 10 + \frac{h_1}{\tan 63^\circ} = 10 + \frac{h_1}{2}$$

$$\text{OFFSET}_2 = 10 + \frac{h_2}{\tan 63^\circ} = 10 + \frac{h_2}{2}$$

Offset due to Batter A batter angle for waste and coal (1:2 slope), equal to half of the thickness of the benches.

Special Design Offset In addition to the above offsets, an additional working width of 25 metres has been allowed between the top of the dragline chop cut horizon in the Ramrod Creek and Whites Creek zone and the closest working bench for shovel operations. This offset allows safe truck haulage operations to be carried out adjacent to the dragline working area.

Because of the large number of potential working benches at Mount Arthur North and the length of the pit, it is not necessary to have to work on all major mining benches at the same time to achieve the scheduled production rate. Accordingly, the mining bench arrangement has been organised, as shown in Figure 10.1, to provide only for major mining operating benches on every nth horizon. The value of "n" depends on the number of benches at any one time within the zone in such a way that the overall working face slope equates to the values given above. The effect of the special design offset is to permit simultaneous working of a number of benches, rather than be constrained to work in an inflexible sequence from the top of the pit to the bottom of the pit.

10.6.3 Excavation End Wall Batters

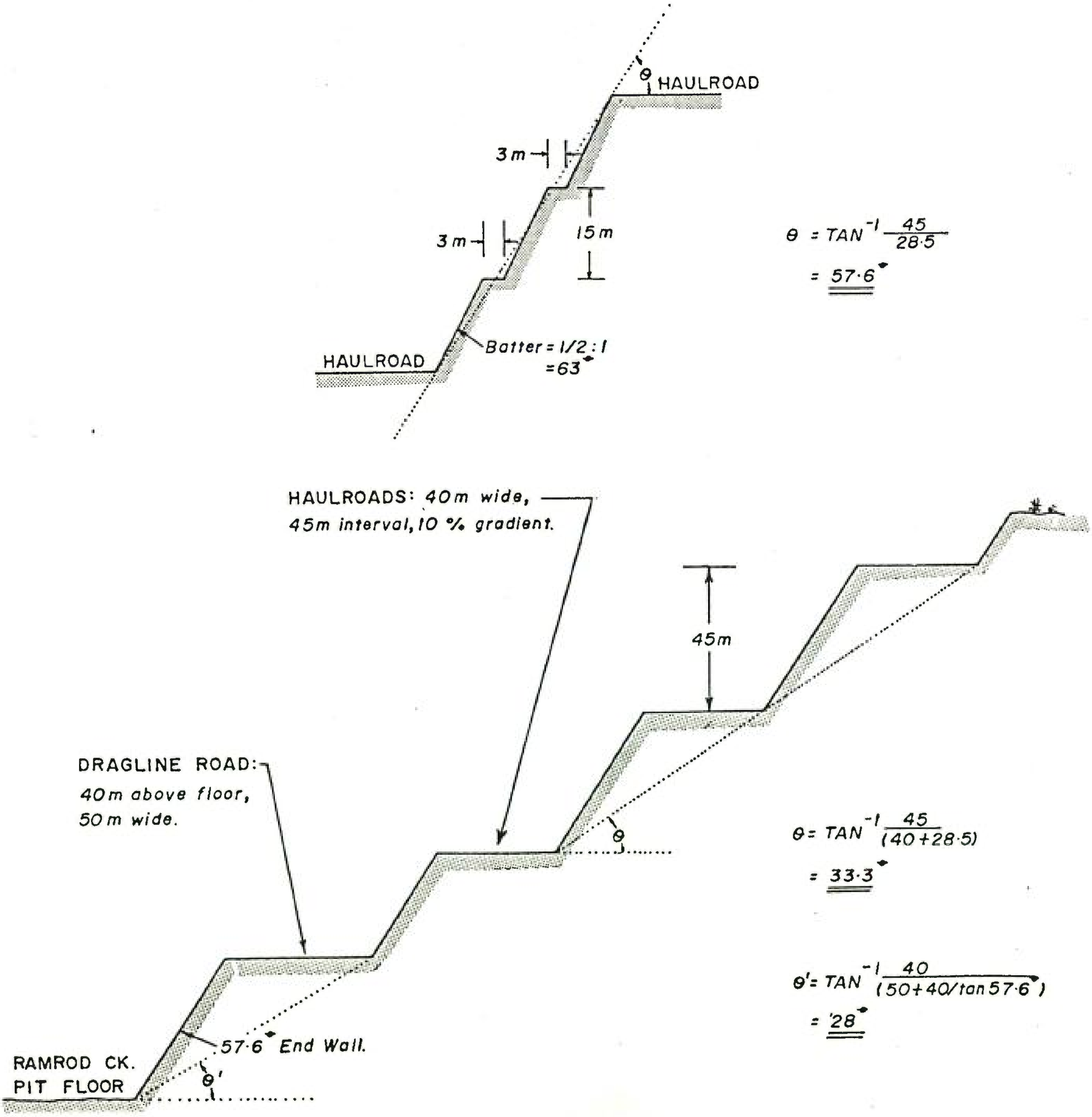
The excavation batters used for the basic design of the end walls are indicated in Figure 10.3. As shown in this figure, the end wall batters incorporate major haul roads at a vertical separation of 45 metres as well as a 3 metre safety berm at 15 metres vertical intervals along the wall. This yields an overall angle of 33.3 degrees for the main end wall batter. Additional allowances have been made for a wider dragline walk road on the southern side of the Whites Creek zone and the northern end of the Ramrod Creek zone.

10.6.4 Haul Road Design

On the northern end of the Ramrod Creek zone and southern end of the Whites Creek zone, independent haul roads direct waste excavation from upper benches of the excavation face to the upper benches of the refill face while, simultaneously, the lower haul roads direct waste from the lower excavation face benches to the lower refill benches. In this way, it is always possible for the trucks to work on independent haul routes which do not cross, resulting in minimum interference between trucks working in different parts of the pit. In the central region of the mine, all of the trucks are required to cross the

Figure 10.3

SIDE BATTER AND END WALL DESIGN



pit at the boundary between the northern end of the Whites Creek zone and the southern end of the Basil zone. This is an area of potential congestion and, accordingly, a 60 metre wide bridge has been established across to the spoil side in this area. Haul roads on the end wall batters of the Basil zone direct traffic from the various benches onto this central bridge and onto the various refill levels on the inside dump.

Apart from the haul road in the central cross pit bridge, which has been designed at 60 metres wide, all haul roads have been designed at 40 metres width. Whilst this road width is greater than most road widths adopted for new mines operating in the Hunter Valley, it is considered essential at Mount Arthur North for the following reasons.

1. The significant number of trucks using the same haul road.

2. The associated support equipment will need to be using the haul roads at the same time as the haul trucks without being constrained by the speed of travel of the haul trucks, or without interfering with the progress of these trucks.

3. The two different (sizes of) haul trucks may be travelling at different speeds and the above road width will minimise potential congestion. A cross-section of a typical haul road showing the truck sizes drawn to scale with allowance for drainage and safety berms is shown in Figure 10.4.

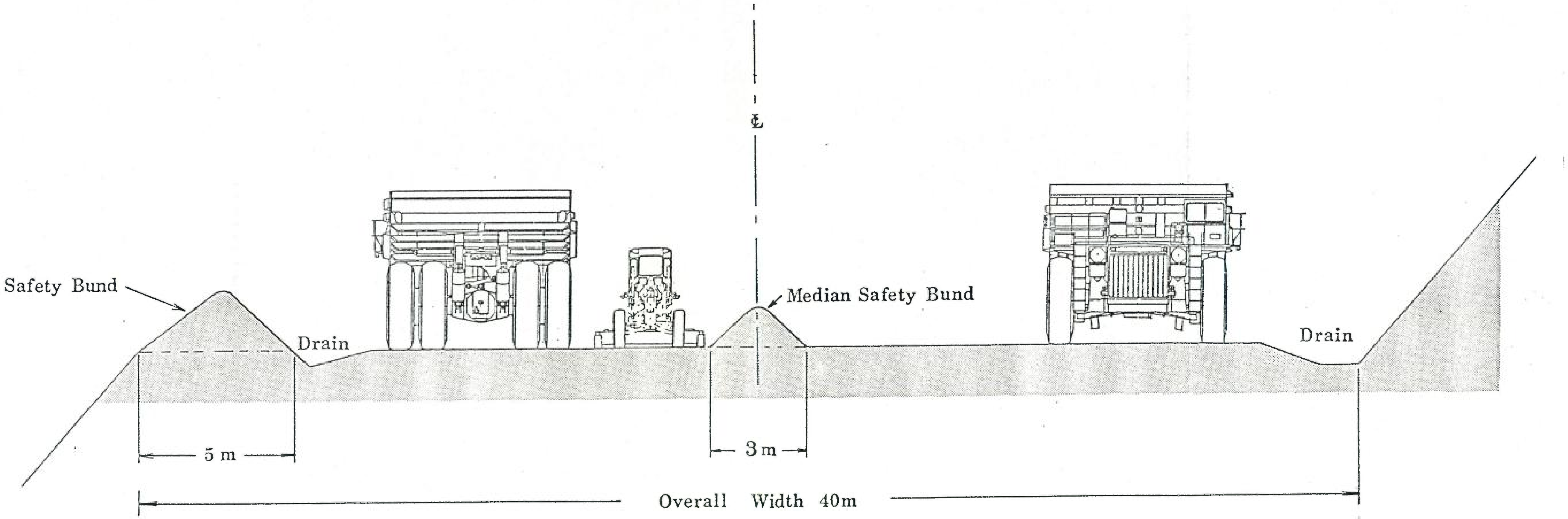
4. It provides the opportunity for unrestricted operation of the water trucks to suppress dust.

The selection of an optimum haul ramp gradient involves the assessment of tradeoffs between mining efficiency and refill design, within the constraints imposed by the deposit geometry and mining method. Since waste material swells upon excavation and since the mining method entails progressive backfilling as the mine advances down dip, the seam dip is a major constraining factor in haul road design. The major elements in the determination of optimum haul road gradients are outlined in Reference 9.

All roads were designed on a standard gradient not exceeding ten percent on the refill face. Since it was also considered prudent that the same grade be adopted on excavation end wall batter roads (to eliminate the need for gear changes on the mechanical drive trucks), this overall gradient has been adopted generally throughout the entire mine design.

Figure 10.4

TYPICAL HAUL ROAD CROSS-SECTION



Computer-based simulations have indicated that the economics of the project are not sensitive to haul ramp gradient, within plus or minus several percent of the adopted figures.

10.6.5 Waste Dump Design

The philosophy in the design of the waste dumping bench arrangement is that, at all times, the overburden material will be hauled the minimum possible distance and the minimum possible overall elevation. To achieve these aims, haul roads are located in the end wall batters every 45 vertical metres. This allows the simultaneous mining and dumping of waste material from all working benches on the excavation face to all working levels on the refill face with minimum interference of haulage equipment. Also, since dumping at the lowest available dumping level will always take precedence, the final design height of the overburden dumps will only be achieved when no other alternative is available for dumping. This has the following important advantages.

1. Waste truck productivity is maximised, particularly in the early life of the mine.

2. Maximum (final) waste bench height is not reached until Year 15 of operations with the consequence that the visual impact of the waste dumps is generated slowly and gradually over the life of the mine.

In accordance with this philosophy, trucks will haul waste material from the excavation face around the end wall batters of the pit (which are established with ramps leading up to the in-pit refill) and continue on to the refill face at 30 metre vertical intervals. The actual dump level may not necessarily be fixed at any particular RL.

In practice, it is expected that only half of the nominal dumping benches would be open at any one time so that the overall slope of the refill face will typically average 23 degrees.

In addition to the 30 metre RL difference between dumping levels, a 60 metre horizontal offset has been allowed to permit the dumping of overburden in the upper refill levels simultaneously with dumping of overburden in the lower levels. It is anticipated that during the course of the dumping operations for each strip, the width of these major dumping levels would fluctuate between 30 and 60 metres as each phase of the dump was progressively advanced. Accordingly, it is not necessary to always commence dumping in any one strip of advance from the bottom-most level up but the dump may be advanced progressively from each of the major (60 metre wide) established dump levels. In this way, it is always possible for the overburden on the lower benches of the excavation face to be disposed of on the lower benches of the refill face and, similarly, the overburden from the upper benches on the excavation face dumped on the upper benches of the refill face. This refill dumping arrangement provides great flexibility in the way dumping levels may be developed and results in the minimum amount of elevation of the waste material from the excavation face to the refill face. Since this factor (elevation of material) is the single most important factor affecting truck productivity (see Reference 9), the adopted refill design provides for maximum truck productivity. This, in turn, minimises the number of trucks required, and consequently reduces the environmental impact of the waste removal operation.

The haul roads from the excavation end wall batters to the in-pit refill dumps have been designed as a continuous haulage road from the excavation face to the refill face. This simple arrangement eliminates the need (as is the case in many mines) for trucks to zig-zag out of the pit - and should provide for more favourable conditions for haul roads as well as reduced wear on truck tyres and transmissions. In general, fairly regular haulage routes are also available for coal haulage trucks between the coal faces and the Run-of-Mine dump station. However, because of the significantly lower volumes of coal to be trucked, the coal haulage routes have been designed to be integrated with the overall waste handling strategy, and may therefore appear suboptimal if viewed in isolation.

Because of the working area that must be developed at Mount Arthur North and the fact that the mine is advancing down-dip, a large amount of waste material must be placed totally out of the pit before in-pit dumping can be balanced with the volume of excavation. The final design adopted for outside dumps was developed by the application of appropriate slope and maximum height parameters to the volume requirements dictated by the mining quantities and mining method.

The overall shape of the final waste dump was based on environmental considerations. Slopes were designed to be generally less than 7.5 degrees, although some small localised areas exhibit slopes of up to 10 degrees. The maximum elevation of the final waste dump is RL240 in both the Whites Creek zone and the Ramrod Creek zone. This dump will be built up progressively in vertical lifts as required over the initial 20 year life of the mine, as shown in Figure 10.5.

GOOD IDEA

Figure 10.5
DUMP CONSTRUCTION METHOD

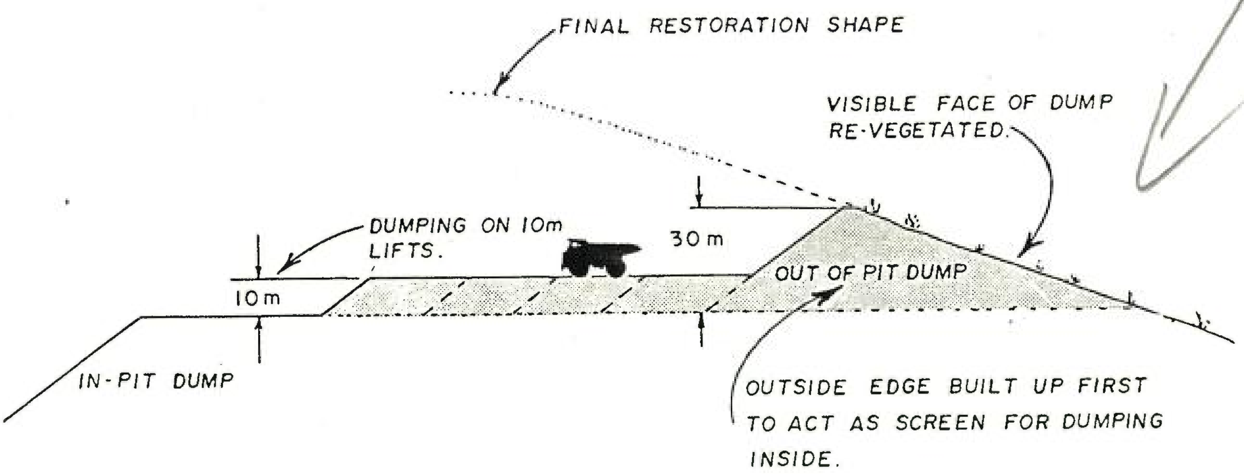


Figure 10.5 highlights the essential features of this dump construction.

1. The visible (outside) part of the dump is initially built up in 30 metre lifts and re-contoured, topsoiled and revegetated so that the environmental impacts are minimised.

2. Once the 30 metre outside lift has been developed, trucks dumping within that pit area will be obscured from observers outside the mine area. Dumping within that area will generally be accomplished in 10 metre lifts to minimise the actual haulage height for material.

3. When the dumping from the 10 metre lifts is within 10 metres of the RL of the environmental screen, this screen will again be built up by a further 30 metres to allow an additional 30 metres of dumping within it.

4. The overall slope of the "flat" area within the outside dump will be adjusted for drainage in such a way that water will collect at sumps appropriately located to allow settling of silt and efficient use of any water for later dust suppression.

10.6.6 Waste Dumping Approach

The adopted waste dumping method will ensure that there is adequate waste dumping space for exploitation of the deposit well beyond the initial 20 year period. The waste dump is built up gradually in vertical **lifts**, each approximately 10 metres high, with all exposed dumping areas readily accessible by water trucks. The method minimises the number of trucks required for waste haulage, and provides for tailngs disposal within the spoil.

The alternative strategy of constructing the waste dump in "vertical" slices from east to west was considered but was found to be much less attractive, primarily because almost all truck-shovel waste in the initial 20 year period would need to be hauled out of pit, with a consequent major increase in the number of haul trucks required. The economies of the project would be significantly affected.

SCHEDUEL OF OUT OF PIT
DUMPING AND PLAN OF
AREA UTILIZED

NOT CLEAR.

In addition, it was considered that the alternative dumping strategy had several environmental drawbacks, viz.

a. the height of the waste dump would rise rapidly with consequent negative visual impacts,

b. the only waste dumped within the pit would be dragline spoil. This would present difficult access problems for water trucks to water the large area of exposed spoil, and

c. although it is intended to continue mining beyond the initial 20 year period, an early cessation of mining would result in a very large void in the pit.

Waste dumping strategies which only addressed waste dumping space for the initial 20 year period were rejected. Such strategies would prevent the efficient and orderly extraction of coal beyond year 20, and therefore jeopardise the opportunity of using the deposit as a long term supply of low cost coal for power generation.

CHAPTER 11

DEFINITION OF MINING QUANTITIES

11. DEFINITION OF MINING QUANTITIES

11.1 Mining Reserves

The mining block plan was developed to delineate a mining reserve on a bench-by-bench basis for each of the zones. Each bench is divided into a number of strips and some of the strips in the early part of the mine development are further sub-divided into a number of blocks. Approximately 6,000 blocks were used to detail the mining reserves.

Table 11.1 summarises mining reserves for each of the four zones. The reserves blocked out extended to Strip 43 in the Ramrod Creek zone, Strip 35 in both the Whites Creek zone and Basil zone, and the entire Edinglassie zone. Over the initial 20 year mine life, only 23 percent of these reserves are currently planned to be extracted.

11.2 Mining Recovery, Dilution, and Coal Quality

An analysis of expected coal mining recoveries has been carried out based on experience in other projects being planned in the Hunter Valley, with due allowance for the particular conditions applying at Mount Arthur North. Mining recoveries were generally determined on the basis of a certain amount of coal lost from the top and bottom of the seam during mining as a consequence of the size and type of mining equipment used.

Table 11.1

MT. ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY

3·5 M.T.P.A. PRODUCT CASE

MINING RESERVE VOLUMES BY PIT

Item	Ramrod Creek Pit	Whites Creek Pit	Edinglassie Pit	Basil Pit	Total Reserve
1. Waste Volume (truck/shovel)	318,160,626	576,600,349	29,096	396,175,021	1,290,965,092
2. Dragline Prime Volume	157,445,544	156,021,364	6,650,932	-	320,117,840
3. Dragline Rehandle	0.724	0.714	0.252	-	0.710
4. Dragline Total Volume	271,366,263	267,347,240	8,328,329	-	547,041,832
5. Total Prime Waste Volume	475,606,170	732,621,713	6,680,028	396,175,021	1,611,082,932
6. Coal Volume In situ	78,385,909	109,209,692	1,616,413	40,499,974	229,711,988
7. Coal Tonnes In situ	118,440,153	163,202,419	2,349,659	60,164,610	344,156,841
8. Coal Mining Recovery	0.901	0.889	0.943	0.871	0.890
9. R.O.M. Coal Tonnes	116,831,040	157,993,862	2,411,776	57,082,318	334,318,996
10. Ratio (5/9)	4.07	4.64	2.77	6.94	4.82

Top of Seam Loss
(dependent on overburden removal above seam)

Waste Removal Scheme	Typical Thickness Range	Coal Seam Thickness Loss
Dragline	Greater than 15 m (lower benches only)	150 mm
Rope Shovels	8 - 15 m	150 mm
Hydraulic Excavators	4 - 8 m	100 mm
Front-end Loaders	Less than 4 m	75 mm

Bottom of Seam Loss
(dependent on coal seam mining equipment)

Coal Removal Scheme	Typical Thickness Range	Coal Seam Thickness Loss
Hydraulic Excavator	Greater than 3 m thick	150 mm
Hydraulic Excavator/ Front-end Loader	1 - 3 m	125 mm
Front-End Loader (only)	Less than 1 m	100 mm

When applied to the situation at Mount Arthur North, the actual mining recoveries associated with the above losses are shown graphically in Figure 11.1.

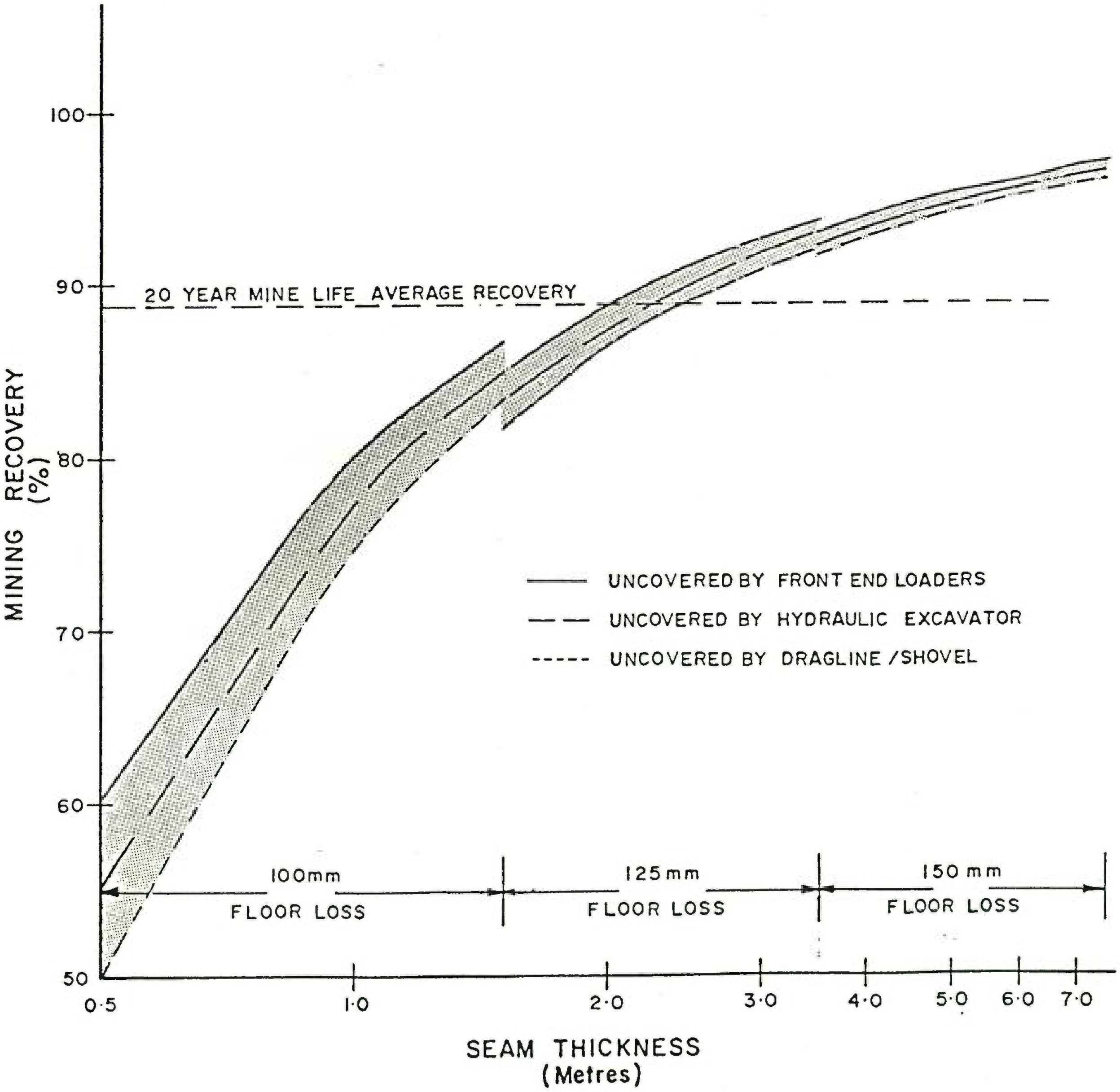
Whilst the above losses are consistent with the estimates and practice used by other operators in the Hunter Valley, the following points with particular relevance to Mount Arthur North should be noted.

1. Over the life of the project, 23 percent of the coal is exposed by dragline. Typically, draglines have low selectivity due to their large bucket size.
2. The relatively hard waste benches of Mount Arthur North require a high powder factor for blasting. This blasting may result in a higher disturbance of coal with consequent generation of fines and greater coal losses.

The calculated mining recoveries are applied to the in-situ coal reserves in order to establish the raw recoverable reserves.

Figure 11.1

COAL MINING RECOVERY BY SEAM THICKNESS



Dilution of the raw recoverable reserves arises from the addition of out-of-seam waste material and moisture during mining operations. Based on experience in similar operations, it is anticipated that the run-of-mine coal will contain out-of-seam dilution equivalent to 2 percent by weight of 100 percent ash material. It is expected that the run-of-mine coal would have a total moisture of eight percent. Since the inherent moisture of the raw recoverable reserves varies on a seam-by-seam and block-by-block basis throughout the mine, adjustments to coal qualities for moisture addition and out-of-seam dilution during mining were applied on a block-by-block basis.

11.3 Waste Volume Disposal and Allocation

As indicated in Section 10.6.5, the design of the in-pit refill involved a fixed allocation of overburden material from the excavation faces to the refill faces in order to calculate truck requirements in detail. The actual allocation of individual blocks is included as back-up data to this report.

CHAPTER 12

MINING EQUIPMENT SELECTION AND OPERATING TECHNIQUE

12. MINING EQUIPMENT SELECTION AND OPERATING TECHNIQUE

12.1 General

The basic criterion for selection of mining equipment at Mount Arthur North is to make maximum use of large equipment to achieve the most efficient low cost operation possible. This strategy has beneficial environmental effects in that the number of traffic movements on the site is minimised. Particular emphasis has been placed on overburden haulage equipment productivity and dragline operations because these will account for a large proportion of the operating costs of the mine. In line with this philosophy, the high utilisation of the main overburden haulage trucks has, in some instances, been at the expense of lower utilisation of loading units and some of the less important equipment items (e.g. road maintenance equipment). In addition, maximum use was made of electrically powered excavators in preference to excavating equipment running on fuel oil. About 80 percent of the waste excavation on the site will be undertaken by electrically powered equipment.

12.2 Overburden Excavation - Draglines

Approximately 30 percent of the overburden on the site is in benches that are arranged geometrically in such a way as they can be mined by dragline.

12.2.1 Single Seam Strip Cut Operations

The proposed method of operation in the single seam sections of the mine at Mount Arthur North is the extended bench (rehandle bridge) method of operation. This operating technique is employed in most other mines in Australia and provides for maximum productivity while excavating wide pits. The details of this method of operation are indicated in Reference 10.

The method of calculation of productivity for the dragline for this method accounts for the following factors:

1. Machine operating time per hour.
2. Delays due to positioning, waiting on dozer, etc.
3. Bucket filling times.
4. Swing times.
5. Dumping, delay, and other operating times.

During single seam operations, it is estimated that the production rate from this machine will be in the order of 2,201 bank cubic metres per operating hour. The estimate of productivity based on bank cubic metres includes the volume of rehandle where rehandle is also expressed in equivalent (unswelled) bank cubic metres. Adjustments for dragline rehandle on a block-by-block basis were input separately to the mining model depending on the position of the strip, bench width, seam dip, and overburden thickness.

12.2.2 Two Seam Strip Cut Operations

The method of operation of the dragline for extraction of two seams simultaneously, as shown in Figure 12.1 is described as follows:

1. Excavation of a key cut and chop cut for waste material overlying the Edinglassie seam and spoiling of this material onto the dragline working bench level. The chop cut thickness is limited to 5 metres due to the presence of comparatively hard material in the interburden above Edinglassie seam.

2. Excavation of the main volume of overburden overlying Edinglassie seam and continued construction of the dragline extended bench.

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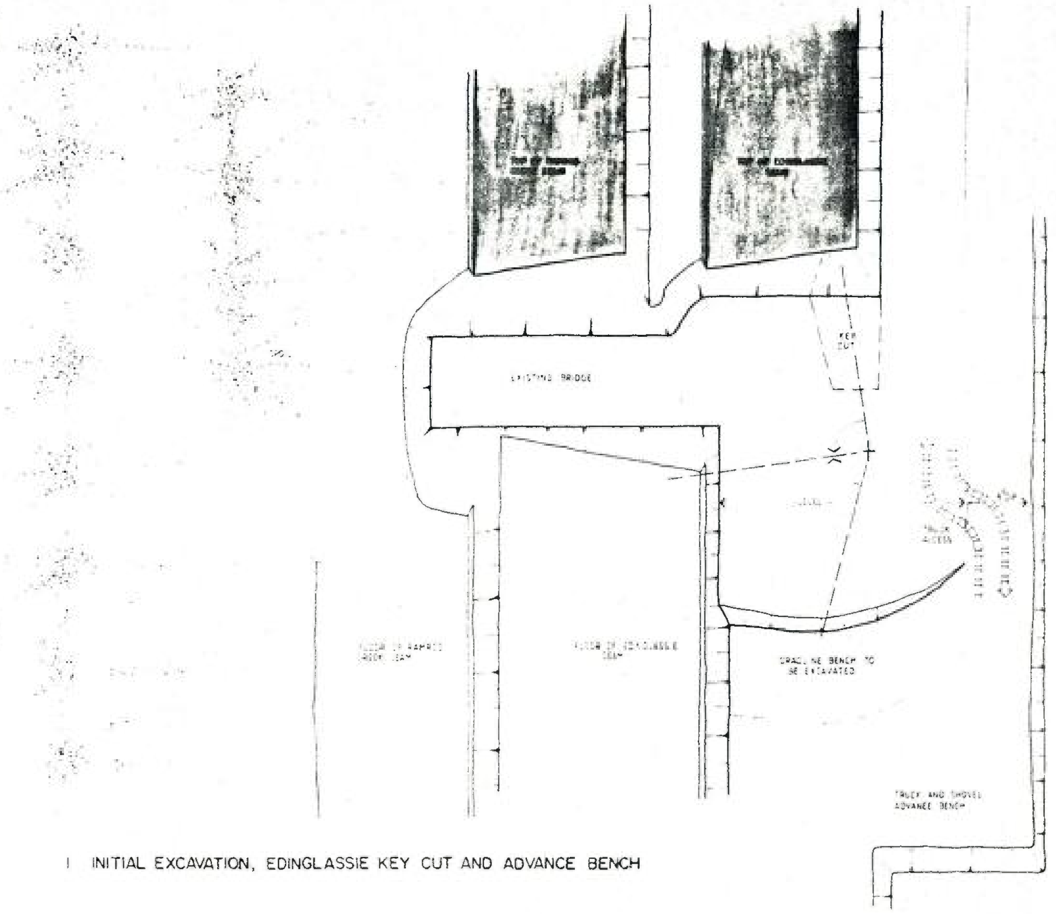
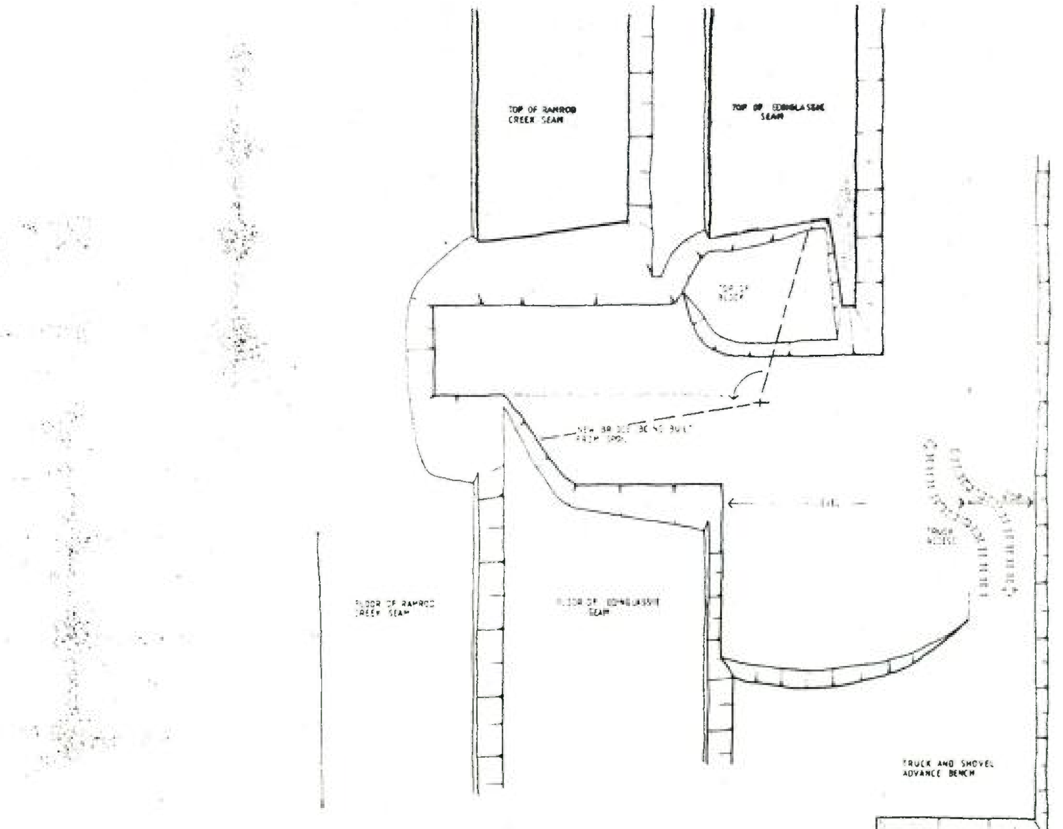
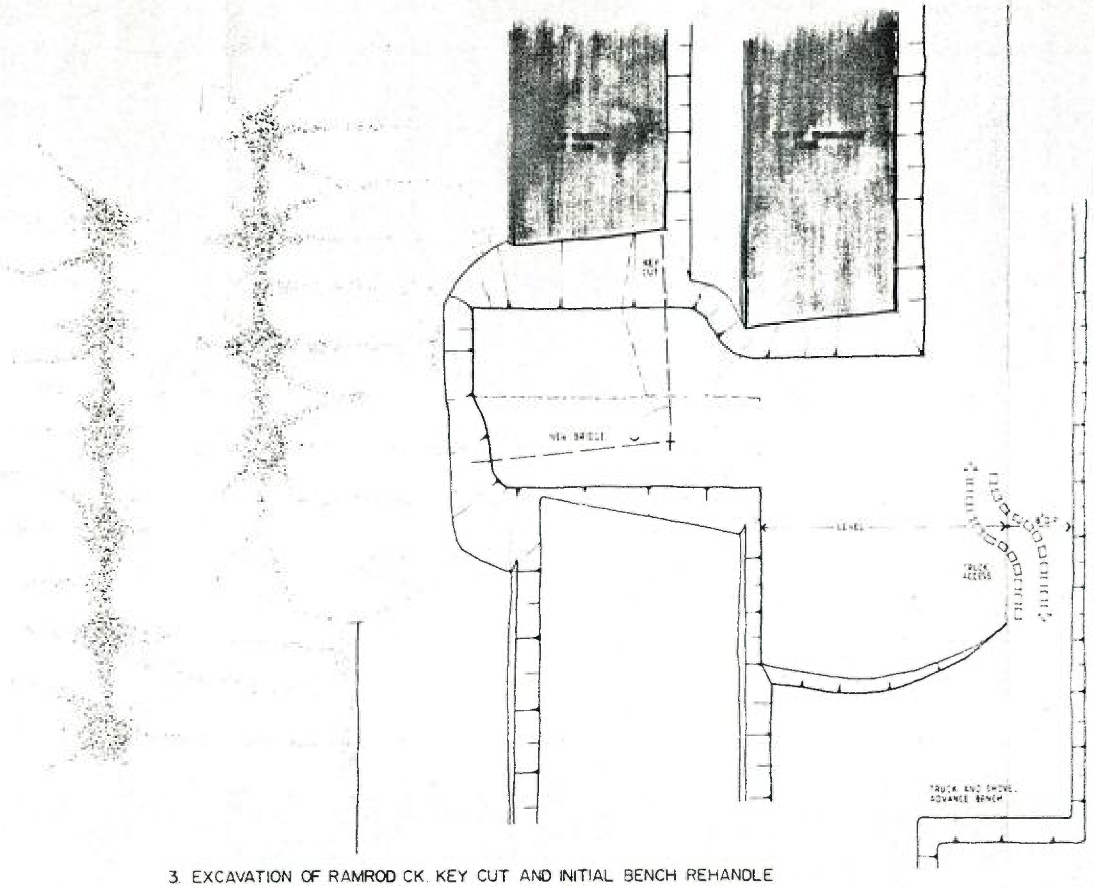
PLAN VIEWS



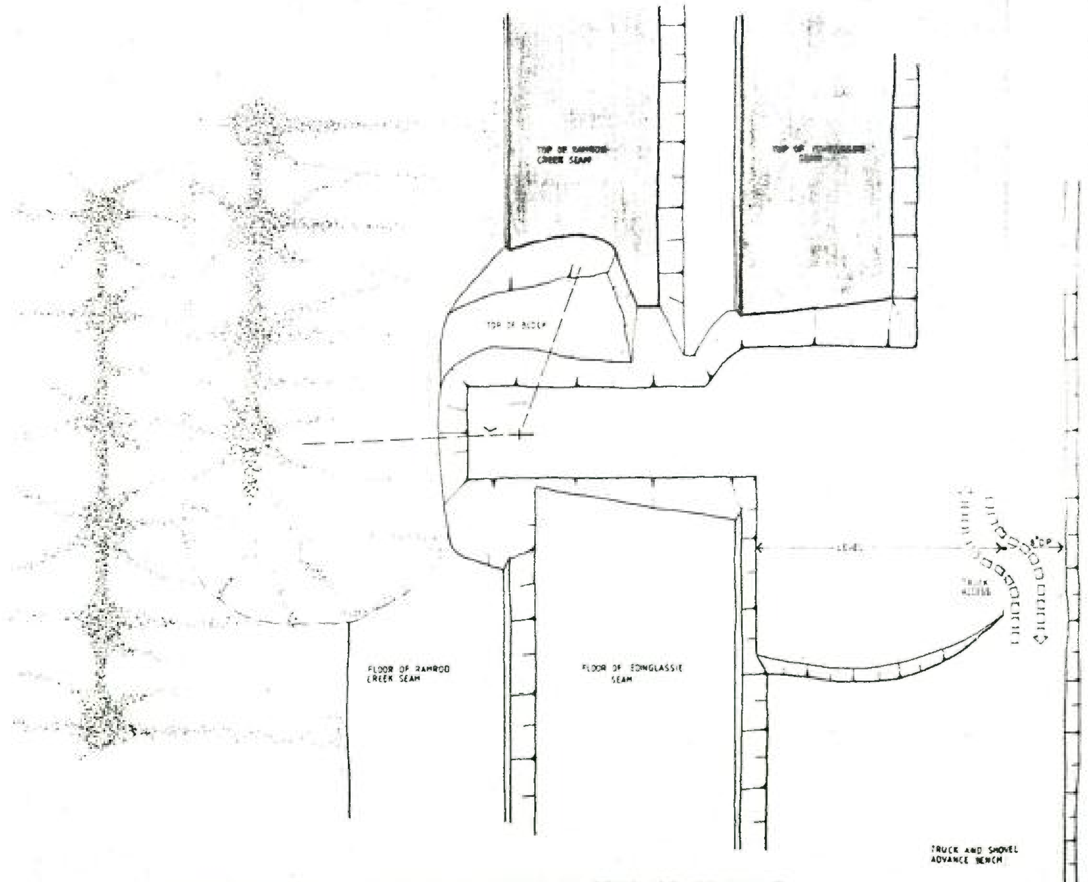
1. INITIAL EXCAVATION, EDINGLASSIE KEY CUT AND ADVANCE BENCH



2. MAIN EXCAVATION, WASTE ABOVE EDINGLASSIE SEAM

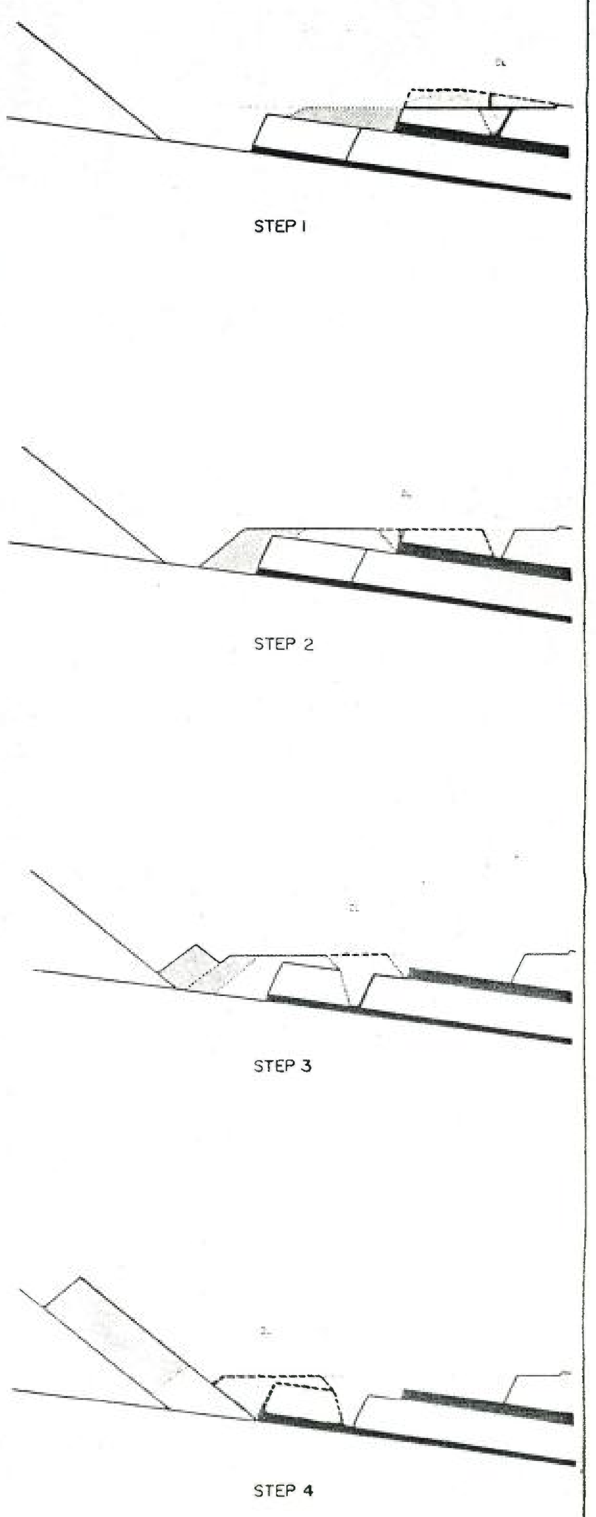


3. EXCAVATION OF RAMROD CK. KEY CUT AND INITIAL BENCH REHANDLE



4. FINAL EXCAVATION, WASTE ABOVE RAMROD CK. SEAM AND REHANDLE

SIDECASTING DIAGRAMS



▭ EXCAVATED MATERIAL ▨ SPOILED MATERIAL

RUNGE AND ASSOCIATES PTY. LTD.
BRISBANE QUEENSLAND AUSTRALIA

PREPARED FOR:
MT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY

RAMROD CREEK
EXCAVATION SEQUENCE OF DRAGLINE

DATE	JUNE 1982	SCALE	NOT TO SCALE
DRAWN	T. B.	DRAWING No	
CHECKED		FIGURE 12·1	
ORIGINAL DATA			

3. Excavation of a key cut down to the base of the lower seam (usually the Ramrod Creek seam) and associated rehandling of the previous bench overlying this key cut. Disposal of this material either on the end of the new extended bench or directly into the spoil pile.

4. Excavation of the balance of the overburden overlying the lower seam and the rehandling of the remaining superimposed extended bench. This material is disposed directly onto the spoil pile.

Where the Lower Ramrod Creek seam exists, the interburden between it and the Ramrod Creek seam will be excavated by truck/shovel methods. In this situation, the dragline spoil pile will be constructed such that the toe of the pile clears the Lower Ramrod Creek seam.

Because of the many factors which affect the dragline operating capability in this two seam situation, a computer program was utilised to design for optimum operation whilst still providing for key cutting of both interburden materials and direct disposal of waste. In some cases, additional waste material above the Edinglassie seam was allocated to the dragline in order to more evenly balance the scheduling requirements between draglines and shovels.

A production rate of 2,218 bank cubic metres per operating hour during double seam operations is anticipated. As with the single seam method, this production rate also applies to the rehandling component of the operation when rehandle volumes are expressed in equivalent bank cubic metres. The actual rehandle associated with each block has been calculated on a block-by-block basis, depending on the location of the strip, seam dips, offsets, thicknesses and amount of interburden assigned to the dragline above the Edinglassie seam.

Over the life of the mine, the average rehandle percentage is extremely high by comparison with other Australian operations and is fully explained by the following:

1. Most Australian dragline oprations are single seam situations.

2. The operating scheme adopted involves simultaneous excavation of two seams; and, of necessity, this scheme involves high rehandle. Simultaneous excavation of two seams provides for the slow linear rates of advance necessary for scheduling of such large equipment in a confined pit situation.

3. The influence of the Transition seam between Edinglassie and Ramrod Creek seams means that, in many cases the effective amount of overburden material being moved by the dragline is small compared to the volume of rehandle necessary to establish the extended bench. This effect is slightly more pronounced in the Whites Creek zone.

4. The operating conditions at Mount Arthur North involve spoiling up-dip at a steeper dip than most other Australian mining operations. In areas of steep dip, the added height of the resulting spoil pile means that narrower pits must be adopted. Since the volume of rehandled material in the bridge is relatively constant, in areas of steeper dip (narrower pits), the proportion of rehandle is higher.

At a production rate of 3.5 million tonnes of product coal per annum and with the development of the large single pit, the adopted dragline method, despite the high rehandle, does not contribute significantly to increased mining costs.

A number of alternative dragline methods were investigated but these did not satisfy all of the constraints imposed upon dragline operation in the Mount Arthur North deposit. A two pass technique could result in lower rehandle percentages but was rejected in the light of geotechnical considerations and the need to maximise scheduling flexibility. The positioning of a dragline on the spoil pile was not recommended, at least initially, by the Commission's geotechnical consultant and, in any case, the hard interburden material above the Ramrod Creek seam is not suited to cross-chopping by a dragline located on the spoil side.

12.3 Overburden Excavation - Rope Shovels

Approximately 79 percent of the truck/shovel overburden on site is in benches thicker than 8 metres and is therefore suited to excavation by large rope shovels. Current large rope shovel sizes available on the mining equipment market are as follows:

Shovel	Bucket Capacity	Normal Maximum Face Height	Applicable Truck Sizes
P&H 5700	46 - 50 m^3	20 m	154 - 280 tonne
P&H 2800	23 - 26 m^3	16 m	110 - 200 tonne
B-E 395-B	23 - 26 m^3	16 m	110 - 220 tonne
Marion 204M	23 - 26 m^3	16 m	110 - 200 tonne
P&H 2300	17 - 20 m^3	14 m	100 - 154 tonne
B-E 295-B	17 - 20 m^3	14 m	100 - 154 tonne
Marion 201M	17 - 20 m^3	14 m	100 - 154 tonne

Although there is a large proportion of overburden thicker than 8 metres, only 19 percent of the truck/shovel overburden is also thicker than 15 metres and for this reason no real consideration has been given to the application of the largest rope shovel available (P&H 5700). Of the other large shovels available, the most widely used machine to date has been the P&H 2800 and therefore this machine was selected as a model for use at Mount Arthur North and production rates associated with this machine calculated accordingly. At the Mount Arthur North site, this unit could be equipped with a bucket size of 24.5 cubic metres. It should be noted however that a number of the other shovels from the above table could be equally well used and no consideration has been given in this report to the benefits of adoption of shovels from a particular manufacturer.

The production from a P & H 2800 working in this configuration has been calculated using known estimating techniques. In this calculation, allowance has been made for single and double sided loading as well as for the time lost in walking around the face and other typical delays. Since the shovel productivity is also linked to the productivity of the trucks, this aspect was also considered in determining truck productivity, and the effects of truck/loader match as detailed in Reference 9 were examined.

12.4 Overburden Excavation- Hydraulic Excavators

Waste benches in the range 4 to 8 metres will be excavated generally using large hydraulic excavators. These units provide the economics of operation of fairly large equipment without the inefficiencies in bucket filling associated with the use of rope shovels on thin benches. For the purposes of this study, hydraulic excavators in the 14 cubic metre bucket size range are appropriate working with trucks of 108 tonne capacity. Whilst a number of manufacturers have developed machines in this size range, currently there is only one brand of machine (Demag H-241) of this size working in Australia.

12.5 Overburden Excavation - Front-End Loaders

For removal of overburden thinner than 4 metres and to support the hydraulic excavators in some of the overburden in the thickness range 4 to 8 metres, large front-end loaders have been selected. These units provide the flexibility required for selected overburden removal tasks about the mine, and due to their mobility and control of bucket position are ideally suited to selective mining of thin overburden with minimum contamination of the underlying coal seams. Being deployed on thin benches means that the linear advance in any one excavation face is quite fast. This is an additional aspect which requires the use of very mobile equipment not constrained by trailing cables. For the task required at Mount Arthur North, the following units are currently available.

Front-end Loader	Power Rating (kW)	Bucket Capacity	Maximum Loading Height
Cat 992-C	5.1	10.3	4.1
Le Tourneau L-800	641	11.5	4.9
Le Tourneau L-1200	895	16.8	5.6
Dart D600/620	597	11.5	4.8
International Hough 580	811	16.8	5.4
Michigan 475C	477	7.7	4.5

For the purposes of calculation of productivities, the 641 kilowatt Le Tourneau L-800 has been adopted as a model representative of the class of unit suitable for the task. No preference for the unit from any particular manufacturer is implied.

12.6 Overburden Haulage - 154 Tonne and 108 Tonne Trucks

For overburden haulage of large size material in the most efficient manner, the only appropriate size and type of unit which could be realistically selected is the 154 tonne size rear dump haulage truck. These units work almost exclusively with the large rope shovels.

For thin waste benches, the front-end loader and hydraulic excavator are not strictly suited to this size of truck due to the high loading height necessary and the number of passes required to fill it. Accordingly, trucks in the 108 tonne size range have been matched with the smaller loaders.

Since the operation of these trucks will account for a sizeable proportion of the operating cost of the mine, the production rates and operating conditions for these trucks were assessed in detail. Production rates were calculated according to the following methodology:

1. The haul route was determined by the volume allocation, as shown in Section 10.6.4.

2. A contour plan was developed at significant phases during the mine advance showing the RL of the haulage route over the entire journey from the loader to the dump area and return.

3. This haulage route was analysed by computer simulation for the truck concerned to determine the estimated travel time over the route.

4. Associated fixed times for loading and dumping, etc., were added to determine the truck productivity.

5. A second simulation was undertaken on selected profiles to assess the interaction between the trucks and the loader to determine the optimum match of equipment and to make adjustments to the production rates accordingly.

After determination of the appropriate production rates for the major mining benches, the production rates for equipment on all the other benches in the intermediate phases of mine life were calculated by linear interpolation between the major phases. In this way, actual truck production rates for every block of overburden and coal in the mine life were determined.

In addition to the above calculation, due consideration was given to the sensitivity of the truck production calculations to variations in estimated input data such as road rolling resistances and road gradients. Reference 9 was prepared on a study similar to Mount Arthur North and the items identified in this paper as having the greater sensitivity to truck productivity were critically assessed so that the estimates included in this report could prove to be as reliable as possible.

12.7 Coal Haulage - 108 Tonne Trucks

108 tonne trucks have been selected for coal haulage for the following reasons.

1. A rear dump (high power: weight ratio) truck is necessary for the gradeability required to haul out of the pit. If bottom dump trucks were used, then lower haul ramp gradients would be necessary - with consequent increases in mine operating cost.

2. The thickness of the seam and size of the corresponding loading units is suited to this size of truck. Smaller trucks would require a larger number of trucks with consequent increases in manning requirements and traffic volumes.

3. Use of the 108 tonne truck allows standardisation with the 108 tonne unit used for overburden removal. During the build-up phase, coal haulage requirements are not great and standard body overburden units or combination body units could be used for coal haulage.

12.8 Coal Loading

The requirements of coal loading units are:

1. Flexibility required for diversity of working areas.

2. A sufficiently high break out force on thin seams to ensure adequate recovery of coal.

3. A minimum generation of fines from operation of equipment.

The possibility of using a small rope shovel for excavation of some of the coal in the thicker seams (Edinglassie and Ramrod Creek seams) was examined. Whilst some potential does exist for use of electrically powered rope shovels for loading in these seams, this option was not seriously considered due to the poor mobility of these rope shovels and the relatively poor use that would be made of them in other areas of the mine. Consequently, the choice for coal loading equipment was again reduced to selection of a large front-end loader and/or a large hydraulic excavator.

For compatability with the equipment used for overburden excavation, the same front-end loaders and tracked hydraulic excavators were nominated - with the hydraulic excavator being used preferentially on the thicker seams (Ramrod Creek seam, Edinglassie seam, Bayswater seam, Piercefield seam, Vaux seam, Mount Arthur seams).

Production rates and scheduled production times for these two units were calculated.

12.9 Overburden Drilling

The assessment of overburden drilling requirements for the Mount Arthur North project has required considerable attention in this study due to the constraints imposed by environmental factors on the blasting operation. Selection of drill type for any particular bench was based on the particular blast zone in which the bench was located, as defined in the previous E.I.S. [Reference 1] and the height of the bench to be blasted. All drills will be fitted with dust collection equipment.

12.9.1 Large Rotary Blasthole Drills (B-E 45-R Class)

At Mount Arthur North large drills are appropriate for Blasting Zones 4, 5 and 6 for benches greater than 12 metres in height. A drill with a 13.4 metre mast to drill 229 millimetre or 250 millimetre diameter blastholes was selected for the following reasons:

1. This size drill is suited to average bench dimensions to be encountered. Single pass drilling will be possible for a substantial proportion of the drilling.

2. A large number of similar sized drills are in use in Australia and a great deal of operating experience is available on these units.

Drill production rates for the mine scheduling were expressed in terms of bank cubic metres per drill hour. The major factor influencing the effective productivity of these units is the pattern to be drilled. The pattern is dependent on both blasting zone and height of bench and allowance has been made in the calculation to cope with these two factors as well as the presence or otherwise of coal beneath the bench (subgrade drilling).

1. Powder factor is dependent on digging machine. Powder factors used were as follows:

Machine	Powder Factor
Dragline	0.33 kg per bcm
Rope Shovel	0.38 kg per bcm
Hydraulic Excavator	0.40 kg per bcm
Front-end Loader	0.42 kg per bcm

2. Explosive to be used is loose poured ANFO at a density of 0.82 grams per cubic centimetre.

3. Firing is to a free face.

4. Holes are drilled on a staggered "V" pattern.

5. Height of explosive is such that the collar is generally equal to the burden.

To facilitate good toe digging conditions and to ensure optimum face stability and safety, angle hole drilling (10 - 15 degrees from the vertical) is recommended.

12.9.2 Medium Size Rotary Blasthole Drills (GD 35T Class)

A medium sized truck-mounted drill has been selected for intermediate waste bench drilling. Major categories of waste which will be drilled using this size of drill are:

Category	Description
A	All benches in range 6 - 12 metres.
B	Benches in Blasting Zones 1 and 2 greater than 12 metres in height where no subgrade drilling is necessary.
C	Benches in Blasting Zone 2 where subgrade drilling is required.

To accomplish this task the drill has a mast of 7.6 metres and is capable of drilling holes of 175 millimetre diameter. This size drill has a proven track record in similar applications and is well suited to the diversity of tasks for which it must be employed. Most benches which are drilled by this unit do not require more than two passes of the drill.

12.9.3 Small Drills (GD RDC 16-B Class)

All waste material thicker than 2 metres not already covered in the previous two sections will be drilled by a small drill. Determination of reliable estimates of production rates for these drills is most difficult since the productivity is very sensitive to setting-up time and operator experience. Accordingly, the thickness cut-off of 2 metres between drilled overburden and ripped overburden may need to be refined once some operating experience has been gained. Whilst the 2 metre cut-off limit may be low compared to other mines being operated in the Hunter Valley, the relatively hard ground conditions which appear to exist on the site dictate that a higher proportion of thin benches be drilled and blasted.

To accomplish the above tasks, a crawler-mounted drill with a mast of 9.1 metres has been selected. Although this is a track-mounted drill, it is diesel powered and has a high manoeuvrability. Several units of this type are in operation in Central Queensland and in other areas of the Hunter Valley. With nine such units on site, the availability of a drill close to any particular mining bench can be guaranteed.

For coal benches 1 - 5 metres thick a truck-mounted drill of the Mayhew 1000 size and class, to drill a 127 millimetre diameter hole, has been selected. This drill is highly mobile and is suited to the aereal distribution of benches at Mount Arthur North.

The 127 millimetre diameter hole is needed to satisfactorily meet the vibration and overpressure limits of the previous E. I. S. [Reference 1, 7]

12.10 Dozing Requirements

Allowance has been made for both tracked and rubber tyred dozers to carry out a variety of tasks at the Mount Arthur North site. Principal tasks undertaken by the dozer fleet are:

Unit	Task	Shift Schedule
500 kW Tracked Dozer	Pushing overburden on waste dumps	2 shifts per day
335 kW Tracked Dozer	Ripping overburden less than 2 metres thick	3 shifts per day
	Ripping and dozing of coal	3 shifts per day
	In-pit refilldump	2 shifts per day
	Periodical haul road maintenance	Day shift only
	Temporary in-pit ramp Construction	Day shift only
	Clean up for draglines	3 shifts per day
187 kW Rubber Tyred Dozer	Clean up around rope shovels	3 shifts per day
	Clean up around over-burden drills	3 shifts per day
	Clean up on top of coal	3 shifts per day

Apart from the above major tasks which have been well defined in the study, an allowance for minor dozing tasks has been included in the estimates for operating time of the 335 kilowatt size dozers.

This allowance covers activities such as,

1. towing and positioning pumps, cable boats and transformers about the site,

2. escorting tracked equipment (for safety reasons) when it is moving up and down ramps,

3. towing bogged equipment out of difficult situations, and

4. any other unforeseen circumstances requiring the use of a dozer.

Depending on how the operators of the mine put into effect some of the recommendations in this report, dozing requirements could vary substantially from the numbers presented. In particular, the thickness criteria for coal and waste drilling and blasting versus ripping and dozing, should be examined further once the mine comes into production.

Production rates for the 500 kilowatt and 335 kilowatt dozers working in the defined ripping and dozing situations have been determined using standard off-the-job estimating procedures, as per the Caterpillar Performance Handbook.

12.11 Other Support Equipment

The calculations of requirements for support equipment are presented in the back-up data to this report.

12.11.1 Front-end Loaders (224 kilowatt and 92 kilowatt)

Tasks handled by these small front-end loaders are:

1. Stemming of blastholes.
2. Clean-up of reject material overflow in the R.O.M. dump station area.
3. Assistance with drainage, including positioning of mine dewatering pumps.
4. Clean-up of in-pit waste material.
5. Towing of cable boats.

6. Loading and assistance with spreading of top course material for semi-permanent haul roads.

7. Clean-up around industrial area.

The two front-end loaders will generally be allocated to work with the mine road maintenance and construction fleet.

12.11.2 Scrapers (336 kilowatts)

Scrapers have been included in the equipment list and assigned to carry out topsoil removal operations. A unit of this type is well suited to this task because it can strip topsoil selectively from in front of the prestripping benches and dump it directly on to reclaimed spoil areas in topsoil windrows.

12.11.3 Road Grader (187 kilowatts)

In order to maintain major haul roads and overburden dump areas in a satisfactory condition for effective operation of haulage trucks, a large motor grader (187 kilowatt) has been included in the major equipment list. This unit will work on the major overburden haul roads and in waste dump areas. In addition to these major tasks, the grader will be used for minor tasks such as,

1. trimming final restoration areas,
2. industrial area clean-up and
3. trimming of minor drains and batters.

12.11.4 Water Trucks

In addition to the above equipment, allowance has been made for 4 large 45,000 litre water trucks. These units will be fully employed on day shift and afternoon shift as well as on a lesser duty on night shift for major haul road maintenance and dust suppression purposes. Water truck requirements build up progressively over the life of the mine as haul truck numbers increase and as the length of operational haul roads increase.

12.11.5 Other Equipment

The mining operation will require the usual fleet of support equipment, including:-

- Manhaul Trucks
- Fuel/Lube Trucks
- General Purpose Trucks
- Mechanical Repair Trucks
- Electrical Repair Trucks
- Welding Trucks
- Cable Reeler
- Low Loader
- Crane 90 tonne
- Crane 20 tonne (rough terrain)
- Crane 5 tonne
- Forklift 5 tonne
- Tyre Handler 224 kilowatt
- Fire Truck
- Ambulance
- Pumps (High Head)
- Pumps (Low Head)
- Lighting Plants
- Utilities/Sedans
- 4WD Vehicles

CHAPTER 13

MINE SCHEDULING

13. MINE SCHEDULING

13.1 Schedule Production Time

Operations at the mine have been scheduled on a three shifts per day basis wherever possible to achieve the maximum utilisation of equipment. Based on current practice in the Hunter Valley and requirements for flexibility detailed in the previous chapters, and the high production rates required, shift schedules used were as follows.

Schedule	Equipment/Overburden
315 production days per year 20 shifts per week 47 weeks per annum 7 hours per shift	All dragline overburden removal operations
215 production days per year 5 days per week 3 shifts per day 7 hours per shift	All truck/shovel overburden removal and coal extraction operations
215 days per year 5 days per week 3 shifts per day 7 hours per shift (excludes travelling time)	Overburden drill and coal drilling.
215 days per year Day shift operations,	Overburden and coal blasting, haul road construction and

13.2 Scheduling Progress and Constraints

The following summary depicts the major progress in scheduling of the excavation sequence for the initial years of the mine life.

Pre-production & Year 1

Equipment:	1 dragline, 1 rope shovel, 1 hydraulic excavator, 1 front-end loader (FEL)
Excavation:	Dragline operation in Ramrod Creek zone and prestripping upper material to expose the Bengalla and Edinglassie seams in both the Ramrod Creek zone and Basil zone. Dragline operation moves into Edinglassie zone.
Dumping:	Out-of-pit dump adjacent to Ramrod Creek zone; construction of environmental screens adjacent to Denman Road and Mitchell Line of Road

Year 2

Equipment:	Second rope shovel, additional hydraulic excavator (for waste loading).

Excavation:	Dragline excavates boxcut in Whites Creek zone; 1 shovel prestripping in Whites Creek zone; other operations in Ramrod Creek and Basil zones continue as in Year 1.
Dumping:	Outside dumping areas adjacent to Ramrod Creek zone and substantial waste dumping commenced in out-of-pit dump adjacent to Whites Creek zone.

Year 3

Equipment:	Third large rope shovel introduced.
Excavation:	Continuing major excavation in Basil zone and prestripping operations as required in Ramrod and Whites Creek zones.
Dumping:	Some in-pit refill into Basil zone and Edinglassie zone. Majority of waste dumped in Whites Creek out-of-pit dump.

Year 4 - 6

Equipment:	Additional purchases to bring equipment up to full complement of 1 dragline, 4 rope shovels, 1 large hydraulic excavator (waste), 1 large FEL (waste), 1 large hydraulic excavator (coal), 1 large FEL (coal).
Excavation:	Completion of excavation in Edinglassie zone in Year 3; establishment of major mining benches in Ramrod Creek, Basil and Whites Creek zones.

Scheduling operations were undertaken using an interactive computer-based technique to assess the ease or difficulty of manoeuvring the amount of equipment around the site subject to the constraints described previously. It was found that the scheduling operation was relatively easy to accomplish and that the overall bench arrangement indicated in the conceptual planning could be maintained over the mine life. It was found that the most critical aspect of the scheduling was the extraction of coal beneath the major dragline horizons and future studies using the current layout should give this aspect consideration when re-calculating schedules using different equipment or at different production rates to the ones in this study. The major constraints imposed by extraction of the coal in these two seams are:

1. If extraction of the Ramrod Creek and Edinglassie seams is excessive (mining kept too close to the dragline) then too high a proportion of the coal in any one year may be taken from these seams.

2. If insufficient tonnages of coal are extracted from the Edinglassie and Ramrod Creek seams, there is limited scope for repositioning the dragline and still maintaining maximum dragline utilisation (i.e. a dragline coal

bound situation). The ability to leave large quantities of coal within the dragline pit is dependent on the particular benches being excavated by the shovels at the same time. Invariably a large proportion of the inventory coal held within the pit must remain in the Ramrod Creek and Edinglassie seams.

Since the working room available in the Basil zone is restricted by the adopted strategy of minimising the advance of that zone relative to the other zones, only limited amounts of inventory can be held in the Basil zone.

13.3 Pit Inventory

In order to maintain a constant rate of coal **extraction** (despite fluctuations in the rate of **uncovering** coal) an inventory has been kept in the pit to smooth out these fluctuations on a month-by-month basis. In general, pit inventory of about 1.0 million tonnes of R.O.M. coal is available at any one time. During the 20 year scheduling period of the mine, at no stage was any difficulty encountered in maintaining suitable inventories.

13.4 Scheduling Operations

It was determined at an early stage in the study that the successful operation of a mine of the complexity of Mount Arthur North at the designated production rate would revolve around the sophistication and control which could be incorporated in the scheduling of the extraction sequence. The extraction sequence was simulated using an interactive computer-based technique to assess the various components of the operation and ease or difficulty of scheduling.

CHAPTER 14

PRODUCTION AND OPERATING SCHEDULES

14. PRODUCTION AND OPERATING SCHEDULES

14.1 Schedule Summaries

Based on data derived from detailed scheduling described in Chapter 13, mining production and major operating summary schedules have been compiled. All major equipment items considered in previous chapters have been included in these schedules, which are presented in the following tables.

Table	**Description**
14.1	Mine Production Schedule, 20 Years
14.2	Major Equipment Operating Hours Schedule, Years 1 - 20
14.3	Major Equipment Purchase and Replacement Schedule, Years 1 - 20
14.4	Major Equipment Fleet Numbers Schedule, Years 1 - 20
14.5	Minor Equipment Fleet Numbers Schedule, Years 1 - 20
14.6	Mine Manpower Schedule, Years 1 - 20

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Table 14.1 MINE PRODUCTION SCHEDULE

(Sheet 1 of 3)

PRODUCTION QUANTITIES		Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Yrs 8-19 (average)	Year 20	TOTAL
Overburden Quantities												
DRILLED VOLUME	[cu.m.]	3126	9544	16722	20657	21400	22160	20876	21205	19005	9761	373515
RIPPED VOLUME	[cu.m.]	5	32	104	175	306	386	310	283	400	166	6564
EXCAVATION VOLUMES												
Dragline Prime	[cu.m.]	1028	4692	7163	9054	8537	8164	7727	6555	5334	3320	120243
Dragline Rehandle	[percent]	24.65	25.23	28.56	35.3	43.49	50.06	53.16	57.46	65.57	68.18	55.37
Dragline Total	[cu.m.]	1281	5875	9208	12250	12250	12250	11835	10321	8831	5583	186828
Rope Shovel Prime	[cu.m.]	504	2814	6091	9304	11032	12380	11606	11136	11053	9094	206597
Hydraulic Excavator Prime	[cu.m.]	15	303	1302	1869	1116	1134	1661	2019	1939	1545	34236
Front-End Loader Prime	[cu.m.]	19	110	302	570	618	851	890	930	1148	932	19003
TOTAL EXCAVATED PRIME	[cu.m.]	1566	7919	14858	20797	21303	22529	21884	20640	19474	14891	380079
Coal Operations												
DRILLING AND BLASTING	[tonnes]		1780	3171	3946	3955	3891	3871	3785	3741	3721	73014
RIPPING AND DOZING	[tonnes]		3	40	114	106	143	155	248	279	273	4432
R.O.M. COAL MINED												
by Hydraulic Excavator	[tonnes]		1612	2910	3253	3052	2741	2764	2669	2313	2106	48867
by Front End Loader	[tonnes]		181	354	820	1024	1263	1214	1304	1615	1785	27322
TOTAL R.O.M. COAL (8% moist)	[tonnes]		1793	3264	4073	4076	4004	3978	3973	3928	3891	76190
Coal Summary												
UNCOVERED R.O.M. COAL	[tonnes]	448	2161	3466	4074	4058	3997	3977	3975	3926	2918	76190
INVENTORY R.O.M. COAL	[tonnes]	448	816	1018	1019	1001	995	993	995	980	-	-
Mining Recovery	[percent]		92.39	93.36	92.13	92.19	91.17	90.75	90.47	89.72	89.46	90.36
R.O.M. COAL MINED	[tonnes]		1793	3264	4073	4076	4004	3978	3973	3928	3891	76190
Raw Ash	[percent]		25.08	23.3	24.78	24.9	24.45	24.16	23.48	23.6	23.4	23.81
Raw Specific Energy	[Mj/kg]		22.55	22.98	22.44	22.41	22.53	22.65	22.88	22.86	23.01	22.79
Raw Sulphur	[percent]		0.79	0.76	0.77	0.76	0.74	0.77	0.74	0.76	0.73	0.76
Plant Yield	[percent]		86.38	87.01	88.73	88.67	90.27	90.85	90.96	92.01	92.88	91.15
PRODUCT COAL as rec'd	[tonnes]		1500	2750	3500	3500	3500	3500	3500	3500	3500	67250

(All Production Quantities, multiply by 1000)

Table 14.1 MINE PRODUCTION SCHEDULE

(Sheet 2 of 3)

PRODUCTION BY ZONE	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	TOTAL
RAMROD CREEK ZONE																						
PRIME OVERBURDEN REMOVED [cu m.]	999	3339	2786	7112	7300	6888	5784	4552	5202	5455	5954	3820	4515	4121	4166	5675	7187	5869	5413	5348	3734	105217
R.O.M. COAL MINED [tonnes]		1252	419	1252	1300	1289	1200	951	1160	1118	1578	1006	1294	1148	1124	1262	1148	1119	1182	1141	1039	22981
Plant Yield [percent]		86.58	86.34	87.4	88.2	88.92	89.47	89.03	89.03	89.55	90.3	90.3	90.21	89.98	90.05	90.04	89.95	89.81	89.99	90.47	90.47	89.39
PRODUCT COAL [tonnes]		1050	350	1060	1110	1110	1040	820	1000	970	1380	880	1130	1000	980	1100	1000	973	1030	1000	910	19893
WHITES CREEK ZONE																						
PRIME OVERBURDEN REMOVED [cu m.]		602	2785	4127	5200	6397	6155	7305	9223	8230	11011	7632	6402	7110	6865	6024	6977	7003	6850	7461	6733	130091
R.O.M. COAL MINED [tonnes]			840	1279	1399	1576	1452	1556	1448	1492	1293	1797	1398	1679	1724	1448	1760	1788	1723	1756	1883	29290
Plant Yield [percent]			86.02	86.41	87.1	88.45	88.88	89.58	89.88	89.99	91.84	91.35	91.62	92.25	92.25	92.69	92.69	92.8	92.92	92.92	93.24	90.95
PRODUCT COAL [tonnes]			700	1070	1180	1350	1250	1350	1260	1300	1150	1590	1240	1500	1540	1300	1580	1607	1550	1580	1700	25797
BASIL ZONE																						
PRIME OVERBURDEN REMOVED [cu m.]	149	1935	6743	8745	7942	9243	9944	8784	7822	7052	6034	6534	6958	6733	6981	7091	6173	6382	6282	6140	4424	138091
R.O.M. COAL MINED [tonnes]		71	799	1253	931	1139	1326	1466	1372	1359	1069	1133	1237	1094	1072	1202	1005	1004	1004	1003	970	21507
Plant Yield [percent]		87.6	90.52	93.15	93.16	94.31	94.26	93.69	93.29	93.46	93.72	93.89	94.34	94.41	94.42	94.49	94.56	94.59	94.64	94.7	94.78	93.92
PRODUCT COAL [tonnes]		60	700	1130	840	1040	1210	1330	1240	1230	970	1030	1130	1000	980	1100	920	920	920	920	890	19560
EDINGLASSIE ZONE																						
PRIME OVERBURDEN REMOVED [cu m.]	418	2043	2544	814	862																	6680
R.O.M. COAL MINED [tonnes]		470	1206	290	446																	2412
Plant Yield [percent]		85.66	85.62	85.6	85.6																	85.62
PRODUCT COAL [tonnes]		390	1000	240	370																	2000

(All Production Quantities, multiply by 1000)

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Table 14.1 MINE PRODUCTION SCHEDULE

(Sheet 3 of 3)

R.O.M. PRODUCTION BY SEAM	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	TOTAL
RAMROD CREEK SEAM GROUP		1659	2844	2888	2907	2418	2192	1924	1987	1887	1615	1586	1507	1437	1428	1359	1367	1353	1324	1252	1167	36102
TRANSITION SEAM		67	162	263	40	56	67	63	52	70	78	62	70	70	67	67	70	52	46	59	42	1524
EDINGLASSIE SEAM		67	155	551	748	885	975	1075	984	998	932	935	953	926	879	843	836	831	821	786	696	15879
BENGALLA SEAM GROUP			77	234	183	194	206	154	186	221	420	352	330	258	300	300	286	269	263	289	246	4768
CLANRICARD SEAM			26	95	81	79	95	107	108	95	221	171	155	181	185	166	175	180	186	190	202	2698
EDDERTON SEAM				27	54	106	122	116	89	85	100	114	126	154	147	143	139	129	129	133	166	2078
WYNN SEAM GROUP				4	13	49	53	20	23	40	48	63	74	67	65	69	55	55	57	59	57	871
BROONIE/BAYSWATER SEAMS				11	21	40	52	145	163	198	208	240	265	299	284	320	328	341	402	419	446	4182
VAUX SEAM GROUP					9	56	80	226	233	243	202	285	290	303	313	349	352	356	305	323	392	4316
PIERCEFIELD SEAM					7	41	54	142	153	131	111	113	117	135	140	133	124	143	154	156	182	2036
UNCORRELATED G SEAM														2	3	6	6	7	11	12	12	59
MT. ARTHUR SEAM GROUP											4	15	41	89	108	158	174	194	207	218	273	1481
UNCORRELATED Z SEAM																		1	3	3	10	17
OTHER SEAMS					13	78	83	1	2	1												178
TOTAL R.O.M. PRODUCTION		1793	3264	4073	4076	4004	3978	3973	3980	3969	3940	3936	3928	3920	3919	3912	3913	3911	3908	3900	3891	76190

(All Production Quantities expressed in Tonnes by 1000)

Table 14.2 MAJOR EQUIPMENT OPERATING HOURS

MAJOR EQUIPMENT ITEM	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Yrs 8-19 (average)	Year 20	TOTALS
Dragline, B-E 1570-W	578	2649	4151	5523	5523	5523	5336	4653	3982	2517	84237
Rope Shovels, P&H 2800 equiv.	393	2195	4751	7257	8605	9657	9053	8686	8628	7094	161227
Hyd. Excavators, Demag H-241		446	1823	2617	1563	1588	2326	2828	2716	2164	47947
Front-end Loader, LeTour L-800		278	654	1232	1335	1838	1923	2009	2480	2013	41042
Hyd. Excavators, Demag H-241		1323	2387	2668	2504	2248	2268	2190	1898	1728	40092
Front-end Loader, LeTour L-800		208	407	944	1178	1453	1397	1500	1858	2054	31437
Rear Dump Trucks, 154 tonne (O/B)	2425	11487	21858	38239	49772	56914	53616	55666	66000	55423	1137400
Rear Dump Trucks, 108 tonne (O/B)		2639	8211	14295	11157	13011	16804	21024	26282	21524	424049
Rear Dump Trucks, 108 tonne (Coal)		11421	19852	27760	27403	27960	27500	27870	27439	28063	527097
Waste Drill, B-E 45-R	1177	4447	7728	11019	10652	10755	10463	8949	9418	9171	187377
Waste Drill, G.D. RDC-16B	456	2684	6015	6581	6517	8129	10044	10988	12462	7000	207958
Waste Drill, G.D. 35-T		2950	4167	5769	6287	7707	8185	9351	7656	2769	139057
Coal Drill, G.D. RDC-16B		242	981	825	983	961	747	723	456	332	11266
Coal Drill, Mayhew 1000		1781	1902	3064	2474	2424	2595	2565	2968	3267	55688
Tracked Dozer, 500 kW		1600	1600	3200	3200	3200	3200	3200	4533	4800	78396
Tracked Dozer, 335 kW	676	2705	6761	9659	9761	10006	9877	9628	9395	8478	180291
Rubber Tyred Dozer, 187 kW		3527	8816	12595	12599	12505	12471	12465	12407	12358	236220
Open Bowl Scraper, 336 kW		935	1567	2100	2254	2130	1964	1704	1400	1089	30543
Water Truck, 45000 litre	160	1519	2995	4818	5300	5873	5875	6274	7183	6301	125311
Road Grader, 187 kW	80	759	1498	2409	2650	2937	2938	3137	3592	3150	62662
ANFO Truck, 12 tonnes	210	840	2100	3000	3000	3000	3000	3000	3000	3000	57150

It should be noted that, by direction, the scope of this study specifically excludes consideration of the coal handling and preparation plant and any services external to the mine site. The above schedules therefore do not include allowance for those items.

14.2 Production Schedules

Table 14.1 indicates mine production over the 20 year mine life from overburden drilling requirements to coal delivered to the Run-of-Mine dump station. Notable features of this table are:

1. Production by zone and by seam group

2. Expected weighted average recovery and run-of-mine coal quality data

3. Volumes of waste material removed by each of the overburden equipment items

4. Total mining quantities and weighted average qualities for the whole of the 20 year initial mine life

The annual coal mining quantity on a seam group basis is shown diagrammatically in Figure 14.1. It can be seen that the relative importance of the Ramrod Creek seam group and the Edinglassie seam declines steadily after Year 5. As the mine progresses to the west, more coal seams are encountered. The contribution of these seams (notably Bayswater, Vaux, Piercefield and Mount Arthur) to the annual production target increases, resulting in a corresponding reduction in contribution from the Ramrod Creek and Edinglassie seam.

Figure 14.2 shows the total waste volume excavated by major equipment type. The main feature of this figure is the decreasing importance of the dragline beyond Year 8 and the increasing importance of truck/shovel methods. This trend is another manifestation of the previously discussed trend of the reduced significance over time of the Ramrod Creek and Edinglassie seams - the seams uncovered by dragline.

14.3 Equipment Operating Hours Schedule

Annual operating hours for all of the major equipment items shown in Table 14.2 have been determined on the basis of the shift operating schedules described in Section 13.1. These operating hours include periods when the unit is operating but is not being used on its normal production task. This category includes deadheading time, shovels waiting for trucks, truck queueing times, etc. Information relating to the minor equipment has been drawn up on the basis of experience in similar operations.

14.4 Equipment Initial Purchase and Replacement Schedules

Table 14.3 shows purchases of all major mining equipment over the 20 year initial mine life. The equipment life reflects the shift schedule employed and duty required of the equipment and the useful life achieved at similar mining operations in the Hunter Valley.

14.5 Equipment Fleet Numbers Schedules

Table 14.4 shows the fleet numbers in any year for the major equipment items, whilst Table 14.5 shows the fleet numbers for the minor equipment.

Figure 14.1

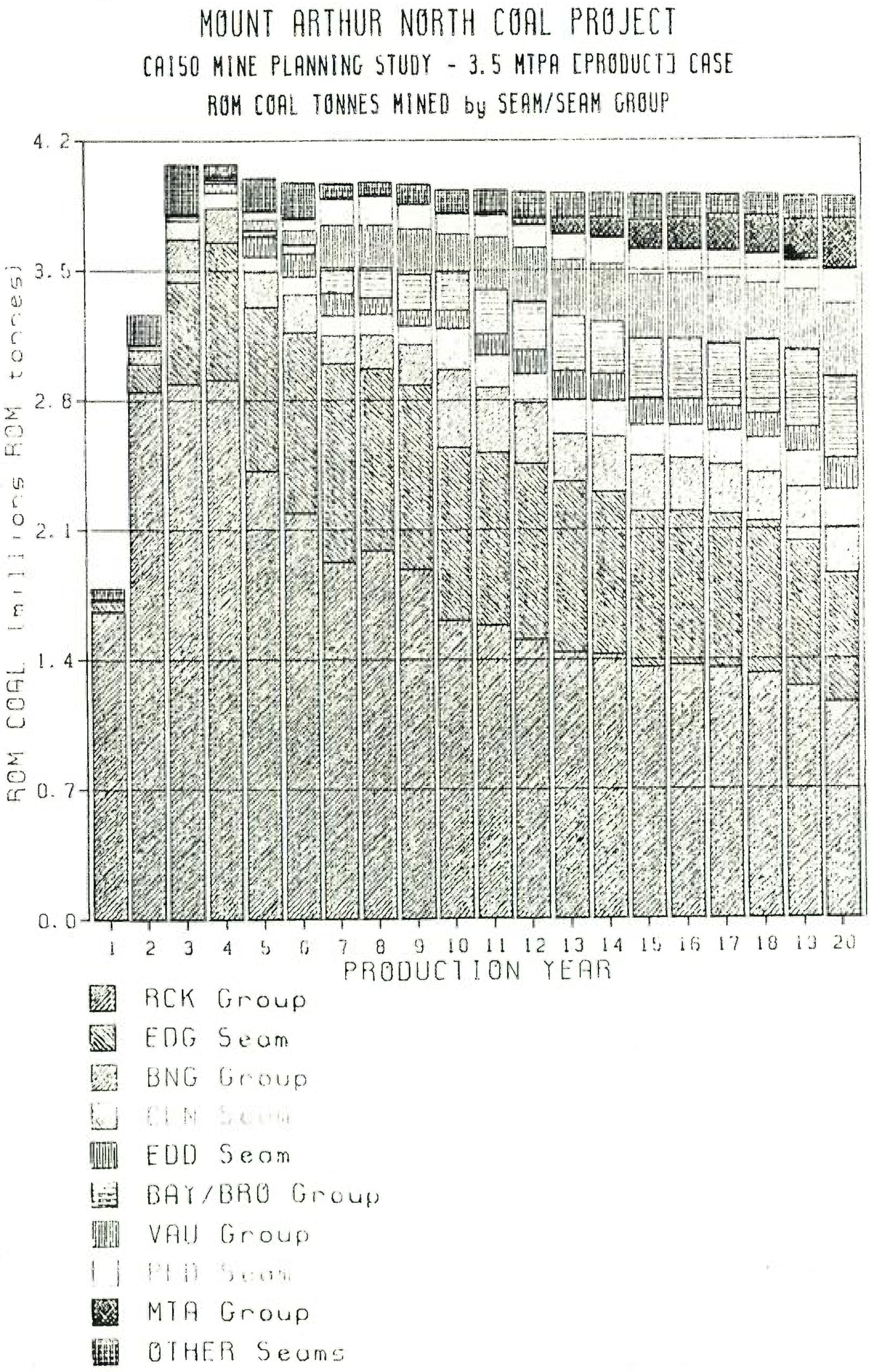
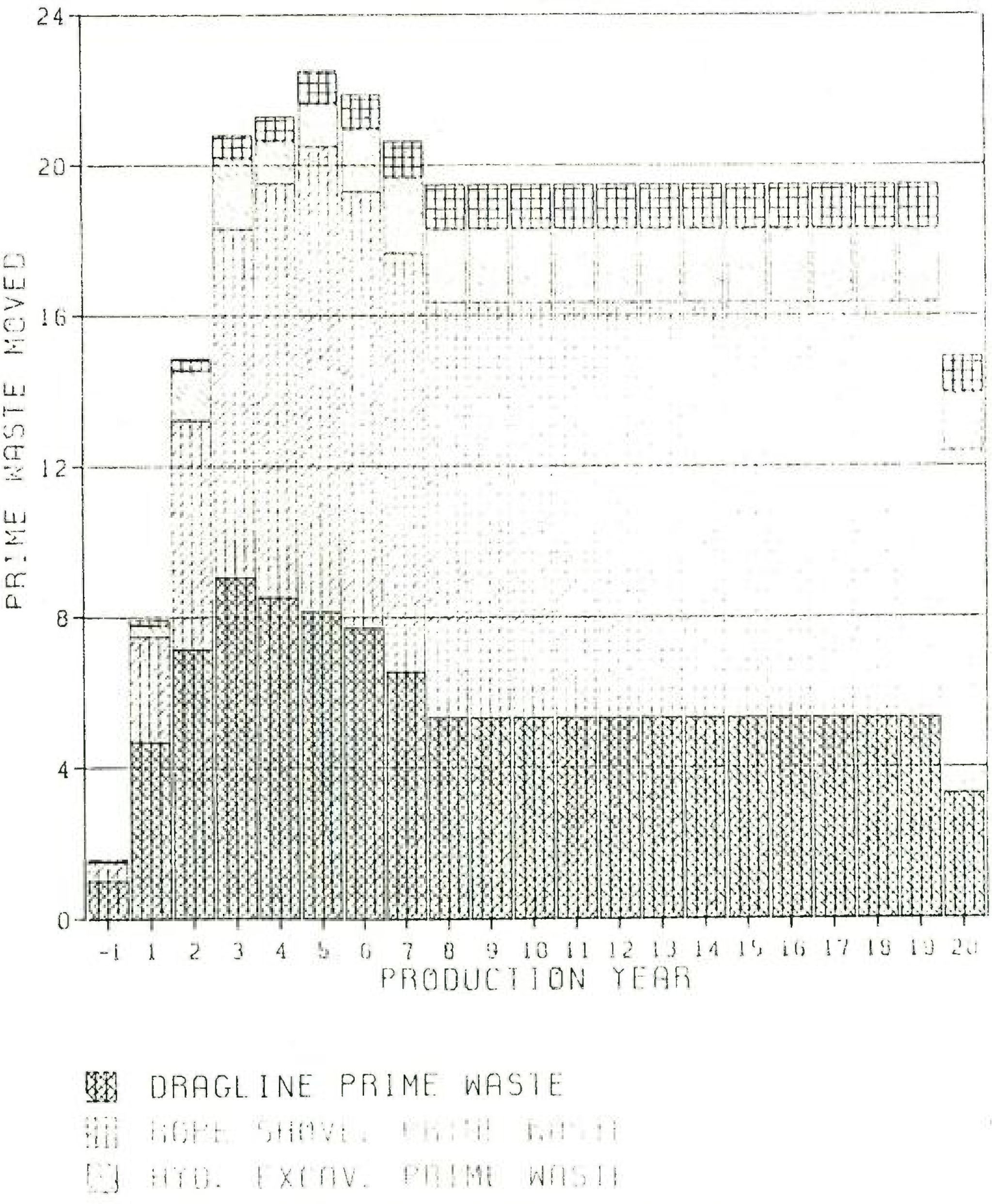

MOUNT ARTHUR NORTH COAL PROJECT
CA150 MINE PLANNING STUDY - 3.5 MTPA [PRODUCT] CASE
ROM COAL TONNES MINED by SEAM/SEAM GROUP
ROM COAL (millions ROM tonnes)
0.0
0.7
1.4
2.1
2.8
3.5
4.2
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
PRODUCTION YEAR
RCK Group
EDG Seam
BNG Group
CLN Seam
EDD Seam
BAY/BRO Group
VAU Group
PLD Seam
MTA Group
OTHER Seams

Figure 14.2



MOUNT ARTHUR NORTH COAL PROJECT

CA150 MINE PLANNING STUDY - 3.5 MTPA [PRODUCT] CASE

WASTE REMOVED BY EQUIPMENT TYPE

MT. ARTHUR NORTH COAL PROJECT
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3.5 M.T.P.A. PRODUCT CASE

Table 14.3 MAJOR EQUIPMENT PURCHASES

(Sheet 1 of 2)
(Initial Purchases)

	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Dragline, B-E 1570-W	1										
Rope Shovels, P&H 2800 equiv.	1		1	1		1					
Hyd. Excavators, Demag H-241			1								
Front-end Loader, LeTou L-800		1									
Hyd. Excavators, Demag H-241		1									
Front-end Loader, LeTou L-800						1					
Rear Dump Trucks, 154 tonne	6		2	6	4	3			4		
Rear Dump Trucks, 108 tonne		1	2	3			1	1	1	1	
Rear Dump Trucks, 108 tonne		7	1	2		1					
Waste Drill, B-E 45-R	2		1	1							
Waste Drill, G.D. RDC-16B			2			1		1			
Waste Drill, G.D. 35-T		1		1		1					
Coal Drill, G.D. RDC-16B	1										
Coal Drill, Mayhew 1000		1									
Tracked Dozer, 500 kW		1		1							1
Tracked Dozer, 335 kW	1		2	1							
Rubber Tyred Dozer, 187 kW		2	2	1							
Open Bowl Scraper, 336 kW		1	1	1							
Water Truck, 45000 litre	1	1							1		
Road Grader, 187 kW	1										
ANFO Truck, 12 tonnes	1		2	1							

MT. ARTHUR NORTH COAL PROJECT
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3.5 M.T.P.A. PRODUCT CASE

Table 14.3 MAJOR EQUIPMENT REPLACEMENTS

(Sheet 2 of 2)
(Replacement Purchases)

	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18
Dragline, B-E 1570-W											
Rope Shovels, P&H 2800 equiv.											
Hyd. Excavators, Demag H-241							1				
Front-end Loader, LeTou L-800			1								1
Hyd. Excavators, Demag H-241								1			
Front-end Loader, LeTou L-800							1				
Rear Dump Trucks, 154 tonne			6			6	4	3	2		
Rear Dump Trucks, 108 tonne					2	2			3	1	3
Rear Dump Trucks, 108 tonne				6	3			1		1	
Waste Drill, B-E 45-R											
Waste Drill, G.D. RDC-16B		1				1	1	1		2	
Waste Drill, G.D. 35-T	1		1		1			1		1	
Coal Drill, G.D. RDC-16B											
Coal Drill, Mayhew 1000		1								1	
Tracked Dozer, 500 kW					1		1				
Tracked Dozer, 335 kW	1	2	1						1	2	1
Rubber Tyred Dozer, 187 kW	2	2	1					2	2	1	
Open Bowl Scraper, 336 kW				1	1						
Water Truck, 45000 litre				1	1						1
Road Grader, 187 kW	1				1				1		
ANFO Truck, 12 tonnes			1		2	1					

Table 14.4 MAJOR EQUIPMENT FLEET NUMBERS

MAJOR EQUIPMENT ITEM	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8-19	Year 20
Dragline, B-E 1570-W	1	1	1	1	1	1	1	1	1	1
Rope Shovels, P&H 2800 equiv.	1	1	2	3	3	4	4	4	4	4
Hyd. Excavators, Demag H-241			1	1	1	1	1	1	1	1
Front-end Loader, LeTou L-800		1	1	1	1	1	1	1	1	1
Hyd. Excavators, Demag H-241		1	1	1	1	1	1	1	1	1
Front-end Loader, LeTou L-800						1	1	1	1	1
Rear Dump Trucks, 154 tonne	6	6	8	14	18	21	21	21	25	16
Rear Dump Trucks, 108 tonne		1	3	6	6	6	7	8	10	11
Rear Dump Trucks, 108 tonne		7	8	10	10	10	10	11	11	11
Waste Drill, B-E 45-R	2	2	3	4	4	4	4	4	4	4
Waste Drill, G.D. RDC-16B			2	2	2	3	3	4	4	2
Waste Drill, G.D. 35-T		1	1	2	2	3	3	3	3	1
Coal Drill, G.D. RDC-16B	1	1	1	1	1	1	1	1	1	1
Coal Drill, Mayhew 1000		1	1	1	1	1	1	1	1	1
Tracked Dozer, 500 kW		1	1	2	2	2	2	2	3	3
Tracked Dozer, 335 kW	1	1	3	4	4	4	4	4	4	4
Rubber Tyred Dozer, 187 kW		2	4	5	5	5	5	5	5	5
Open Bowl Scraper, 336 kW		1	2	3	3	3	3	2	2	2
Water Truck, 45000 litre	1	2	2	2	2	2	2	2	3	3
Road Grader, 187 kW	1	1	1	1	1	1	1	1	1	1
ANFO Truck, 12 tonnes	1	1	3	4	4	4	4	4	4	4

How many for Rehabilitation

Top Soil. Any other work?

Note: Some equipment used for dual purposes during initial years of operation

Table 14.5 MINOR EQUIPMENT FLEET NUMBERS

MINOR EQUIPMENT ITEM	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8-19	Year 20
MANHAUL TRUCKS	1	2	4	6	6	6	6	6	6	6
FUEL / LUBE TRUCKS	1	2	3	4	4	4	4	4	4	4
GENERAL PURPOSE TRUCKS	1	2	3	4	4	4	4	4	4	4
MECHANICAL REPAIR TRUCKS	1	2	3	3	3	3	3	3	3	3
ELECTRICAL REPAIR TRUCK	1	1	1	1	1	1	1	1	1	1
WELDING TRUCK	1	1	1	1	1	1	1	1	1	1
CABLE REELER	1	1	1	1	1	1	1	1	1	1
LOW LOADER TRAILER	1	1	1	1	1	1	1	1	1	1
CRANE 90 tonne	1	1	1	1	1	1	1	1	1	1
CRANE 20 tonne (Rough Terrain)	1	1	1	2	2	2	2	2	2	2
CRANE 5 tonne	1	1	2	2	2	2	2	2	2	2
FORKLIFT 5 tonne	1	1	2	2	2	2	2	2	2	2
TYRE HANDLER 224 kW	1	1	2	2	2	2	2	2	2	2
FIRE TRUCK	1	1	1	1	1	1	1	1	1	1
AMBULANCE	1	1	1	1	1	1	1	1	1	1
PUMPS (High Head)	1	2	3	3	3	3	3	3	3	3
PUMPS (Low Head)	2	4	6	6	6	6	6	6	6	6
LIGHTING PLANTS	2	4	6	8	8	8	8	8	8	8
UTILITIES / SEDANS	6	10	22	30	30	30	30	30	30	30
4 WHEEL DRIVE VEHICLES	8	15	20	25	25	25	25	25	25	25
FRONT END LOADER 224 kW	1	1	1	1	1	1	1	1	1	1
FRONT END LOADER 93 kW	1	1	2	2	2	2	2	2	2	2

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3.5 M.T.P.A. PRODUCT CASE

Table 14.6 MANPOWER SUMMARY

	Year -1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
STAFF																					
Executive Management	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Mine Production	10	19	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Maintenance	8	18	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
Technical Services	6	11	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Environment	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Administration	8	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Employee Relations	5	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Sub-total	47	84	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107	107
WAGES																					
Mine Operations																					
Overburden Removal	26	49	93	143	152	169	171	177	187	187	187	187	187	187	187	187	187	187	187	187	148
Coal Mining	15	27	43	51	49	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47	47
Pit Services/ Rehabilitation ? / ?	10	20	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Sub-total	51	96	163	221	228	243	245	251	261	261	261	261	261	261	261	261	261	261	261	261	222
Maintenance																					
Tradesmen/Operators	22	36	60	86	89	96	97	100	105	105	105	105	105	105	105	105	105	105	105	105	87
Trades Assistants	7	11	18	27	28	30	31	32	33	33	33	33	33	33	33	33	33	33	33	33	27
Sub-total	29	47	78	113	117	126	128	132	138	138	138	138	138	138	138	138	138	138	138	138	114
Absentee Allowance	5	9	15	20	20	21	22	22	23	23	23	23	23	23	23	23	23	23	23	23	20
TOTAL WORKFORCE	132	236	363	461	472	497	502	512	529	529	529	529	529	529	529	529	529	529	529	529	463

14.6 Mine Manning Schedules

Table 14.6 shows manning requirements for the mine by department and by category throughout the mine life. Manning schedules have been derived to reflect normal operating procedures and allowances have been made for the following:

1. Absenteeism allowance has been included, in accordance with the recent historical average for New South Wales operations, as tabulated in the Joint Coal Board's report for 1981 - 1982. [Reference 11]

2. Provision of adequate supervision at all stages of the mine life with relatively higher levels of supervision prevailing in the initial build-up years to allow for training of personnel.

3. Provision of technical services and environmental services support commensurate with the complexity of technical and environmental influences on the mine at the designated production rate.

4. Manpower requirements for maintenance reflect the philosophy of undertaking almost all maintenance on site. Maintenance manning is commensurate with the labour content of

maintenance envisaged for both normal and overhaul maintenance requirements on the nominated equipment fleet.

5. Apprentices have not been shown separately. However, the manning levels for tradesmen categories include provision for apprentices at various stages of their apprenticeship in accordance with New South Wales Government policy. The exact implementation of this policy will be influenced by other local factors and has not been pursued further in this study. A Master of Apprentices has been included in the workforce to co-ordinate the training and education of apprentices.

6. Manning levels for administrative functions reflect the current trend towards computerisation of many administrative tasks including stores inventory and purchasing, cost and financial accounting, payroll and personnel administration. It has been assumed that the mine site will be self-sufficient in these areas.

These manning levels are influenced significantly by two major assumptions in this study - the use of conventional truck/shovel methods of waste removal and the environmental limitations for blasting superimposed on the hard nature of the interburden material.

Once full production is reached, the manning levels for the project (excluding the coal handling and preparation plant operating and maintenance personnel) will increase from 474 in Year 3 to 547 in Years 8 - 19. This increase over the early years reflects the trend in haul truck requirements and the need for personnel to operate, maintain and service these units.

Major contributors to the manning levels are operating and maintenance personnel for overburden drills and waste haul trucks. Overburden drill numbers are a function of the hard overburden material and vibration limits imposed on blasting. Increased knowledge of both factors gained through operational experience could result in a reduction in the requirement for overburden drillers and associated maintenance personnel.

Waste haul truck numbers are a function of the decision to apply a conventional truck/shovel method in this study. The requirement for truck drivers and associated maintenance personnel could be reduced by the adoption of alternative mining methods including crusher/conveyor and trolley-assisted haulage.

CHAPTER 15

CONCLUSIONS AND RECOMMENDATIONS

15. CONCLUSIONS AND RECOMMENDATIONS

15.1 Conclusions

The various geological, geotechnical and environmental factors affecting the mining operation at Mount Arthur North have been identified and their implications for mine planning have been incorporated into the mine plan.

The conceptual mine plan existing at the commencement of this study was reviewed in the light of results of investigations undertaken during 1981, particularly the additional exploration drilling of the major fault zone.

A revised conceptual mine plan was developed, based on a single pit including the central fault zone.

A review of the dragline working method was also undertaken and a revised method of operation was developed - this method satisfies the many geotechnical and seam geometry constraints as well as enhancing scheduling flexibility and machine utilisation.

The most important outcome of the study was the adoption of the single pit concept and the demonstration, by scheduling, of its workability at the nominated production rate. The single pit concept provides for maximum recovery of the coal resource and consequent extension of the ultimate working life of the deposit. It also enables the realisation of a 19 percent reduction in truck/shovel waste requirements for a given coal output.

This concept has a major environmental benefit in that all operations are restricted to a single confined area, facilitating the implementation of control measures and monitoring procedures.

The dominant influence of overburden removal, and in particular the removal by truck/shovel methods, on manning was demonstrated. The significance of drilling and blasting was also highlighted and identified as an area where potential reductions could be achieved, given ongoing information from operating experience on the site.

The study highlighted the strategic significance of the Mount Arthur North deposit as a long term, low cost source of coal for electricity generation.

15.2 Recommendations

Drilling and Blasting

Since drilling and blasting represents an area for potential reduction at any adopted production rate, it is recommended that a scientific programme of blast monitoring and recording be designed, ready for implementation as soon as site operations commence.

CHAPTER 16

ACKNOWLEDGMENT

16. ACKNOWLEDGEMENT

A highlight of this study has been the strong working relationship established between the consultants and the Commission staff. In fact, the development of the single pit concept, with its many advantages, was the result of positive contributions and ideas generated by the ongoing co-operative efforts of the Commission mining engineers and geologists, and the consultants.

The assistance and enthusiam offered by the Commission personnel is gratefully acknowledged.

The support and encouragement of the Commission management throughout the study is also acknowledged. The development of the single pit concept represents a vindication of the judgement of the Commission officers in expanding the study scope to re-assess the planning concepts at an early stage in the study.

CHAPTER 17

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17. REFERENCES

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