EIS 428 Vol 1

AB019094

Mount Arthur North Coal Project environmental impact statement

THE ELECTRICITY COMMISSION OF NEW SOUTH WALES

MOUNT ARTHUR NORTH COAL PROJECT

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1

PREPARED BY

SINCLAIR KNIGHT & PARTNERS PTY LTD

JANUARY 1981

THE ELECTRICITY COMMISSION OF NEW SOUTH WALES

MOUNT ARTHUR NORTH COAL PROJECT

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1

ENVIRONMENTAL IMPACT STATEMENT

PREPARED BY

SINCLAIR KNIGHT & PARTNERS PTY LTD

JANUARY 1981

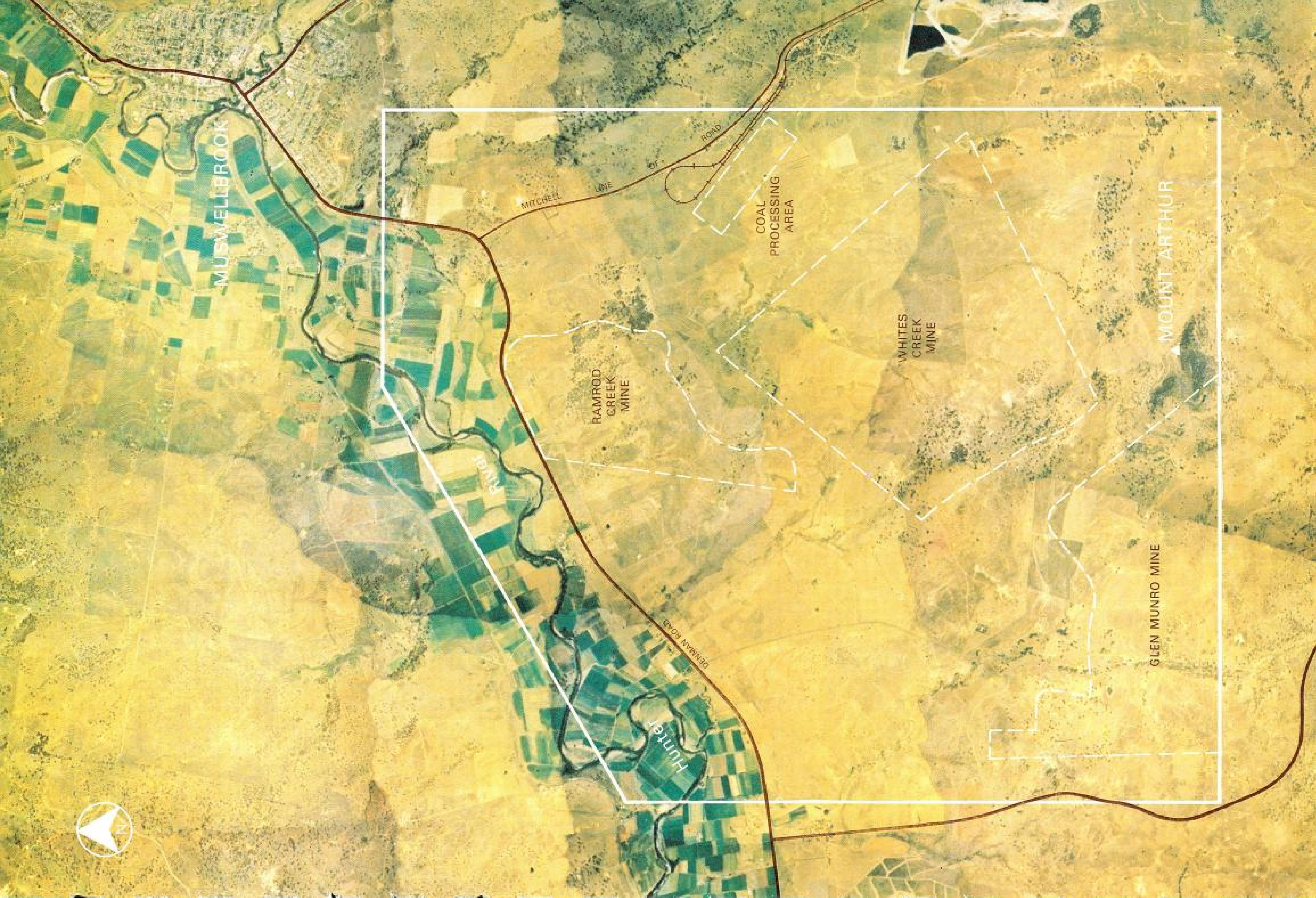

MUSWELLBROOK
MITCHELL LINE OF ROAD
COAL PROCESSING AREA
WHITES CREEK MINE
MOUNT ARTHUR
RAMROD CREEK MINE
River
Hunter
DENMAN ROAD
GLEN MUNRO MINE
N

TABLE OF CONTENTS - VOLUME I

TABLE OF CONTENTS continued - VOLUME I

TABLE OF CONTENTS continued - VOLUME I

TABLE OF CONTENTS continued - VOLUME I

TABLE OF CONTENTS continued - VOLUME I

LIST OF TABLES - VOLUME I

LIST OF TABLES continued - VOLUME I

LIST OF EXHIBITS - VOLUME I

2. INTRODUCTION

3. PROJECT BACKGROUND

4. DESCRIPTION OF THE PROPOSAL

5. EXISTING ENVIRONMENT

LIST OF EXHIBITS continued - VOLUME I

TABLE OF CONTENTS - VOLUME 2

SUMMARY

1. SUMMARY

1.1 PROJECT OUTLINE

This Environmental Impact Statement has been prepared in support of a proposal by the Electricity Commission of New South Wales to establish the Mount Arthur North Coal Project on the site of Authorisation No 168. The site is located in the Shire of Muswellbrook, New South Wales as shown on **Exhibit 2.1, Locality Plan.**

The Environmental Impact Statement will be lodged in support of a mining lease application to the Department of Mineral Resources and in support of an application to Muswellbrook Shire Council for development consent. It will form the basis for subsequent licence applications under the Clean Waters Act, Clean Air Act, and Noise Control Act.

The proposal is the establishment of three open cut mines which will be progressively developed over the years from 1983 to 2004. Further long term development of the project past 2004 has been outlined. Maximum annual coal production will be achieved by 1989 at a total of 11 million tonnes of raw coal per year.

Associated works and site infrastructure include a coal processing plant, (comprising crushing, screening, washing, stockpiling and reclaim facilities), conveyor systems, a tailings and clean water dam, administration and amenity facilities, road relocations, creek diversions, railway works and a construction camp.

The Mount Arthur North Coal Project will principally supply steaming coal to the Bayswater and Liddell Power Stations which are located approximately 10 kilometres to the south east of the Mount Arthur North coal processing plant. Coal to the power stations will be transported by overland conveyor. An extension of the rail spur from the proposed Drayton mine balloon loop will enable the transport of a coking coal fraction to the Port of Newcastle for export, plus the facility to supply steaming coal shortfalls at other power stations in New South Wales.

This document describes the proposals of the Commission for the first stage development of the Mount Arthur North project to the year 2004. Subsequent development will be subject to a separate environmental impact statement.

From the outset of the project studies and investigations, environmental considerations have been included as an integral part of the planning process. Every effort has been made to assess the environmental implications thoroughly and to minimise impacts by attention to design safeguards and operational controls.

1.2 MINING PROPOSAL

The coal resource of the Mount Arthur North Authorisation area is contained in the Wittingham Coal Measures which form part of the Singleton Super Group. Coal exploration commenced in the 1950's and a detailed drilling programme began in 1976. The Measured Reserves amount to 511 million tonnes of raw coal. The Recoverable Reserves are estimated at 412 million tonnes. The mining *operations detailed in this Statement involve the production by open cut means of 210 million tonnes of raw coal from 12 seams over the period 1983 to 2004. Proposals for subsequent extraction of the remaining open cut coal reserves are outlined but do not form part of this proposal. The mine plan covers the development of three open cut mines:*

Ramrod Creek Mine: *a dragline strip mine in the northern part of the Authorisation. The mining operations will commence in 1983 and be completed by 1992. Approximately 41 million tonnes of coal will be recovered from this mine at an annual production rate of up to 6 million tonnes.*

Whites Creek Mine: *the main mine of the project and located in the centre of the Authorisation. This will be a shovel and truck, open cut operation and it is likely that in-pit crushers and conveyors would also be used for movement of overburden. Approximately 133 million tonnes of coal will be recovered from this mine at an annual production rate of up to 8.4 million tonnes. The floor of this pit will reach a depth of 300 metres below existing ground levels. Production from this mine will be continuous over the period 1984 to 2004.*

Glen Munro Mine: *the last mine to be developed is a dragline strip mine in the southern part of the Authorisation. Development of the mine will commence in 1992 when plant and equipment will be transferred from the Ramrod Creek mine. Approximately 36 million tonnes of coal will be recovered from this mine at an annual production rate of up to 3.5 million tonnes.*

Raw coal from each of the mines will be processed at a central coal handling and preparation area on the eastern boundary of the site. The plant will produce the following output at full production:

- *7.7 million tonnes per annum of high ash steaming coal (20 to 22 percent ash) for conveyor transport to Bayswater and Liddell Power Stations*
- *1.0 million tonnes per annum of soft coking coal (7.5 percent ash) for transport by rail to Newcastle for export*
- *approximately one million tonnes per annum of low ash steaming coal (14 to 15 percent ash) for railing to other power stations in NSW.*

Each mine will have its own separate office, workshop, stores and amenity facilities. The coal preparation plant will similarly have its own self-contained administration, maintenance and amenity facilities.

Coal will be transported to the Liddell and Bayswater Power Stations by an overland conveyor proposed under the Environmental Impact Statement for Bayswater Power Station. For the movement of export coking coal and surplus steaming coal, the rail spur to the proposed Drayton mine will be extended to Mount Arthur North with a balloon loop located adjacent to the coal processing area. Coal will not be transported by road.

Direct mine operational employment will increase over the period from 1983 to 1988, reaching 1 142 by 1988. Employment will peak at 1 281 in 1998. Construction works will be carried out over the period 1981 to 1986 with the construction workforce peaking at 500 in the years 1983/84.

3.1 ENVIRONMENTAL SAFEGUARDS

In order to identify the potential environmental impacts and consequences of the development, it was necessary to firstly describe the existing environment of the project site along with its local and regional setting. This study of the ambient environment enabled the potential constraints on the development to be identified. Appropriate modifications to the development proposal were then *made along with the design of a number of operational safeguards to control, to the extent possible, potentially adverse impacts.* ***Chapter 5, Existing Environment*** *and* ***Chapter 6, Environmental Safeguards****, cover these aspects of the study. Safeguards are described to minimise water, air and noise pollution during the clearing and topsoil removal, drilling and blasting, overburden removal, coal extraction and haulage, overburden disposal, coal preparation and handling operations.*

The project will not be a source of water pollution because, in general, all water produced or affected by mining and processing activities will be recycled within the lease area in order not to contaminate off-site streams and the Hunter River.

Dust creating activities will be controlled by measures such as water spraying of roads, stockpiles and crushers, use of dust collection equipment on drills, limiting of blasting operations in high winds, and the early rehabilitation and revegetating of overburden disposal areas.

Noise emanating from the site will be controlled by measures such as the use of haul trucks fitted with noise reduction equipment and rubber lined load trays, locating haul roads in cuts or behind earth bunds, use of conveyors instead of trucks for some operations, acoustically screening fixed plant and limiting the blasting operations.

Site test blasting was carried out in order to develop blast charge levels for each zone of each of the three mines.

Regular monitoring has been carried out during the initial investigations of the various water, air and noise parameters and it is proposed that this programme be continued and expanded. Site monitoring equipment will be installed during the construction period and regular surveys carried out to record climatic data, water qualities, noise levels, vibrational effects from blasting, and air quality levels. The results obtained will enable a continuous control to be kept on site practices.

Careful attention has been paid to visual aspects of the project. A composite landscape plan has been developed for, not only the rehabilitated mining areas, but, the complete site area. This plan provides for the early rehabilitation and revegetation of all disturbed areas. Landscaping measures will be carried out from the beginning of the construction period. The landform has been designed to produce a landscape consistent with the surrounding topography and to provide screening of operational areas. Buildings will be designed to present an attractive but unobtrusive appearance.

An important provision for the environmental management and control of the project will be the appointment of a professional environmental officer to the mine management structure. This person will be responsible to the resident engineer and will ensure that safeguards detailed in this Statement are implemented and that the monitoring programme is managed to ensure compliance with the lease conditions and licence requirements.

1.4 IMPACTS OF THE DEVELOPMENT

This Statement assesses the effects and impacts of the project on both the physical, social and economic environment.

Earthmoving operations will be extensive and the placement of approximately 1 000 million cubic metres of overburden spoil outside the open cuts will raise the existing land surfaces appreciably. A new landform is proposed which *conforms with the surrounding landscape and will not appear conspicuous or incongruous.*

It is expected that the proposals to control runoff and to recycle on-site all waters affected by the mining operations will be effective in controlling water pollution and minimise soil erosion. There will be no impact on the water quality of the Hunter River.

The environmental investigations show that the project operations will generate increased noise and dust levels. However the design and operational safeguards and controls will ensure that noise levels and dust fallouts are reduced to acceptable levels outside the mine area and its buffer zone. Restrictions are proposed on some night time operations, care will be taken when mining or operating in those parts of the site nearest residences, and operations will be curtailed in adverse weather conditions, such as during high winds.

Impacts from blasting effects will be controlled to the standard acceptability limits set by both local and international authorities. Levels approaching the limiting criteria will only be experienced by a small number of residences. Continuous monitoring will regulate all blast strengths.

There will be an unavoidable impact on wildlife and vegetation on the site. Mining operations will displace the existing native fauna. However, it is expected that through progressive rehabilitation and improved pasture, the area will in time be again repopulated. The landscaping and rehabilitation programme with native species will add to the vegetation cover over the complete site and will generally enhance the aesthetics of the area.

A number of existing landholders will be displaced. Agricultural productivity will suffer marginally by the loss of agricultural land away from the river flats. Agricultural production along the Hunter River flood plain will not be affected. During mining operations, unaffected areas of the site will continue in their present agricultural use. Following progressive rehabilitation of mined areas, additional land will be returned to agricultural uses.

Because of the magnitude of the project, unavoidable changes in the visual environment will occur. The planned extensive programme of earth profiling and tree planting along the public roads will reduce visual impacts. The impact on views from high points in Muswellbrook and from across the Hunter River will be moderated by distance. While views of the operation will be restricted, the screening will also restrict the present broad vistas into the site and give a more enclosed character. The deviation of Denman Road will reduce slightly the views now available across the Hunter River Valley and result in some loss of quality in the setting of those houses adjacent to the deviation.

The Mount Arthur North project will eventually provide direct employment for over 1 200 persons in the operation workforce. As well as direct employment associated with the mine, there will be additional employment generated in mine support, service industries and consumer industries. It is estimated that a total of up to 3 200 new jobs will be created by the project. It is expected that a substantial portion of this workforce will be housed in the Muswellbrook Shire and particularly in Muswellbrook itself.

The most recent population projections for the Muswellbrook Shire show a growth from the 1976 census total of 11 520 to a population of 22 376 by 1991. The growth in Muswellbrook's population over the same period is projected to be from 7 805 to 15 497. It can be expected that a similar growth rate will continue past 1991. Over this period, the contribution to the growth of the town of Muswellbrook by the Mount Arthur North project is estimated to vary between 18 and 25 percent. The rapid growth rate places a need for extensive *areas of urban land to be made available for residential, commercial and industrial purposes in both Muswellbrook and Denman. There will also be a need to provide additional social, recreational, health and educational services.*

The present built-up area of Muswellbrook covers some 550 hectares of land. The town will need to almost double in area during the next decade. Residential development will need to proceed at twice the rate of required consumption to allow for spare capacity to develop in order to hold down prices. For the next five years, residential land should be released at double the current rate of building of 270 dwellings per annum.

The Mount Arthur North project will have a considerable economic impact on the Upper Hunter Region. Total annual wages will reach $30 million of which a significant proportion will flow back into the local economy. Increased rates on new residential land and contributions under the Local Government Coal Levy will add significantly to the Shire revenue. On a State and Commonwealth level, the project will generate considerable benefits. Foreign exchange earnings from the export of the coking coal fraction will exceed $40 million per annum. The Federal Treasury will benefit from income tax on salaries, company tax, shipping and product charges. State revenue will amount to approximately $23 million per annum from coal royalties, payroll tax, port charges and railway freight charges.

1.5 CONCLUSIONS

The Mount Arthur North project will be one of the largest coal mine developments in Australia and as a conseqence will have impacts on the rural area in which it is located and on the town of Muswellbrook.

Investigation, planning and design work, of a magnitude consistent with the scale of the project, have been carried out by the Commission. This impact statement describes in detail both the design and the environmental studies related to the establishment of the three mines, the coal processing and handling facilities and the infrastructure requirements.

Environmental consequences have been a major consideration in the planning and design of the project and extensive safeguards will be included in order to minimise the potential adverse effects of project activities. Details have also been provided of a comprehensive monitoring programme which will assess and control the effectiveness of the proposed safeguards.

The environmental investigation and the resultant operational and design controls that have been proposed have demonstrated that the development of Mount Arthur North can take place in a manner as to protect the local environment and yet enable a major coal resource to be developed. The development of the resource, which will enable additional electricity generating capacity to be brought on line, will ensure that the Electricity Commission is able to continue to meet its responsibilities for electric power supply to the State of New South Wales.

The development of Mount Arthur North will provide significant job opportunities and a significant impetus to increased economic development of the Upper Hunter region. The effects of this development and others planned for the Upper Hunter will mean that the Muswellbrook Shire area and, in particular, Muswellbrook itself, will enter a new and challenging phase in their development. The process of change will require a coordinated and responsible approach between State and Local Government instrumentalities and the developers to ensure that the transition is carefully planned, equitably managed and properly controlled.

INTRODUCTION

2. INTRODUCTION

The objectives of the Commission's Proposal to establish the Mount Arthur North development are presented. Ultimate objectives are outlined to enable assessment of the full significance of the Proposal.

The Commission's Proposal is outlined along with a brief description of other existing and proposed mining developments within the area of impact.

The objectives of the Environmental Impact Statement and its scope are outlined to enable a clear appreciation of the contents and organisation of the document.

2.1 OBJECTIVES OF THE PROJECT

The Mount Arthur North Coal Project will supply coal principally to the Bayswater and Liddell Power Stations, which are located to the south east of the project site as shown on **Exhibit 2.1, Locality Plan.**

The Bayswater Power Station, now under construction, is adjacent to the 2 000 megawatt (MW) Liddell Power Station which was completed in 1965. Bayswater is scheduled to commence generation of electric power in 1985 with two units each of 660 MW capacity. It is proposed that a further two units of 660 MW capacity will be installed in 1986.

A base load power station comprising four 660 MW units, such as proposed at Bayswater, could consume up to 150 million tonnes of coal during its life. The existing Liddell Power Station is expected to consume approximately 70 million tonnes throughout the remainder of its operating life. There is therefore a primary requirement to provide reserves totalling approximately 220 million tonnes of steaming coal for these stations. Having regard for the large investments in land, water supply systems, coal transport and other facilities associated with major power station development, there is every likelihood that Bayswater and Liddell Power Stations will be rebuilt sometime in the future. Provision should therefore be made to increase the reservation of coal to approximately 500 million tonnes in consideration of this eventuality.

Total measured reserves of 511 million tonnes have been delineated within the Authorisation area from which a recoverable reserve of 412 million tonnes has been calculated. Coal will also continue to be drawn from mines utilising the remaining reserves within the Commission's leases at Ravensworth No 2, Swamp Creek and Liddell State mines.

The multi seam nature of the coal in the Mount Arthur North Authorisation area necessitates an open cut development in order to maximise the use of the enormous resource by mining as much coal as possible from the area. An underground mining development of this type of resource would not be feasible in terms of maximising the resource potential and meeting the demands for coal from the power stations.

The maximum annual production rate will be approximately 11 million tonnes of raw coal which is equivalent to a final product peak production rate of approximately 9.7 million tonnes. A component coking coal fraction will provide one million tonnes of export coking coal per year as an adjunct to the supply of steaming coal to the power stations.

2.2 DEVELOPMENT PROPOSAL

This Environmental Impact Statement has been prepared by Sinclair Knight & Partners Pty Ltd at the request of the Electricity Commission of NSW to support applications to the NSW Department of Mineral Resources for a mining lease, Muswellbrook Shire Council for development consent, and to other Commonwealth and State Government Authorities for licences and approvals. The proposal is the establishment of three open cut mines on properties owned by the Electricity Commission and contained within the confines of Authorisation No 168 in the Shire of Muswellbrook in the Upper Hunter Valley of New South Wales.

Studies and investigation programmes of geological exploration, mine planning, geotechnical aspects, groundwater, surface water, site water management, acoustics and blasting, site soils, and planning, marketing and financial feasibility, have been commissioned by and completed for the Commission. A further study, as yet to be completed, is the urban infrastructure and planning study for Muswellbrook Shire Council. The environmental consultant has separately carried out studies related to regional heritage aspects, agricultural aspects, site landscaping and rehabilitation, fauna and flora, socio-economic assessment and an aboriginal relics site survey.

The development proposal presented in this Environmental Impact Statement defines the developments to the year 2004. An outline of the principal facets of the development are listed below:

- Ramrod Creek and Whites Creek Mines commencing production in 1983/1984
- the Glen Munro mine commencing production in 1992
- site industrial facilities comprising coal handling and preparation plant
- overland conveyor to Baywater Power Station (not actually part of this development proposal but included under the works proposed for Bayswater Power Station - see **Reference 4**)
- rail spur extension from the proposed Drayton balloon loop to a Mount Arthur North balloon loop
- site facilities and amenities for each of the mines

Site construction is due to commence in 1981 with mining programmed to commence in 1983. Anticipated annual raw coal production rates in million tonnes per annum (mpta) are given in **Table 2.1, Coal Production Schedule.**

TABLE 2.1 - COAL PRODUCTION SCHEDULE

Year	Raw Coal Production (mtpa)
1983	0.8
1984	2.6
1985	5.4
1986	8.0
1987	10.0
1988	10.5
1989-2003	11.0
2004	8.0

To evaluate the Mount Arthur North proposal it is necessary to view this development in the full context of other planned developments in the Muswellbrook area in the immediate future. Existing and proposed projects within the boundaries of the Shire of Muswellbrook are set out in **Chapter 3, Project Background.** Where possible, in the evaluation of environmental impacts, assessment has been made of what the cumulative effects may be on the regional environment.

Further development of the Mount Arthur North site is foreshadowed well into the twenty first century. In **Chapter 4, Description of the Proposal,** the scope of future development is outlined to the extent possible at this time. It should be appreciated that a resource of the magnitude of Mount Arthur North will have a very long development time frame and future planning can only be indicative. Any future additional proposals to that presented in this Impact Statement would of course be covered by further environmental impact statements.

The project has been designated as the Mount Arthur North Coal Project which encompasses all facets of mining operations and associated infrastructure, facilities and amenities. Throughout the text of this document the qualification 'proposal' is omitted in the interests of brevity and unnecessary repetition.

2.3 SCOPE AND OBJECTIVES OF THIS ENVIRONMENTAL IMPACT STATEMENT

This document is presented to detail formally the Commission's proposal for the Mount Arthur North Coal Project and to specifically describe the relationships and impacts between the mining proposals and the existing environment and the procedures proposed to safeguard that existing environment.

In the preparation of this document, the Commission and their consultants have consulted with Departments and Authorities to seek their advice and requirements and to keep them informed of the progress of the study. Continuous liaison has been maintained particularly with both the Department of Environment and Planning and the Muswellbrook Shire Council.

This document will serve as the means by which the project is to be evaluated. Every effort has been made to consider all the environmental implications of the project and to assess, without prejudice, the short and long terrn environmental implications. The document is prepared as a basis for discussion. Any omissions or clarifications of any aspects which may appear to the Determining Authority to be insufficiently covered will be answered by the Commission.

The document has been prepared in accordance with the relevant sections and clauses of the Environmental Planning and Assessment Act 1979 and the accompanying Environmental Planning and Assessment Regulations 1980. It also meets the requirements contained in Environmental Standard E1-4 of the State Pollution Control Commission. The Suggested Contents Brief for the Environmental Impact Statement for a Typical Surface Coal Mining Proposal, which was prepared by the State Pollution Control Commission prior to the proclamation of the new Act, was also followed.

The Impact Statement has been prepared in parallel with the technical evaluation and preliminary design of all aspects of the development. This has ensured that environmental considerations have been incorporated from an early stage in the design of the project. A full description is provided of the design and operational safeguards that have been incorporated for environmental protection. This Impact Statement demonstrates and reflects the standard of environmental investigation and protection that has been provided for the Mount Arthur North Coal Project.

The document will be the basis for seeking approval from the Determining Authority and obtaining development consent and will also support an application for an invitation to apply for a mining lease. The studies supporting this statement will form the basis for future licence applications under the various pollution control acts.

The information contained in VOLUME I - ENVIRONMENTAL IMPACT STATEMENT, is summarised below:

- **Chapter 1:** SUMMARY of the Impact Statement outlining the proposal, environmental safeguards and the impacts of the development.

- **Chapter 2:** INTRODUCTION, describing the objectives of the development, an outline of the development proposal, and the scope and objectives of this document.

- **Chapter 3:** PROJECT BACKGROUND, presenting an overview of power generation in New South Wales, the existing and proposed coal developments in the Upper Hunter Valley, and a resume of the development history of the Mount Arthur Site.

- **Chapter 4:** DESCRIPTION OF THE PROPOSAL, describing in detail the Commission's proposal for development of the project.

- **Chapter 5:** EXISTING ENVIRONMENT, describing the characteristics of the existing environment both locally and regionally, and the identifying of the potential constraints on the mining proposal.

- **Chapter 6:** ENVIRONMENTAL SAFEGUARDS, outlining the measures developed to protect the environment.

- **Chapter 7:** INTERACTIONS AND IMPACTS, setting out the effects and consequences of the proposal on the environment.

- **Chapter 8:** LEGAL APPROVALS NECESSARY FOR COMMENCEMENT OF OPERATIONS

- **Chapter 9:** REFERENCES

VOLUME 2 - SUPPORTING DOCUMENTS, contains supportive study report text and miscellaneous data tables relevant to the environmental impact assessments.

2.4 ENVIRONMENTAL STUDY PERSONNEL

The following personnel were responsible for the various components of the Study.

- **Sinclair Knight & Partners Pty Ltd**
  B D Robertson BE, DipHE(Delft), - Director of the Study
  T W Macoun BE, MEngSc. - Study Project Manager
  S W Brooke BE, DipTCP - Study Coordinator

R A Beatty BE(Mineral)
D Low Choy BA(Geog)
A K Davie BE, GradDipEnvEng
N L Case BE, BEc.
D C Ansley BSc(CivEng).

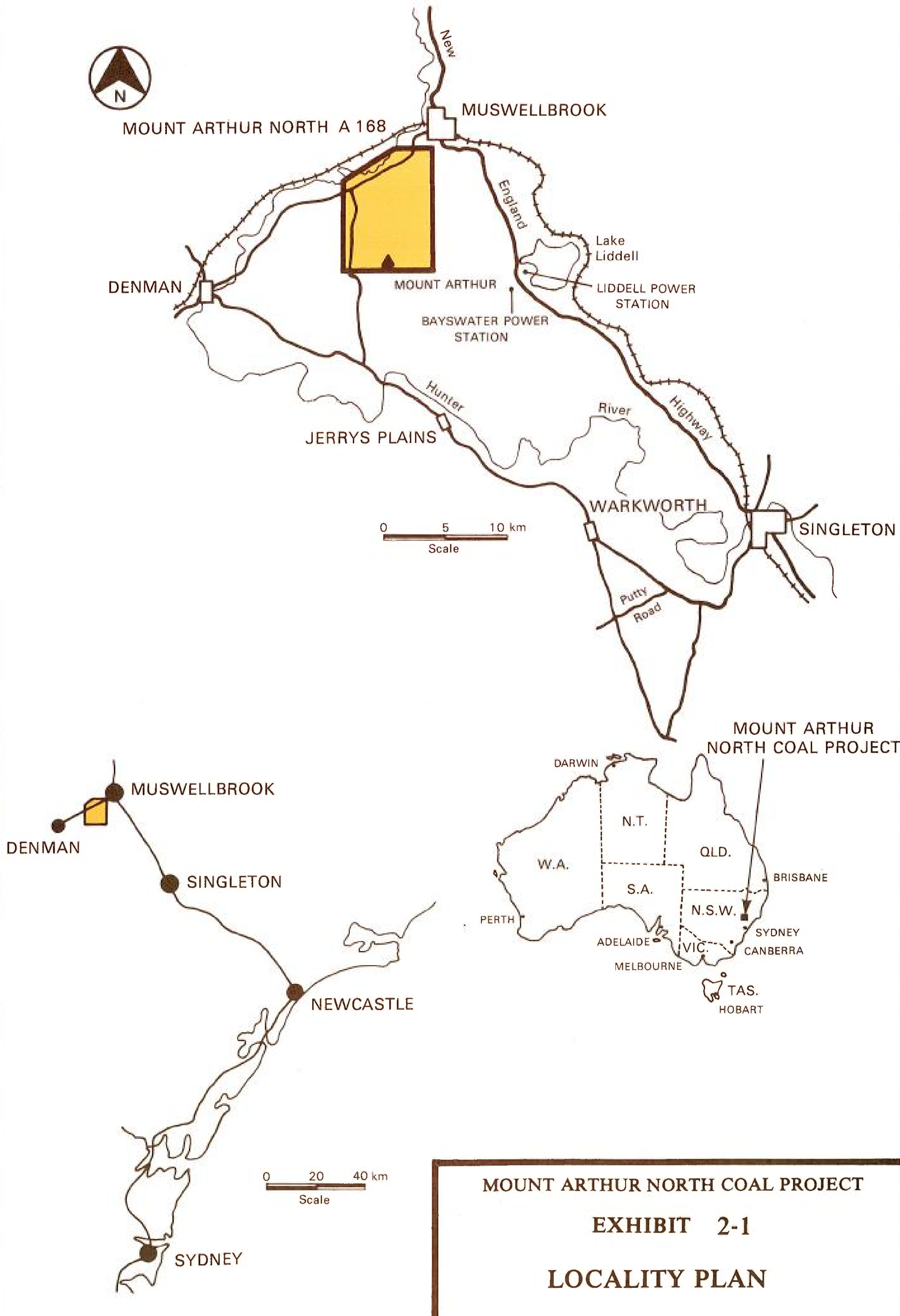
. **Consultants to Sinclair Knight & Partners Pty Ltd**
Prof. L K Dyall, University of Newcastle - Aboriginal Relics
D Conybeare, Planning Workshop Pty Ltd - Heritage Survey
J Cook, Sloane Cook & Co Pty Ltd - Agricultural Assessment
C Bull & N Corkery, Edmond, Bull & Corkery Pty Ltd - Landscape Planning
I Cowie, Peter Hollingsworth & Associated Consultants Pty Ltd - Fauna Survey

. **Consultants to the NSW Electricity Commission**
Australian Groundwater Consultants Pty Ltd - Groundwater, surface water and leachate hydrology and quality
Golder Associates Pty Ltd - Geotechnical and mine planning
Longworth & McKenzie Pty Ltd - Mine operation and materials handling
McDonald Wagner & Priddle Pty Ltd - Mount Arthur North to Bayswater Power Station conveyor design
Paul Weir Company (USA) - Mine planning
Planner West & Partners Pty Ltd in association with J B Sedgman & Associates Pty Ltd - Coal preparation and treatment plant design
Gutteridge Haskins & Davey Pty Ltd - Road and rail design; Muswellbrook planning study
Sinclair Knight & Partners Pty Ltd - Water management and dust control
Sinclair Knight & Partners Pty Ltd - Environmental impact statement
Soil Conservation Service of NSW - Soil type and erosion potential
Wilkinson Murray Consulting Pty Ltd - Acoustics and blasting
Australian Coal Industry Research Laboratories Pty Ltd - Coal analysis.

The Mount Arthur North Coal Project is managed for the Electricity Commission by the following officers:

. Mr N B Heal - Manager, Fuel Division, Electricity Commission of NSW
. Mr J A Wall - Project Manager, Mount Arthur North Coal Project, Electricity Commission of NSW.
. Mr M Gray - Engineer, Electricity Commission of NSW
. Mr N Lynch - Engineer, Electricity Commission of NSW
. Mr V Pitrans - Engineer, Electricity Commission of NSW

The officers of Muswellbrook Shire Council, the Department of Environment and Planning, the Department of Mineral Resources, the State Pollution Control Commission, the Water Resources Commission, the Soil Conservation Service and the Department of Agriculture are thanked for their cooperation and assistance.



MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 2-1

LOCALITY PLAN

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

PROJECT BACKGROUND

3. PROJECT BACKGROUND

A background of the production of thermal electricity in NSW is presented along with an overview of the coal resource of the Upper Hunter Valley.

A review of the exploration and investigation programme for the Mount Arthur North Coal Project is presented with a discussion of other possible coal mining developments in the Mount Arthur area.

3.1 POWER GENERATION IN NSW

The total installed capacity of NSW power stations is approximately 7 700 megawatt (MW). In addition, an entitlement of up to 2 600 MW was available to NSW from the Snowy Mountains Hydro-Electric Scheme for periods of peak demand. The maximum demand experienced until the end of 1979 was 6 500 MW, the remaining capacity being required for spinning reserve, maintenance and transmission losses. The existing thermal generating stations and their classifications by the NSW Electricity Commission are listed in **Table 3.1, NSW Thermal Power Stations.**

TABLE 3.1 - NSW THERMAL POWER STATIONS

Station	Capacity (MW)
Liddell	2 000
Munmorah	1 400
Vales Point B	1 320
Wallerawang C	500
Tallawarra B	200
Vales Point A	875
Wallerawang B	120
Wangi B	180
Tallawarra A	120
Wallerawang A	120
Wangi A	150
Muswellbrook	30
Pyrmont	200
White Bay	100
TOTAL	7 315

Since 1970 the peak demand for electricity in NSW has grown by about 6 percent per annum. This growth will increase the demand in NSW by approximately 2 500 to 3 000 MW by mid 1985. In addition, further capacity will be required for major new base load industries which have been attracted to the State.

In particular the aluminium industry in the Hunter region will further increase the demand for power. The present smelter at Kurri Kurri uses about 130 MW but, when its expansion is complete and the other two proposed smelters at Lochinvar and Tomago are on line, the combined electricity requirement will be about 1 000 MW. NSW will thus require approximately 11 200 to 11 700 MW of installed capacity by mid 1985.

There are no further economic opportunities for any substantial increase of hydro-electric power generating capacity within NSW. The Electricity Commission will continue to develop thermal power stations to meet the increase in demand.

A large thermal power station requires firstly a large resource of coal of suitable quality and in reasonable proximity. A 660 MW power generating unit, for example, requires a supply of coal of approximately 1.8 million tonnes per year. The second crucial requirement is a reliable supply of water. While there are coal deposits in the north of NSW and the Riverina district, over 90 percent of New South Wales proven coal resources occur in the Main Coal Province. This province stretches from Gunnedah down the Hunter Valley to Newcastle on the coast and down the coast to beyond Wollongong. The province includes the Western Coal Fields around Lithgow. The relatively few locations within reasonable proximity to the electrical load centres in NSW which have proven coal and water resources of sufficient quality and quantity for a thermal power station are within the Main Province. The resources are available on the Central Coast, in the Central Hunter between Muswellbrook and Singleton, and on the Western Coal Fields between Lithgow and Portland.

The programme for power station construction utilises all three locations as listed in **Table 3.2, NSW Thermal Power Station Construction to 1987.**

TABLE 3.2 - NSW THERMAL POWER STATION CONSTRUCTION TO 1987

Station	Unit No	Unit Size (MW)	Date of Start Up	Cumulative Capacity (MW)	Location
Wallerawang	8	500	1981	8 200	Western Coal Field
Eraring	1	660	1982	8 860	Central Coast
	2	660	1983	9 520	Central Coast
	3	660	1983	10 180	Central Coast
	4	660	1984	10 840	Central Coast
Bayswater	2	660	1985	11 500	Central Hunter
	1	660	1985	12 160	Central Hunter
Bayswater	3	660	1986	12 820	Central Hunter
	4	660	1986	13 480	Central Hunter
Mount Piper	2	660	1987	14 140	Western Coal Field
	1	660	1987	14 800	Western Coal Field

Source: Electricity Commission of NSW

The Government announced on 29 April 1979 their intention of proceeding with the construction of Bayswater Power Station. The choice of the specific site in the Upper Hunter Region is detailed in the Bayswater Power Station Environmental Impact Statement **(Reference 4).**

The Wollombi Coal Measures contain few seams of economic importance although development of the two or three thicker seams may yield some steaming coals in the future.

The Wittingham Coal Measures contain about 15 seams of economic interest and these contain both steaming and coking coals. The thickness of the individual seams varies throughout the Measures, but the occurrence of very thick coal beds of up to 25 metres renders them very suitable for deep open cut mining. The coal quality varies within these seams with steaming coals towards the tops of the seams and soft coking coals in the lower portions.

The Newcastle and Tomago Coal Measures are the same geological sequence as the Singleton Coal Measures but have been separated by the Lochinvar Anticline. The Newcastle and Tomago Coal Measures therefore have somewhat similar characteristics to the Singleton Measures, with the quality varying from steaming to soft coking blend coals, and a variable ash content. The Greta Coal Measures are typically low ash coking blend coals with a relatively high total sulphur content of between 2 to 5 percent.

The importance of the Hunter Valley coal resource to NSW and Australia can be judged from **Table 3.3, Regional Importance of Hunter Valley Coal and Electric Power.** Hunter Valley coal production currently represents approximately one third of the total Australian production and above 60 percent of the NSW coal production. Power stations fed by Hunter Valley coals annually supply 80 percent of the State's power requirements. In the immediate future, the importance of the Hunter Valley resource is projected to increase.

TABLE 3.3 - REGIONAL IMPORTANCE OF HUNTER VALLEY COAL AND ELECTRIC POWER

Coal Production	1979	1985
Hunter region as proportion of Australian production	32%	n.a.
Hunter region as proportion of NSW production	59%	70%
Proportion of Hunter region coal exported	43%	50%
Proportion of Hunter region coal used for power	45%	42%
Electricity Generation	**1979**	**1985**
Hunter region as proportion of NSW total	78%	90%
Proportion of Hunter region electricity used for aluminium smelting	5.2%	20%
Coal Required to Provide for Aluminium Smelting	**1979**	**1985**
Amount (million tonnes)	0.55	4.4
Proportion of Hunter region coal production (approx.)	2%	9%

Source: 'Pollution Control in the Hunter Valley with Particular Reference to Aluminium Smelting' - SPCC, 1980.

3.2 COAL RESOURCES OF THE HUNTER VALLEY

The principal coal bearing basin of NSW is the Sydney Basin which extends from south of Wollongong, to Lithgow to the west, and to Muswellbrook and Newcastle in the north. The Sydney Basin is the principal basin in terms of known resources. Other basins such as the Gunnedah and Clarence-Moreton Basin are, however, largely unexplored. **Exhibit 3.1, Major Coal Bearing Basins of NSW** shows the coal bearing basins of the State. Within the Sydney Basin coal is readily accessible only around the perimeter as the depth of cover increases towards the centre.

The Hunter Valley, almost continuously from Newcastle through to Muswellbrook, is coal bearing. The coal is of Permian origin with the main outcrop belt in the valley generally not exceeding 50 kilometres in width. It is structurally confined on the north and east by faults of the Hunter Thrust System. The principal coal measures are the Newcastle, Tomago, Singleton and Greta Measures.

The Newcastle and Tomago Measures on the eastern side of the valley have been mined extensively since the mid 1800's. These measures are becoming depleted around Newcastle but large accessible reserves exist around Lake Macquarie and as far south as Tuggerah. These reserves will supply Wangi, Vales Point, Munmorah and the future Eraring Power Stations.

The Greta Coal Measures, along the Lochinvar Anticline in the vicinity of Cessnock, have also been worked since the mid 1800's. A few mines will continue in this area but production will progressively decrease as much of the extractable coal has already been mined.

The Singleton Coal Measures, in the middle and upper Hunter Valley, are the sites of major extraction and the centre of future expansion. These extensive measures stretch from Singleton in the east to Denman in the west and from Broke in the south to Scone in the north. The mineable reserves within this area have been estimated at 6 000 million tonnes. These measures occur again near the surface on the upper Goulburn River at Ulan and will also be mined in that area.

The Muswellbrook Anticline results in the Greta Measures approaching the surface again near Muswellbrook. These measures are now being mined and will be the subject of further development. The location and stratigraphic relationships of the principal coal measures of the Hunter Valley are shown in **Exhibit 3.2, Coal Measures of the Hunter Valley.**

Thirteen collieries are currently operating in the Hunter Valley north of Singleton and a further 23 prospecting authorisation areas or coal lease tender areas are held by private enterprise. The Electricity Commision of NSW holds two large prospecting authorisation areas, Mount Arthur North and Mount Arthur South. **Exhibit 3.3, Coal Developments in the Upper Hunter Region,** depicts the existing and proposed coal mining operations of the Upper Hunter Region.

The Singleton Coal Measures outcrop in an area of 2 200 square kilometres in the Hunter Valley representing approximately 13 percent of the total catchment area above Singleton. Most of this is suitable for coal extraction by open cut mining methods. The measures are generally about 1 000 metres thick, and comprise two sub-groups: the upper or Wollombi Coal Measures and the lower or Wittingham Coal Measures. The coal is generally of low ash and low sulphur and the demand for the coals on the domestic and overseas markets is high.

3.3 BACKGROUND TO THE MOUNT ARTHUR NORTH PROJECT

In June 1968 the Department of Mines, Joint Coal Board and the Electricity Commission undertook an initial programme of coal prospecting in the northern half of the Mount Arthur area with a view to locating an additional coal source in the Singleton Coal Measures. Prior to the construction of Liddell Power Station the Commission had investigated the Singleton Measures south of the Liddell area and the Greta Measures to the west (now held by the Drayton Co-Venture). However, the more complex geology of the Greta Measures led to the Commission developing the Ravensworth site as a source of supply for Liddell Power Station. Subsequently, in order to supplement the supply from Ravensworth No 2 and the Swamp Creek mine, an economic source of significant coal resources was required.

An initial programme, comprising six cored drill holes, was carried out between August 1968 and October 1969 and it clearly indicated that the area contained considerable resources of commercial quality coal. By proclamation in the Government Gazette of June 1971, the Mount Arthur area was set aside (area of 16 500 hectares) for future power generation purposes, and an authority issued to the Commission to continue coal prospecting. Exploration drilling was recommenced in July 1972 and has continued ever since. As prospecting continued, it became evident that the coal resources were very large and since a significant proportion of the coal was at relatively shallow depths it offered an attractive prospect for open cut mining. By late 1975 it was evident that the northern section of the reserve showed greater potential for economic large scale mining than any other part of the area and consequently a decision was made to concentrate drilling in this area.

In July 1979 the Government altered the boundaries of the Authorisation into what is now known as Coal Authorisation A168 (North) and A169 (South). The authorisation area was extended north of the Denman Road to the northern side of the Hunter River and to the west of the Edderton Road.

Since July 1979 various studies and investigation programmes have been commissioned. Detail drilling and mine planning results are discussed in **Chapter 4, Description of the Proposal.** Studies commissioned as part of the environmental investigation programme are listed in VOLUME 2 and are described in later chapters.

The Commission has commenced acquiring the land required for the mine operations and to provide a suitable buffer zone adjacent to the operating area. Approximately 5 600 hectares of land will be acquired. Land which is not used for mining or associated uses will be used for grazing or other primary production activities similar to existing uses.

The proposed Mount Arthur South Coal Project does not form part of this Proposal and will be the subject of a separate environmental impact statement. It will be a joint venture between the Electricity Commission of NSW (50 percent), Ampol Petroleum Ltd (17.5 percent), Pioneer Concrete Services Ltd (17.5 percent), the Electric Power Development Company Ltd, Japan (12.5 percent) and Mitsui & Co (Aust) Ltd (2.5 percent). It is expected that a mining lease containing 230 million tonnes of extractable reserves (including reserves of deep coal only extractable by underground mining) will be established within the boundaries of Authorisation A169 and made available to the Joint Venture. Preliminary data indicates that the availability of suitable reserves of coal available for open cut mining might be adequate to support a production scale of up to 4 million tonnes per annum, but this assessment is subject to the further investigations now being carried out.

The Joint Venture Company, subject to the results of current feasibility studies, intends to export this coal to world markets.

3.4 MINING OPERATIONS IN THE MUSWELLBROOK AREA

Although existing mining operations in the Upper Hunter Valley are few, programmed developments over the next 5 to 10 years are considerable. Exhibit **3.3, Coal Developments in the Upper Hunter Region** shows the location of existing and potential developments in the Upper Hunter region.

The following Tables describe existing and proposed coal developments within the Shire of Muswellbrook.

TABLE 3.4 - EXISTING COAL MINES, SHIRE OF MUSWELLBROOK

Mine	Colliery Proprietor	Mining Operation	Raw Coal Production (mpta)
Muswellbrook No 1	Muswellbrook Coal Co	underground	0.60
Muswellbrook No 2	Muswellbrook Coal Co	opencut	0.60
Bayswater No 2	Bayswater Colliery Co	opencut	0.80

TABLE 3.5 - PROPOSED COAL MINE DEVELOPMENTS, SHIRE OF MUSWELLBROOK

	Registered Holder	Area (sq.km)	Status	Future Development
A102	Dept.Mineral Resources	515	Reconnaissance Drilling	Not known
A129	Carpentaria Exploration	14	Reconnaissance Drilling	Not known
A168	Electricity Commission	68	Development Planning	Mining proposed 1983/1984
A169	Electricity Commission	93	Development Planning	Mining proposed 1984
A171	Bayswater Colliery	11	Development Drilling	Extension to Bayswater No 2.
A172	Bayswater Colliery	27	Reconnaissance Drilling	Not Known
A173	Thiess Bros.	32	Development Planning	Mining proposed 1982
A174	Mount Sugarloaf Collieries	22	Development Planning	Mining proposed 1983/1984
A176	Muswellbrook Coal Co	68	Reconnaissance Drilling	Extension to existing development
A209	Carpentaria Exploration		Reconnaissance Drilling	Not Known

Source: Department of Mineral Resources (Reference 22).

The projected coal outputs in million tonnes per annum (mpta) from coal mines in the Shire area over the next decade are given in **Table 3.6, Projected Coal Production, Shire of Muswellbrook.**

TABLE 3.6 - PROJECTED COAL PRODUCTION, SHIRE OF MUSWELLBROOK

Year	Projected Raw Coal Production (mtpa)	
1980	2.0	
1981	2.0	
1982	2.5	
1983	4.5	
1984	9.0	
1985	15.0	)
1986	20.0	) provisional
1987	25.0	) figures
1988	30.0	) only
1989	30.0	)
1990	30.0	)

Table 3.6 is reasonably accurate up until 1985/1986. For the initial years of 1980, 1981 and 1982 production is equivalent to current rates for the existing collieries of Bayswater No 2 and Muswellbrook No 1 and No 2. In 1982 production is due to commence on Drayton (A173). 1983 sees the first production from Mount Arthur North (A168) and increased production for Drayton. 1984 includes increased production on both Drayton and Mount Arthur North and the first year of production on Black Hill (A174) and Mount Arthur South (A169). Total 1985 production assumes significantly increased production for Mount Arthur North and Mount Arthur South.

For 1985 onwards the projected totals are very approximate due to the likelihood of start up on mines for which few details are available of the likely production rates. The mines under preliminary planning are:

. Muswellbrook Coal Company (A176)
  - construction 1985
  - production 1986

. Bayswater Colliery (A171)
  - construction 1984
  - increased production 1985

. Carpentaria Exploration (A129)
  - construction 1985
  - production 1986

Authorisations on which very few details are available and on which development is assumed as unlikely to occur within the next ten years are:

. Department of Mineral Resources (A102)
. Carpentaria Exploration (Coal Lease Application 71, previously Authorisation A209)
. Bayswater Colliery (A172)
. Coal Tender Area E7.

Tender Area E7 is located immediately to the south of Denman. Two tenders have been received and discussions are proceeding. A conflict with the Wollemi National Park in the south would require resolution before development planning could proceed any further.

Reconnaissance drilling on A102, held by the Department of Mineral Resources, is underway. It is understood that a report in mid 1981 will establish whether to proceed with planning for a coal liquefaction plant development. If the project does go ahead a pilot plant could be constructed around 1990.

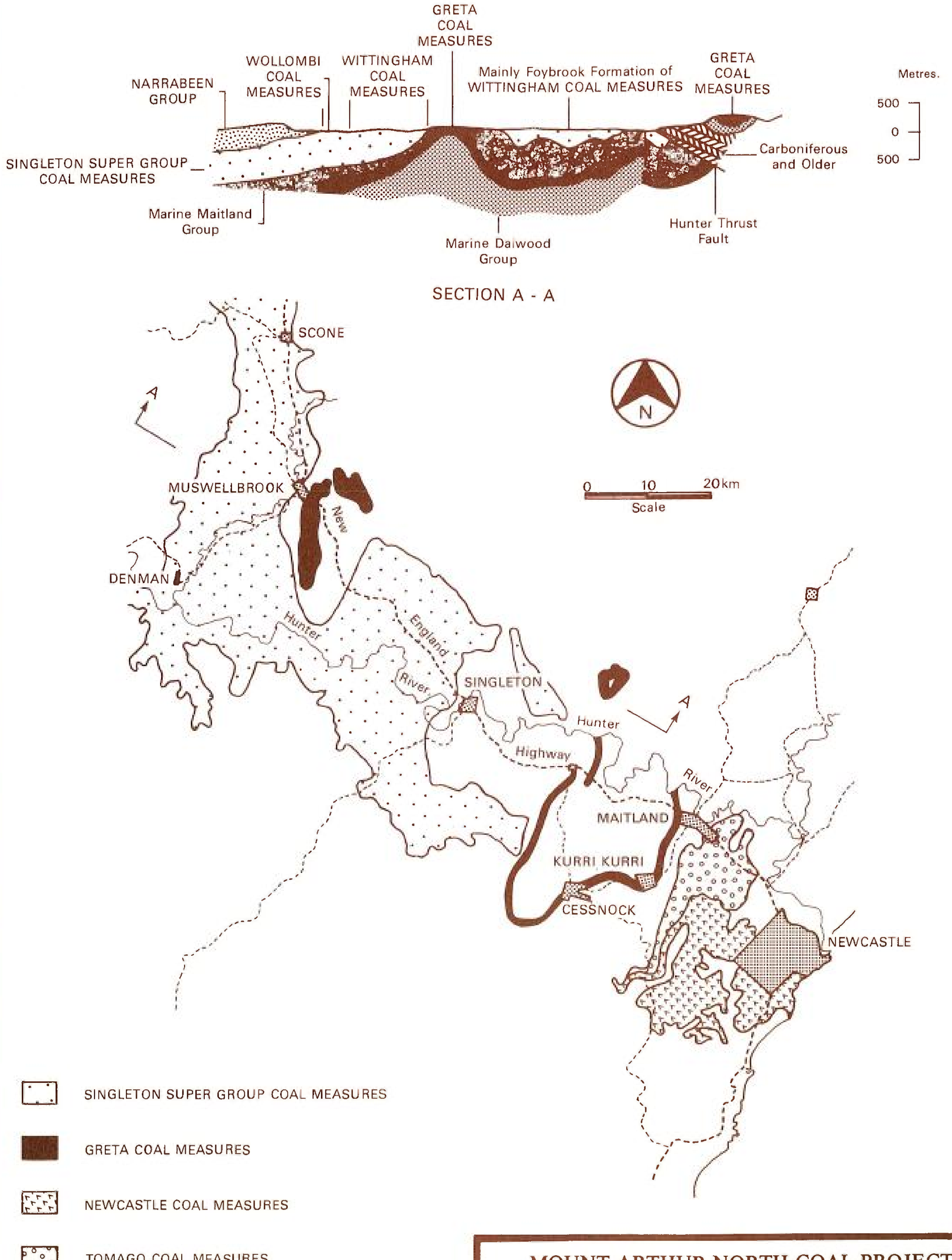
Further information on prospective mine developments in the total Upper Hunter region is contained in Document 12 of VOLUME 2.

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 3-1

MAJOR COAL BEARING BASINS OF N.S.W.

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



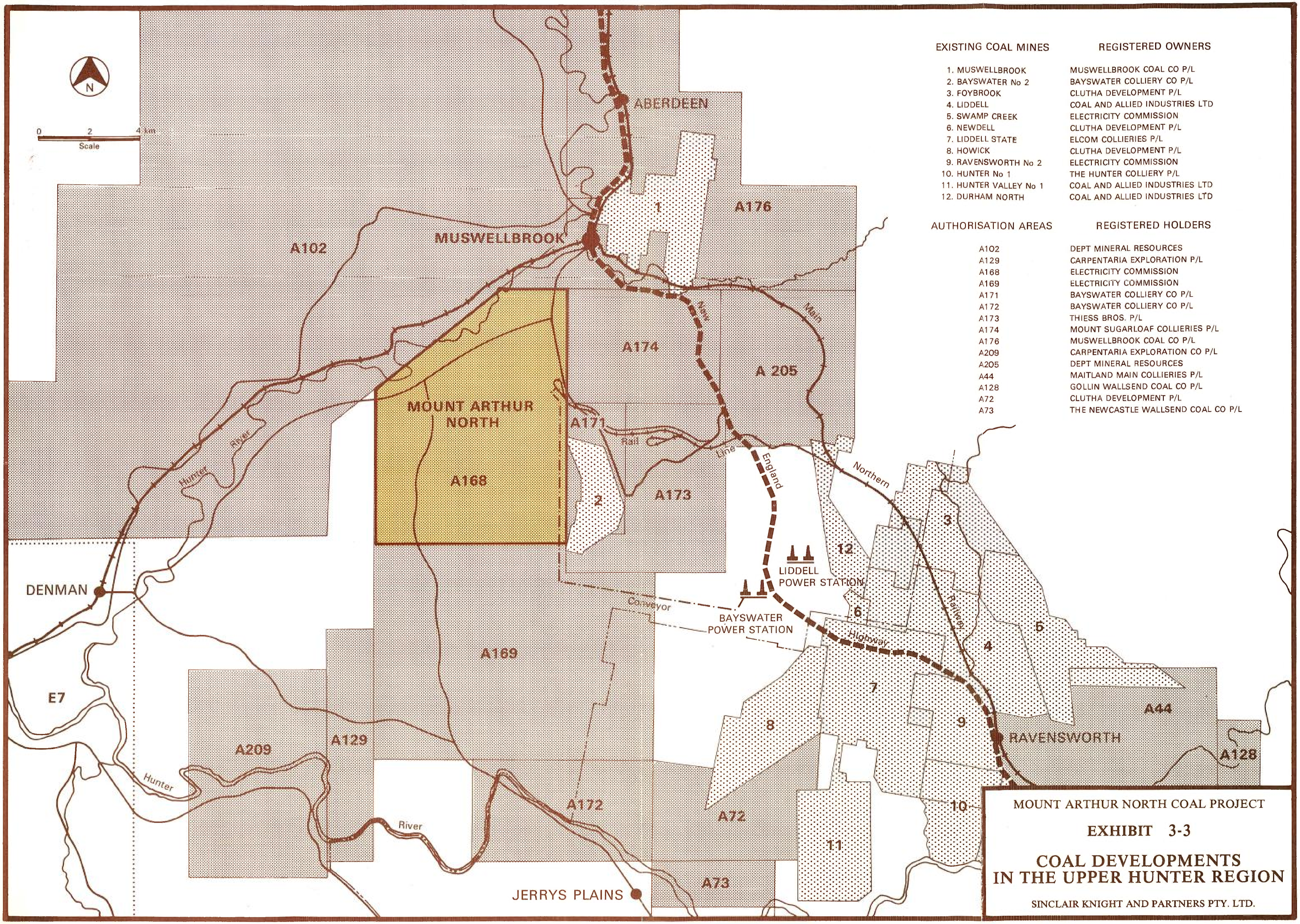
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 3-2

COAL MEASURES OF THE HUNTER VALLEY

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: GEOLOGICAL SURVEY OF N.S.W.



EXISTING COAL MINES	REGISTERED OWNERS
1. MUSWELLBROOK	MUSWELLBROOK COAL CO P/L
2. BAYSWATER No 2	BAYSWATER COLLIERY CO P/L
3. FOYBROOK	CLUTHA DEVELOPMENT P/L
4. LIDDELL	COAL AND ALLIED INDUSTRIES LTD
5. SWAMP CREEK	ELECTRICITY COMMISSION
6. NEWDELL	CLUTHA DEVELOPMENT P/L
7. LIDDELL STATE	ELCOM COLLIERIES P/L
8. HOWICK	CLUTHA DEVELOPMENT P/L
9. RAVENSWORTH No 2	ELECTRICITY COMMISSION
10. HUNTER No 1	THE HUNTER COLLIERY P/L
11. HUNTER VALLEY No 1	COAL AND ALLIED INDUSTRIES LTD
12. DURHAM NORTH	COAL AND ALLIED INDUSTRIES LTD

AUTHORISATION AREAS	REGISTERED HOLDERS
A102	DEPT MINERAL RESOURCES
A129	CARPENTARIA EXPLORATION P/L
A168	ELECTRICITY COMMISSION
A169	ELECTRICITY COMMISSION
A171	BAYSWATER COLLIERY CO P/L
A172	BAYSWATER COLLIERY CO P/L
A173	THIESS BROS. P/L
A174	MOUNT SUGARLOAF COLLIERIES P/L
A176	MUSWELLBROOK COAL CO P/L
A209	CARPENTARIA EXPLORATION CO P/L
A205	DEPT MINERAL RESOURCES
A44	MAITLAND MAIN COLLIERIES P/L
A128	GOLLIN WALLSEND COAL CO P/L
A72	CLUTHA DEVELOPMENT P/L
A73	THE NEWCASTLE WALLSEND COAL CO P/L

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 3-3

COAL DEVELOPMENTS IN THE UPPER HUNTER REGION

SINCLAIR KNIGHT AND PARTNERS PTY. LTD.

SOURCE: JOINT COAL BOARD

THE PROPOSAL

4. DESCRIPTION OF THE PROPOSAL

A description of the Mount Arthur North coal resource precedes details of the design of the three mines and associated coal processing and infrastructural requirements. The operational and development details of the project are fully described.

4.1 SUMMARY OF PROPOSAL

4.1.1 Proposal Outline

The central element of the Electricity Commission's proposal is the development and operation on the Mount Arthur North site of open cut coal mines to supply the nearby Bayswater and Liddell Power Stations. The coal reserves within the Mount Arthur North Authorisation area are of steaming coal quality suitable for use in thermal power stations. There also exists a small fraction capable of benefication to coking coal suitable for export. The mine will utilise part of the coal resources of the Singleton Super Group of coal measures, which occur as a series of coal seams interspersed with shales and sandstone. Details of the coal reserves are given in **Section 4.2, Mount Arthur North Coal Resource.**

Mine planning considerations have indicated the need for three separate mine developments within the Authorisation area of which two will be worked at any one time. The locations of the mines are shown on the plan of the site in **Exhibit 4.1, Site Development Plan.** Raw coal from each of the mines is to be processed at a central coal handling and preparation area. Processed coal is to be transported by overland conveyor to the Liddell and Bayswater power station complex. Export coking coal and excess steaming coal will be transported by rail from the site. An extension of the proposed rail spur from the Antiene junction to the Drayton mine will finish in a balloon loop located on the site and adjacent to the coal handling and processing complex.

In operational terms, the project will be largely self contained within the Authorisation area. **Exhibit 4.2, Operations Flow Chart,** shows the operations chart for the project, and the main commodity movements to and from the site. Under the proposal covered by this Environmental Impact Statement, three mines are to be established. Initially the northern or Ramrod Creek mine and the central or Whites Creek mine will be developed. The Ramrod Creek mine, a traditional dragline operation utilising prestripping, has a life of nine years and is replaced by a similar development in the west of the site known as the Glen Munro mine. The Whites Creek mine is a deep pit multi seam operation for trucks and shovels. Operations in the Whites Creek mine will continue for the full Stage I period up to the year 2004.

Each mine will have its own separate office, workshop, stores buildings, and amenity facilities. The coal processing plant will also be provided with separate workshop, stores area and bathhouse. The description and location of all site facilities are given in **Section 4.5.1, Office, Workshop and Amenity Facilities.**

4.1.2 Development Programme

Site investigations have been undertaken on the Mount Arthur North site over the past 12 years. Sufficient data has now been compiled to permit the detailed planning of mine operations and the scheduling of development. Initial coal production is planned for in the second half of 1983 from the Ramrod Creek mine, and in 1984 from the Whites Creek mine. The Ramrod Creek mine has an expected life of 9 years, whereupon the equipment would be transferred to the Glen Munro mine in 1992/93. The Whites Creek and Glen Munro mines will continue in production until at least 2004. Complete extraction of the mineable coal reserves contained within the Mount Arthur North Authorisation area will take in excess of 50 years of the maximum Stage I rate of production.

Exhibit 4.3, Mine Development, outlines the development time frame for each of the three mines under this proposal. Future development options are outlined in a later section of this Chapter. Future development beyond 2004 would be the subject of a subsequent detailed development proposal contained within a Stage 2 Environmental Impact Statement.

Detailed planning will be substantially complete by the end of 1980. On site activity during 1980/81 will include further bulk sampling and preliminary landscaping works. The period from 1981 to 1983 will require the finalising of designs and specifications, ordering of equipment, construction of the coal processing area, construction of the rail access and overland conveyor to Bayswater Power Station, installation of the power supply system and other public utility services. Facilities will continue to expand progressively until about 1988 when the mines reach their maximum planned rate of production.

4.1.3 Participants

The Mount Arthur North Authorisation area has been allocated by the NSW Department of Mineral Resources to the Electricity Commission of NSW for the supply of coal for power generation and for export. Subject to the granting of a mining lease, the Commission will assume overall responsibility for the development of mining within the lease area. Actual operation of the mines is likely to become the direct responsibility of several operating companies either owned by or contracted to the Commission. The effective ownership and control of the project will therefore lie with the Commission. Further details are given in **Section 4.6, Management and Workforce.**

4.2 THE MOUNT ARTHUR NORTH COAL RESOURCE

4.2.1 Site Geology

The coal resource in the Mount Arthur North Authorisation Area is contained in the Wittingham Coal Measures which, along with the Wollombi Coal Measures form the Singleton Super Group, a Permian deposit underlying the Triassic Hawkesbury Sandstones. Beneath the Singleton Super Group lies the non coal bearing Maitland Group which in turn is underlain by the Greta Coal Measures.

The Wittingham Coal Measures are located on the western flank of the Muswellbrook Anticline, a large regional geological feature. The seams dip to the west at angles varying between one and 10 degrees. Local anomalies cause steepening or flattening of the regional dip in some areas. The coal seams outcrop in approximately north south lines with the lowest seam (Lower Ramrod Creek) outcropping near the eastern boundary of the Authorisation area.

TRIASSIC	Hawkesbury Sandstone	
PERMIAN	Wollombi Coal Measures)	Singleton Super Group
	WITTINGHAM COAL MEASURES)	
	Mulbring Sandstone)	Maitland Group
	Muree Sandstone)	
	Branxton Formation)	
	Greta Coal Measures	

A number of the coal bands split and coalesce giving some 29 separate identifiable seams occurring in the Authorisation area. A typical stratigraphic section is shown in **Exhibit 4.4, Generalised Stratigraphic Section.** The seams range in thickness from a few centimetres to more than seven metres. Economically recoverable coal occurs in 12 major seams and a number of minor seams which are of a thickness greater than 0.5 metres.

Local faulting has resulted in the recoverable coal occurring broadly in three zones. The various zones are shown on **Exhibit 4.5, Coal Zones.** A major fault zone about 700 metres wide runs east to west across the centre of the Authorisation area. The area north of the fault zone is referred to as Zone 1. The southern half of the Authorisation Area is divided by a second fault line running north west to south east and passing near the peak of Mount Arthur. The area to the east of this fault is referred to as Zone 4/5, and the area to the west as Zone 6. In some locations igneous activity has caused some cindering of coal but the area affected is small and not significant in the context of the overall reserves. **Exhibit 4.6, North-South Geological Section,** the location of which is shown on **Exhibit 4.5,** shows the geological relationship between Zone 1 and Zone 4/5 and the details of the intermediate fault zones.

The base of the Wittingham Coal Measures, the Lower Ramrod Creek Seam, outcrops in Zones 1 and 4/5 and is therefore accessible by open cut methods. Because the seams dip to the west, the upper seams of the Wittingham Measures outcrop sequentially moving westward from the Ramrod Creek subcrop line shown on **Exhibit 4.5.** In Zone 6 the Blakefield and Glen Munro seams lie within 70 metres of the surface and dip gently to the south.

4.2.2 Coal Reserves

Geological Coal Reserves

Coal exploration on the Mount Arthur North site commenced in the early 1950's. In 1976 a detailed investigation programme was begun on a 250 metre square grid drilling pattern in Zones 1, 2, 3 and 4. The location of these drill holes is shown on **Exhibit 4.5.** Further, closely spaced drilling is continuing in Zones 5 and 6 to improve the estimates of coal reserves.

Thirty coal samples from 13 large core drill holes and two bulk sample pits have been subject to washability and analytical tests. Initial analytical testing was also performed on samples from some of the slim core holes. From the bulk sample pits, which are located on **Exhibit 4.5,** two 10 000 tonne samples were exposed.

The coal reserves calculated for the area which have been drilled on the 250 metre grid are Measured Reserves as defined in the Code for Calculating and Reporting Coal Reserves produced by the Standing Committee on Coalfield Geology of New South Wales. Reserves have been calculated for all the seams from the Uncorrelated Y seam to the Lower Ramrod Creek seam for Zones 1, 2, 3 and 4 using a computer aided calculation method. Based on further recent drilling in

Zones 5 and 6 a manual calculation has provided estimates of Measured Reserves in these two zones. The total Measured Reserves for each seam for all mining zones are given in **Table 4.1, Geological Coal Reserves.**

The total Measured Reserves including all seams from the Lower Ramrod Creek seam to the Uncorrelated Z seam, amount to 511 million tonnes of raw coal. The four seams at the base of the succession from the Edinglassie to the Lower Ramrod Creek seam account for about 41.5 percent, or 212 million tonnes of the total Measured Reserves. Seven other seams, the Blakefield, Glen Munro, Mount Arthur, Piercefield, Vaux, Bayswater and Bengalla B seams, all with an average weighted thickness of greater than 1.50 metres, account for a further 40.2 percent or 205 million tonnes. Of the remaining Measured Reserves, the major part of the tonnage occurs in the Lower Vaux, Broonie, Lower Broonie, Wynn, Edderton and Bengalla A seams. All of these have an average thickness of greater than one metre and their total tonnage is 74 million tonnes or 15.5 percent of the total.

TABLE 4.1 - GEOLOGICAL COAL RESERVES

Seam	Measured Reserves (million tonnes)	Weighted Average Coal Seam Thickness (metres)
1. Blakefield	10.64	4.75
2. Glen Munro	27.54	3.71
3. Uncorrelated Z	0.92	0.60
4. Mount Arthur	34.39	5.50
5. Lower Mount Arthur	4.25	0.88
6. Piercefield	23.54	2.85
7. Vaux	41.53	3.94
8. Lower Vaux	10.47	1.20
9. Broonie	16.03	1.45
10. Lower Broonie	3.66	1.32
11. Bayswater	42.09	3.21
12. Wynn	12.67	1.29
13. Lower Wynn	3.21	0.59
14. Edderton	14.23	1.13
15. Clanricard	10.91	0.79
16. Bengalla A	16.94	1.16
17. Bengalla B	25.65	1.55
18. Edinglassie	74.66	3.86
19. Transition	6.13	0.66
20. Ramrod Creek	116.41	5.12
21. Lower Ramrod Creek	14.86	1.47
TOTAL	510.73	

No drilling has been carried out north of the Denman Road or on the steep slopes of Mount Arthur. Hence the above reserve figures do not include the considerable reserves known to exist under the Hunter River flood plain and under Mount Arthur.

Recoverable Coal Reserves

The area subject to detail drilling and classified in the Measured Reserve category has been subject to detail examination to determine the quantity of Recoverable Measured Coal Reserve that can be extracted from this area using open cut mining techniques.

The boundaries of the recoverable coal reserves were established by defining an ultimate pit slope of 45 degrees which included room for roads in the excavated slope. Coal under less than 15 metres of cover was excluded due to weathering. In addition, an allowance of 0.25 metres of coal for each seam was made as coal loss in mining and an allowance of 0.08 metres for each seam added to the quantities as a mining dilution factor.

The major fault zone tending east west and located just north of the Whites Creek mine, and two other minor fault zones located just further south of the major fault zone, have been described previously. The precise location of the faults within the fault zone is not known. However, there are indications that each fault consists of several zones of fracturing over a wide area. The mining reserves were divided into three zones separated by the faults and a fourth zone centred on the major fault. The intersection of a 45 degree pit slope centred on the trace of the major fault and the tops of each of the seams defined the limits of Zones 1, 2 and 3. Zones 3 and 4 were separated by a vertical plane along the trace of the minor faults. Zones 5 and 6 were separated by the fault running north west to south east through Mount Arthur.

The summary of Mineable Coal Reserves is given in **Table 4.2, Recoverable Coal Reserves.**

TABLE 4.2 - RECOVERABLE COAL RESERVES (million tonnes)

Dragline Mining Area		
Zone 1		41
Zone 6		36
Open Pit Mining Area		
Zone 4		74
Zone 5		79
	Sub Total	210
Other Potential Mining Reserves		
Zone 1		112
Zone 2		15
Zone 3		38
Zone 5		37
	Sub Total	202
	TOTAL	412

Some of the coal in Zone 2, which is centred on the major fault zone, was not considered mineable because of uncertainty as to the quantities that could be recovered, as well as difficulties in mining across an area with an 80 metre throw. In Zone 3 an adjustment was made to the Measured Reserves because the lower four seams are generally downthrust below the level of the bottom seam in Zone 4 and mining access is difficult. Finally, a miscellaneous deduction from the mineable reserves calculated on a 45 degree ultimate pit slope, was considered appropriate since a final pit slope in actual practice would be somewhat less than 45 degrees to allow equipment to be removed from the mine.

Recoverable Reserves for Zones 1 to 6 inclusive are estimated at 412 million tonnes which is a general recovery factor of 80 percent over the total area of the six zones.

As described in the following section, **Section 4.3, Mining Operations,** over the period 1983 to 2004, a total of 210 million tonnes of raw coal will be produced from the three mine sites. The further development of these mines to complete the total recovery is also outlined.

The coal reserves discussed in this section only relate to those seams investigated in the Wittingham Coal Measures. The Greta Measures may be accessible by underground mining under the eastern part of the Authorisation Area where most of the proposed surface facilities are located including the rail loop, coal processing area, roads and administrative buildings, and the Muswellbrook Shire Council's Industrial Estate. No investigation of the Greta seams has been carried out within the Authorisation.

4.2.3 Coal Quality

The quality of Mount Arthur North coal is described in terms of raw coal quality as received from the mine and the washed coal quality which is described for both final product steaming and coking coals.

Raw Coal Quality
The raw coal quality as shown in **Table 4.3, Quality Data Summary of Raw Coal Analyses,** is based on the analysis of samples from the slim core drilling programme and does not take into consideration dilution effects due to mining which will increase the ash levels of all seams. For that reason, it is expected that most of the coal will require washing even to meet the power station steaming coal specification.

Steaming Coal Quality
All coal from the 12 major seams can be classified as suitable for steaming coal, that is, coal which is suitable for burning to produce heat for power generation, refining of minerals, and various industrial uses. The ash content of the coal is the basic parameter which determines its suitability for steaming coal. Usually coals with an ash content greater than 30 percent are uneconomic for power generation.

From Mount Arthur North it is proposed to produce steaming coal of two different qualities. The coal which will be conveyed to Liddell and Bayswater Power Stations will have an ash content not exceeding 22 percent. To produce this coal, as the run of mine average ash content of the coals is greater than 25 percent, it will be necessary to wash the coarse fraction of the coal to meet the power station specification.

A higher quality coal is to be prepared for shipment to other power stations by rail. As this has to be transported over long distances, it is considered more economic to lower the ash content further by washing selected coals and hence save on transport costs. The ash content of this low ash steaming coal will be 14 to 15 percent.

The average steaming coal specifications are shown in **Table 4.4, Mount Arthur North Steaming Coal Specification.**

Coking Coal Quality
Initial slim core analysis showed that a potential coking coal fraction existed in the Mount Arthur North coal. To evaluate the significance of these results an extensive programme of large diameter core drilling was commenced to provide coal samples for coal washability testing.

TABLE 4.3 - QUALITY DATA SUMMARY OF RAW COAL ANALYSES

Seam Name	Percent Ash @ 8% Moisture				Percent Sulphur @ 8% Moisture				Average Relative Density			
	No Tests	Max	Min	Weighted Average *	No Tests	Max	Min	Weighted Average	No Tests	Max	Min	Weighted Average
Mt Arthur	34	24.6	16.3	20.4	26	0.63	0.35	0.46	34	1.55	1.37	1.46
Lower Mt Arthur	18	17.2	5.3	10.3	13	0.66	0.45	0.55	16	1.43	1.27	1.36
Piercefield	51	28.1	7.7	15.6	45	0.53	0.28	0.39	51	1.57	1.30	1.41
Vaux	60	25.1	7.7	17.8	49	0.81	0.35	0.48	60	1.52	1.28	1.43
Lower Vaux	36	44.5	12.4	24.4	20	0.84	0.39	0.49	36	1.67	1.35	1.49
Broonie	45	46.6	10.8	22.0	38	1.43	0.36	0.50	45	1.70	1.35	1.48
Lower Broonie	16	35.9	18.0	24.2	11	0.61	0.37	0.44	16	1.62	1.45	1.52
Bayswater	61	29.0	13.9	17.4	59	1.27	0.27	0.46	60	1.62	1.36	1.48
Wynn	46	31.3	11.7	23.4	35	4.30	0.35	2.21	46	1.62	1.34	1.49
Lower Wynn	20	36.0	11.8	28.0	4	1.72	0.65	1.30	20	1.64	1.33	1.55
Edderton	56	27.6	9.2	16.1	51	3.94	0.42	1.84	56	1.52	1.32	1.40
Clanricard	53	34.1	10.4	24.1	18	2.89	0.64	1.23	52	1.63	1.37	1.48
Bengalla A	54	37.9	11.5	24.1	28	0.90	0.47	0.57	53	1.73	1.30	1.49
Bengalla B	66	34.4	10.4	19.7	46	1.49	0.32	0.86	66	1.68	1.33	1.46
Edinglassie	101	26.4	15.3	21.6	97	1.37	0.36	0.61	101	1.57	1.34	1.47
Transition	57	30.0	8.4	15.3	30	1.04	0.44	0.61	56	1.65	1.30	1.40
Ramrod Creek	118	34.9	12.1	24.5	94	1.67	0.42	0.85	119	1.69	1.37	1.48
Lower Ramrod Creek	50	27.9	11.5	20.5	44	1.49	0.36	0.65	50	1.54	1.35	1.44

* Note: Weighted Averages computed using relative density and net coal thickness, not by tonnes.

Source: ACIRL

TABLE 4.4 - MOUNT ARTHUR NORTH STEAMING COAL SPECIFICATION

	Low Ash Steaming Coal	Liddell & Bayswater Power Station Steaming Coal
Proximate Analysis		
Inherent Moisture	3.5%	2.5%
Ash	14 to 15	20 to 22
Volatile Matter	29.5%	29.2%
Fixed Carbon	53.5%	46.6%
Specific Energy	27.0 MJ/kg	25.0 MJ/kg
Total Sulphur	0.5%	0.7%
Ash Fusion Temperatures (°C)		
Deformation	1 500	1 500
Flow	1 600	1 600
Analysis of Ash Constituents (%)		
SiO_2	69.3	73.0
Al_2O_3	21.9	20.5
Fe_2O_3	2.37	2.8
TiO_2	0.89	0.88
CaO	0.89	0.52
MgO	0.64	0.48
Na_2O	0.28	0.17
K_2O	1.46	1.29
P_2O_5	0.61	0.19
Mn_3O_4	0.05	0.02
SO_3	0.52	0.28
Ultimate Analysis (% daf)		
Carbon	81.6	82.5
Hydrogen	5.0	5.35
Nitrogen	1.81	1.82
Sulphur	0.05	0.08

In addition to the large diameter programme, it was decided to excavate two large coal bulk sample pits to provide the coal for commercial washing plants tests so that reliable coking coal recoveries could be determined. The two seams selected for the bulk sample testing were the bottom two seams - the Ramrod Creek and Edinglassie seams. These two seams contribute 70 percent of the total run-of-mine coal production during the first 9 years and for this reason the majority of testing has been confined to these two seams. A total of 5 000 tonnes of coal was washed at the commercial washing plant with the samples of coking coal produced sent to potential buyers.

The large diameter washability test results showed that in addition to the Ramrod Creek and Edinglassie seams a coking coal fraction also exists for the Bengalla, Piercefield, Edderton, and Vaux seams. The coking coal fraction accounts for about 30 percent of the run-of-mine coal from each seam, with the remaining coal being suitable for steam generation purposes.

The coking coal specification given in **Table 4.5, Mount Arthur North Coking Coal Specification**, demonstrates that the coal requires blending for coke producing purposes.

TABLE 4.5 - MOUNT ARTHUR NORTH COKING COAL SPECIFICATION

Sizing 12.5 mm x 0.5 m	
Total Moisture	8.0 %
Proximate Analysis	
Inherent Moisture	4.5 %
Ash	7.5 %
Volatile Matter	36 %
Fixed Carbon	52 %
Total Sulphur	0.65 %
Crucible (free) Swelling Index	5
Specific Energy	30.5 MJ/kg
Gray King Coke Type	GI
Ultimate Analysis (% daf)	
Carbon	82
Hydrogen	5.5
Nitrogen	1.9
Oxygen	9.9
Sulphur	0.7
Audibert Arnu Dilatometer	
Maximum Contraction	30
Maximum Dilatation	10
Gieseler Plastometer	
Range ^{o}C	55
Maximum Fluidity (Dial div./min)	150
Maceral Analysis (% by volume)	
Vitrinite	82
Exinite	4
Inertinite	11
Mineral Matter	3

4.3 MINING OPERATIONS

4.3.1 Mine Planning

The selection of an appropriate mining method must take into account the following factors:

. economic efficiency
. maximum utilisation of reserves
. minimum sterilisation of reserves
. extraction rate to meet market demands
. environmental consequences

Coal may be mined by underground or open cut operations. Open cut mining allows a higher recovery of insitu coal, allows extraction of thinner coal seams, and allows the selective mining of thicker seams. These advantages of increased recovery are more evident in multiseam coal measures. Underground mining involves a cost penalty to compensate for an inherently more hazardous working environment, while open cut mining involves a cost penalty for surface rehabilitation and control of potential environmental impacts related to noise and dust. Underground mining is generally limited to coal seams exceeding 1.5 metres in thickness.

The Mount Arthur North coal deposit is characterised by a large number of gently dipping seams, some of which are relatively thin, and all of which out-crop on the site. Many of the seams or splits of seams are in close proximity to each other. Under these circumstances, underground mining could only recover of the order of 25 percent of the insitu reserves as seams or splits of seams of less than 1.5 metres in thickness could not be mined, and substantial mining difficulties would be expected in attempts to extract seams separated by only a few metres of interburden material. This can be compared with the high rate of recovery achieved in the zones amenable to open cut extraction. Under-ground mining would neither achieve a maximum utilisation of the resource, nor would it be able to achieve the required production rate to meet the power station demands. In the later stages of the development opportunities for underground mining will arise.

There are two principal open cut mining techniques: strip mining using drag-lines and open cut mining using trucks and shovels. Strip mining using electric walking draglines has been developed for the removal of burden overlying coal seams down to a depth of approximtely 60 metres. The area is progressively mined from the subcrop using strip cuts generally parallel to the strike of the coal seam. Stripping to greater depths than 60 metres is possible with ancil-liary equipment being used to pre-strip overburden from the surface to leave a constant depth that can be handled by the dragline. Under such conditions, strip mining operations have been developed to a total depth of 130 metres.

Open cut or open pit mining techniques have been developed for conditions where a multiplicity of seams exist at economically favourable overburden to coal ratios or where the dip or nature of the coal deposit precludes strip oper-ation. Under these conditions mining to depths in excess of 250 metres may be economic. Generally a series of operating benches within the pit are developed for the removal of overburden using shovels loading into trucks and transport-ing to disposal dumps within the previously mined pit area. All of the coal seams progressively exposed may be mined from the benches down to seams 0.5 metres thick. Considerable area is required for the development of the benches and a much larger total operating area is required compared to dragline strip mining, particularly for the deeper pits. The shovel truck operation is more flexible in placing overburden than the dragline operation. The open cut mining methods proposed for Mount Arthur North have been adopted following detailed investigation by the Commission and specialist mining consultants engaged by the Commission.

The initial proposal was to develop a dragline mine in Zone 3 at the same time as a combined shovel-truck and dragline mine in Zone 1. The Zone 1 mine would start in a central position with an initial box cut, then the dragline would mine eastwards going up dip while the shovel truck operation would advance down dip. 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 proposal was amended to dragline operations in Zone 1 initially, with the prospect of using shovel truck methods later in the multiseam western sector of Zone 1. However this dragline operation could not satisfy the total production requirement and it was necessary to develop a second mine with a production capacity of about 7 million tonnes per year. The only areas with sufficient reserves to support this production, over an economic equipment life of about 20 years, were Zones 4 and 5. The multiseam formation of this area, shown on **Exhibit 4.9, Mine Sequences, Whites Creek Mine,** indicated the suitability of a shovel truck operation from the outset. The eastern subcrop limit allowed sufficient area for excess overburden disposal to the east behind the initial box cut.

The limit of dragline operation in Zone 1 was estimated to be reached after 9 years of mining operations due to increasing overburden thicknesses and more numerous coal seams. Continued usage of major plant items, such as the draglines, was found in Zone 6. Although overburden is deeper than in Zone 1, two major seams, the Blakefield and Glen Munro, could be recovered by dragline operation with pre-stripping of overburden. Development of a dragline mine in Zone 6 thus provides continuity of dragline production from two sources over the 20 year Stage 1 development period.

The development of these three mines are the core of this proposal. Throughout the text of this Statement the shovel truck mine in Zone 4/5 has been termed the Whites Creek mine, the dragline operation in Zone 1, the Ramrod Creek mine, and the dragline operation in Zone 6, the Glen Munro mine. The following sections describe each of these mines from the period when mine production is commenced in 1983 through to the year 2004. Stage 2 concepts, as they are seen at this point in time, are described in **Section 4.3.6, Future Mine Development.**

4.3.2 Ramrod Creek Mine

Location and Design

The mine has been designed to be operated as a dragline strip mine commencing at the Ramrod Creek seam subcrop line and proceeding down dip in a westerly direction. The southern boundary of the mine was also determined by the coal seam subcrop line. Although no exploratory drilling has been carried out north of the Denman Road, the seams were inferred to extend towards the Hunter River. The northern boundary of the mine was determined after consideration of the following factors:

. preservation of the Hunter River flood plain
. maximisation of coal recovery
. provision for the relocated Denman Road corridor

The Hunter River flood plain was regarded as an area worthy of preservation for a combination of agricultural, scenic and cultural reasons as discussed in **Section 5, Existing Environment.** If the mine boundary was taken at the present Denman Road line the land between the road and river would be subject to significant noise and dust impacts and would be unsuitable for continued residential occupation. As it would be necessary to acquire these immediately adjacent lands, the opportunity was taken to extend the mine area northwards but without infringing on the alluvial flats. The resulting northern boundary of the mine is shown on **Exhibits 4.1 and 4.3.**

The western limit was determined solely on mining criteria as being the limit of dragline operations. The mining operations will commence in 1983 and be completed by 1992.

The depth of the mine was controlled by the location of the base seam, the Lower Ramrod Creek seam, which is at relatively shallow depths over most of the mine area but which begins to dip steeply at the western limit. Prestripping of the overburden has been fixed at a depth of 12 metres above the Edinglassie seam and hence the depth of prestripping will increase as the mine advances.

The two principal seams to be mined are the Edinglassie and Ramrod Creek seams which together contribute 86 percent of the coal recovered from the mine. There is also a small Transition seam between these two and the Bengalla B seam at a higher level. Mine production figures are given in **Section 4.3.5, Mine Production.** The sequence of operations is shown on **Exhibits 4.7, Typical Section, Ramrod Creek Mine,** and **Exhibit 4.8, Mine Sequence, Ramrod Creek Mine.**

Clearing and Topsoil Removal
Clearing of scattered timber will be carried out by bulldozer. Topsoil will be stripped by scrapers to a depth averaging 0.3 metres and in strips about 50 metres wide. 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 similarly to the topsoil or may be mixed with the overburden.

Drilling and Blasting
It will be necessary to drill and blast the overburden before removal. The size and pattern of blasting has been designed to limit vibration and overpressure effects at nearby buildings. The blast design developed in the acoustic and blasting study, which has been included as Document 11 of VOLUME 2, is a burden width of 8 metres, hole spacing of 10 metres, blast hole diameter of 229 mm and a maximum instantaneous charge of 360 kilograms of ammonium nitrate and fuel oil mixture (ANFO). More restrictive limits may need to be imposed for blasts within 300 metres of buildings in order to meet limiting vibration and overpressure criteria. Actual blast design will be developed during site operations by monitoring blast effects in the immediate area.

Prestrip Operation
The prestrip operation will remove overburden down to 12 metres above the Edinglassie seam by shovel and truck methods. Overburden benches will be 50 metres wide with bench heights of 10 metres excavated by two 14 cubic metre electric shovels loading blasted overburden into 120 tonne rear dump trucks. The trucks will place the overburden betweeen the dragline spoil peaks. This will give flexibility to reshaping and final contouring of the reclaimed land. Haul roads will be constructed as shown on **Exhibits 4.20 and 4.21, Site Development 1986 and 1990,** respectively.

The annual prestrip volumes will be 6.2 million bank cubic metres between 1985 and 1987 increasing to 10 million cubic metres in 1989 and 1990.

Dragline Operation and Coal Extraction
Spoil from removal of overburden above the Edinglassie seam will be sidecast by the 40 cubic metre capacity dragline into the previously excavated pit. Overburden will be drilled and blasted prior to the dragline excavation. The Edinglassie seam will then be extracted by front end loaders and loaded into 80 tonne bottom dump coal trucks. Up until 1990 this coal will be hauled up a central ramp through the mine spoil or a southern exit ramp depending on the location of the dragline. After 1990 the central ramp will be relocated 300 metres to the south in a position which requires only a limited amount of cut through the spoil piles. This will enable the central ramp to be backfilled and rehabilitated.

The interburden between the Edinglassie and Transition seams will be removed by front end loader and Transition seam coal will be removed as for the Edinglassie seam. The second dragline positioned on the spoil removed by the first dragline, removes the interburden between the Transition and Ramrod Creek seams after drilling and blasting. This interburden is cast onto the spoil piles behind the machine allowing a bench along which it can retreat to begin the next cut.

A 10 cubic metre hydraulic shovel will excavate the Ramrod Creek seam and load into 80 tonne bottom dump trucks for haulage up the central or southern ramps. A total of seven 80 tonne coal trucks will be required for coal haulage. The overburden spoil heap will be contoured, topsoil spread and the land rehabilitated as an ongoing process as close as possible behind the advancing mine area. Rehabilitation practices are described in **Section 4.8, Rehabilitation Plan.**

The working area will be kept to a minimum but at the final strip will be of the order of 350 metres wide at the surface, approximately 2 000 metres long and 100 metres deep. The volume of this void approximates to one year of mine production. This point represents the limit for prestrip and dragline operation. At this time the dragline operation will progressively transfer to the Glen Munro mine.

It is proposed that the final cut will be left open so that further open pit extraction of the coal resource can be undertaken at a later date. If this option does not develop, excess overburden from the Whites Creek mine will be used to backfill the final void. Future options are further discussed in **Section 4.3.6, Future Mine Development.** Due to the overburden bulking, the final contours of the land will be raised by approximately 20 to 30 metres. The final rehabilitated contours are shown on **Exhibits 4.20 and 4.21.**

4.3.3 Whites Creek Mine

Location and Design

The mine has been designed as an open pit multi seam mine capable of producing up to 8.4 million tonnes of coal per annum. Production will commence from the subcrop line of the lowermost or Ramrod Creek seam. The mine will progress in a south westerly direction down dip to a final highwall determined by economic overburden to coal ratios. Steeply rising terrain which form the foothills of Mount Arthur principally determine this location. Shovel and truck operation will be the principal method of overburden removal. Surplus out-of-pit spoil will be located in the area to the north east of the Ramrod Creek subcrop line. The northern and southern extremities of the mine are principally determined by the required production rates although the northern extent is restricted by the fault zone.

The resulting form of the mine has an initial box cut length of 3 000 metres along the eastern subcrop line which reduces to 2 000 metres at the final highwall at the south western extent where the excavation depth reaches 300 metres below existing ground levels. **Exhibit 4.3, Mine Development,** shows the outline of the mine.

Because of the difficulties associated with mining up to the depth of 300 metres it was necessary to design the last cut first to ensure that sufficient room was left on each mining bench and that a minimum floor width of 150 metres was provided between the toe of the backfill and the bottom of the exposed coal seam. Sufficient floor area is required for in-pit water sumps, haul roads, and in-pit crushers for overburden and coal. The volume of the void between the final highwall and the backfill was calculated in order to assess the order of magnitude of the disposal area required above the original ground level.

The mining cuts and backfill locations were then designed progressively backwards to the initial box cut with a reduction in the number of mining benches as the depth of mining reduced.

The mining face will be benched at principal coal seams and the complete face will advance at an equal rate at top and bottom. The width of benches at the mining face has been set at 100 metres to allow room for haul roads, shovel operation and truck manoeuvering. The overburden spoil pile will have benches 50 metres wide with a maximum bench height of 60 metres to meet stability requirements. The sides of the mine will be benched to provide overburden haul roads connecting the mining benches and spoil benches at approximately the same levels. Ramps will provide access between bench levels. The form of the mine is shown in section in **Exhibit 4.10, Mine Sequence, Whites Creek Mine,** and in plan in **Exhibits 4.20 to 4.23** inclusive for the years 1986, 1990, 1994 and 2004. A schematic drawing showing the general method of operation is shown on **Exhibit 4.9, Artist's Impression, Whites Creek Mine.**

Clearing and Topsoil Removal
Practically no clearing of timber will be needed until after 1995. Topsoil and subsoil will be removed separately using elevating scrapers. The depth of topsoil stripping averages about 0.4 metres but will be varied according to suitability as discussed in **Section 5.2, Terrain.**

Topsoil stripping will advance approximately 100 metres in front of the mining operations. The materials will be carted by the scrapers to the disposal areas. If areas have been prepared to the final spoil level then the subsoil will be laid directly on the overburden surface by the scrapers with topsoil spread as a final surface. Otherwise topsoil will be stockpiled for later spreading. It is estimated that a total thickness of one metre of material will be placed on top of the final overburden surface. Runoff from exposed areas will be controlled by a system of catch drains and settling ponds, and diverted away from the mine.

Drilling and Blasting
Geotechnical examination of the overburden has shown that it consists of interbedded layers of sandstone, shale and mudstone which will require blasting. Unless drilling and blasting is carefully controlled poor fragmentation could cause large boulders particularly in massive sandstones. As crushing and conveying of overburden is being considered, care will be required to ensure good fragmentation. At full production up to 9 rotary blast-hole drilling rigs will be required. Holes will be 229 mm diameter and spaced at not less than 7.5 metre centres. From consideration of vibration and overpressure effects, a maximum drilling depth of 18 metres has been adopted with no more than three holes per delay and a maximum instantaneous charge of 1 200 kilograms of explosive for the northern area of the mine. Higher instantaneous charges, up to 2 400 kilograms, will be used in the southern areas of the mine.

Dewatering ahead of the mining face will be undertaken to reduce the water in blast holes so that ANFO can be the major form of explosive. In wet holes slurry or molanite explosive types will be used.

Overburden Removal
It is proposed to remove the blasted overburden using electric face shovels with a bucket capacity of 22 cubic metres. The machines will load the overburden into 150 tonne rear dump haul trucks. These shovels will be supported by rubber-tyred front-end loaders for times when shovels are out of service. During the initial years the trucks will move the overburden along haul roads to the spoil area located behind the excavation as shown on **Exhibit**

4.20, Site Development 1986. Later, as the pit gets deeper the length of haul increases and steep grades are encountered which considerably increases the haul cycle time. Two separate studies were carried out to determine alternative methods of haulage at later stages of development of the mine.

The first study considered crushing the overburden and transporting it to the disposal area by conveyor. It was not considered practical to place the conveyor on the active mining bench due to the lack of room and the irregular distance between coal seams meant that the crusher conveyor system had to be placed on the side walls with truck haulage from the shovel face. Examination of the haul distances showed that the system was uneconomic for the bottom two benches but for the top three or four benches the crusher conveyor system dramatically reduced the number of trucks required. It is intended to develop the crusher conveyor system following on-site testing and with the expectation of installation two or three years after production has commenced.

The second study considered the use of electric trolley assistance to power the overburden trucks. The trucks would be equipped with a diesel engine driving an electric generator which in turn powers electric motors in the wheels. On sections of steep grade additional electric power could be obtained through a trolley arm connected to overhead power cables. This system is still under investigation but is less favoured then the crusher conveyor system. Overburden removal is proposed 24 hours per day and six days per week.

Coal Extraction and Haulage

Coal requires to be broken by ripping or blasting prior to loading into trucks. It is proposed that all seams greater than two metres thick will be drilled and blasted prior to loading into trucks. Single pass drill rigs with hole diameters of 150 mm will be used for this purpose. The thinner seams will be ripped by bulldozer and front-end rubber-tyred loaders will load the coal into the 150 tonne bottom dump coal haulers. The thicker seams will be excavated using electric powered hydraulic shovels and loaded into the same trucks.

In the initial two years the trucks will haul direct to the coal processing area. After that time a conveyor will be installed for coal haulage from the bottom of the pit. To facilitate future overburden disposal, the conveyor would be encased in a concrete culvert set in a trench on the bottom level of the excavation and designed to be covered by overburden. A coal crusher would be located in the pit at the input end of the conveyor. A second coal conveyor and crusher will be located near the surface to connect with the Mount Arthur seam level, as shown in **Exhibit 4.22, Site Development 1994,** to again minimise truck haulage. Coal will be mined five days per week on a three shift basis.

Overburden Disposal

As previously mentioned the mine was designed from the last cut at the deepest point first to ensure that overburden disposal could be sequenced with mine development. The total quantity of overburden removed during the life of the mine was calculated and after allowances for a swell factor of 30 percent, the quantity of coal extracted, and the size of the void at the completion of mine operations in 2004, the total volume of spoil that required location above the ground level was determined. This volume was estimated at 600 million cubic metres. Replacement of this volume requires that the existing ground level of the mine area from the final cut back to the initial box cut and extending further to the edge of the coal processing area be raised by an average of 70 metres. Because of the large quantity involved and the magnitude of the disturbance to the existing landform, landscaping consultants were appointed to assist in the design of the final landform so that the final landscape would blend with the existing topography of Mount Arthur.

By providing for all 'out of pit' disposal to take place in the initial years of mine development, a situation is quickly reached where spoil is only being moved within the pit area. The spoil disposal face then advances at a similar rate to the mine face or highwall. This allows rehabilitation of the surface of the spoil disposal area to be carried out progressively and continuously behind the advancing pit. Sectional views showing the pit development are given in **Exhibit 4.10, Mine Sequence, Whites Creek Mine.** The resulting surface form and rehabilitation procedures are discussed in **Section 4.9, Rehabilitation Plan.**

4.3.4 Glen Munro Mine

Location and Design

The Glen Munro mine is to be developed from 1992 utilising the plant from the Ramrod Creek mine. The mine will extract coal from the Glen Munro and Blakefield seams which are the uppermost seams of the Wittingham Coal Measures outcropping on the site. The seams in Zone 6 dip in a southerly direction. The Glen Munro seam outcrop is shown in **Exhibit 4.5, Coal Zones of the Authorisation.**

A third seam, the Woodlands Hill seam, located approximately 30 metres below the Glen Munro has been excluded from the mineable reserves because it has undergone extensive cindering caused by a volcanic intrusion. Consequently the coal has lost the greater portion of its volatile content and is not presently considered economic to mine.

The eastern and western boundaries of the mine were determined by the rapidly increasing depth of overburden encountered against the hill slopes on either side. The southern boundary of the mine coincides with the Authorisation boundary and is approximately the economic limit for a dragline and prestrip mine operation. The final highwall is approximately 90 metres above the floor of the Glen Munro seam.

Plant required will be the same as used in the Ramrod Mine. Reserves in the area are in excess of 30 million tonnes and will sustain a mine life of 11 years. Annual production will be three million tonnes until 1998 falling to 2.5 million tonnes by 2003.

Mining Operations

The mining method and mine operation will be similar in all respects to the Ramrod Creek mine. The same plant will be utilised in a similar sequence. Mine production figures are given in **Section 4.3.5, Mine Production.**

Clearing and topsoil removal will be carried out in a similar manner to that described for the Ramrod Creek mine. Topsoil, while being stored, will be seeded and grassed to prevent erosion and dust generation. Topsoil will be returned as soon as possible to stabilise and restore spoil disposal areas.

Prestripping will occur at such a rate that the coal uncovered per year remains relatively constant. To achieve a satisfactory rate of uncovering coal, prestrip will be required to extend down to approximately 40 metres above the Glen Munro seam. The blast design for removal of the overburden for the prestripping operation using trucks and shovels, and the interburden between the Blakefield and Glen Munro seams which is removed by the draglines, is outlined in Document 11 of VOLUME 2.

During the prestrip operation, the Blakefield seam is exposed. This seam, representing 28 percent of total coal, will be mined by two 14 cubic metre hydraulic shovels loading into 80 tonne bottom dump coal haulers and hauled via a central ramp in the spoil to a conveyor station outside the pit. Coal will then be transported by overland conveyor to the coal processing plant.

The dragline operation at this mine therefore becomes a single seam operation, excavating the remaining 40 metres of material above the Glen Munro seam. Both draglines work on the same side of the pit in a mode of operation called 'extended benching'. This has the advantage of allowing 'bridges' to be constructed across the old pit along which prestrip trucks can again access to the spoil piles. No spoil is disposed of outside the mine area. However, normal bulking will raise the general landform by between 20 and 30 metres over the mine area. **Exhibit 4.11, Mine Sequence, Glen Munro Mine,** shows the mining sequence at years 1992, 1998, and 2003. The final cut at the southern boundary of the Authorisation will be approximately 4 000 metres in length, 300 metres wide at the surface and 90 metres deep. The progressive development of the mine, showing all haul road locations, is shown on **Exhibits 4.22 and 4.23, Site Development 1994 and 2004,** respectively. Further development from this cut is outlined in **Section 4.3.6, Future Mine Development.**

4.3.5 Mine Production

The arrangement and method of mining described allows for simultaneous production from two mines. In general, in all mines, coal will be mined on a 3 shift basis, 5 days per week and overburden removed on a 3 shift basis, 6 days per week. Initial coal extraction will commence in 1983 from the Ramrod Creek mine followed in 1984 by coal from the Whites Creek mine. The combined output of these two mines will increase from 0.8 million tonnes in 1983 to eight million tonnes in 1986 and reach the maximum annual rate of production of 11 million tonnes in 1989. The annual rates of coal production planned for each mine and the volumes of overburden to be moved are shown in **Table 4.6, Mine Production Schedule,** over the period 1983 to 2004. Over this period a total of 210 million tonnes of coal will be mined together with 1 300 million bank cubic metres (BCM) of overburden and prestrip material.

When the economic limit for dragline operation in the Ramrod Creek mine is reached in 1991/92, the plant will be transferred to the Glen Munro mine. **Table 4.6** shows that production from the Glen Munro mine will be less than from Ramrod Creek, but production from the Whites Creek mine will be increased to maintain total coal production at 11 million tonnes annually. The excavation and removal of overburden and prestrip material is related to the phasing of coal production. Overburden and prestrip volumes commence at 5.5 million BCM in 1983, rising to 51.5 million BCM in 1989 and peaking at 78 million BCM in 1997.

Operational problems in the development of the mining, particularly in the case of the Whites Creek mine, or reduced demand for the local power stations could affect the predicted production levels given in **Table 4.6** in any particular year. **Table 4.8, Coal Production Schedule,** in the following **Section 4.4, Coal Handling and Preparation Facilities,** gives the predicted product coal output for the years up to 1990. Maximum coal output from the development is planned to be reached in 1988 when the annual production of power station steaming coal reaches 7.7 million tonnes.

It is possible that demand for coal by the power stations in any one year could be as low as 4.7 million tonnes due to mechanical availability problems at the power stations. As Bayswater and Liddell are base load power stations other power stations would be required to go onto base load and the excess coal from Mount Arthur would need to be railed to these other stations.

TABLE 4.6 - MINE PRODUCTION SCHEDULE

Year	Coal Mined (million tonnes)				Overburden & Prestrip Volumes (million bank cubic metres)			
	Ramrod Creek	Whites Creek	Glen Munro	Total	Ramrod Creek	Whites Creek	Glen Munro	Total
1983	0.8			0.8	5.46			5.46
1984	2.0	0.6		2.6	12.53	3.50		16.03
1985	4.5	0.9		5.4	21.86	3.82		25.68
1986	4.5	3.5		8.0	21.86	13.30		35.16
1987	5.0	5.0		10.0	21.86	20.65		42.51
1988	5.5	5.0		10.5	25.69	27.30		52.99
1989	6.0	5.0		11.0	25.69	25.80		51.49
1990	6.0	5.0		11.0	25.69	25.40		51.09
1991	5.4	5.6		11.0	16.86	29.62	5.16	51.64
1992	1.7	7.0	2.3	11.0	6.18	39.83	18.28	64.29
1993		7.5	3.5	11.0		41.40	26.55	67.95
1994		7.5	3.5	11.0		44.48	26.55	71.03
1995		7.6	3.4	11.0		46.89	26.55	73.44
1996		7.8	3.2	11.0		49.22	26.55	75.77
1997		7.9	3.1	11.0		52.06	26.55	78.61
1998		8.0	3.0	11.0		49.68	26.55	76.23
1999		8.2	2.8	11.0		48.38	26.55	74.93
2000		8.2	2.8	11.0		48.38	26.55	74.93
2001		8.2	2.8	11.0		48.38	26.55	74.93
2002		8.2	2.8	11.0		48.38	26.55	74.93
2003		8.4	2.6	11.0		49.56	26.55	76.11
2004		8.0		8.0		51.36		51.36
Total	41.4	133.0	35.8	210.2	183.68	767.40	315.49	1266.57

As described in **Section 4.3.3, Plant Objectives,** it is proposed to produce for off-site use a good quality steaming coal of approximately 14 percent ash to make up shortfalls at other Commission power stations. This production is planned at an output of one million tonnes per year. It is possible that this quantity could be increased by another one million tonnes by increasing the run-of-mine production. An examination of the Ramrod Creek mine production shows that this mine has already been optimised by a prestripping operation in advance of the dragline mining and it is therefore unlikely that the production could be increased above proposed levels.

The production level at the Whites Creek mine could theoretically be increased up to the year 1992 by introducing additional capital plant at an earlier time. However, given the relative size of the mine, it is expected there could be operational problems resulting in difficulties in achieving the planned production rates by the years nominated. For this reason it would be unwise to suggest that increased production could be achieved.

Table 4.7, Mine Equipment Schedule, lists all the items of plant and equipment required for the Whites Creek and Ramrod Creek mines. Progressive requirements are listed for years of operation of each mine. Plant requirements for the Glen Munro mine are essentially the same as for the Ramrod Creek mine.

4.3.6 Future Mine Development

By the year 2004, the end of Stage 1 of mine development and the period covered by this proposal, voids will remain in each of the three mines. However, it is proposed at this time to further extend each of the mines to recover the remaining reserves of the Mount Arthur North Authorisation area. Future mine planning is dependent on further detail exploration, however, from what information is currently available, certain proposals can be outlined. **Exhibit 4.3** shows the possible Stage 2 developments.

The Whites Creek shovel truck operation would extend northwards to mine through Zone 3 and into Zone 1 and to connect to the final void left by the Ramrod Creek mine. A further extension to the west, parallel to the Denman Road and across the Edderton Road, is also foreshadowed. Spoil from these mine operations would be used to backfill the voids of both the Whites Creek and Ramrod Creek mines.

On the south east corner of the Whites Creek mine additional relatively steeply dipping coal exists which eventually passes under Mount Arthur. It is envisaged that a truck shovel mine will be developed in this location and progress in a southerly direction with fill being placed along the south eastern boundary of the Whites Creek mine backfill area. For that reason the edge of this backfill has not been blended with the natural contours surrounding Mount Arthur but cut back at relatively steeper slopes in anticipation of fill being placed there from this future mine. If this mine does not eventuate, final quantities of overburden from the Whites Creek mine will be used to blend the backfill edge with the existing local contours to the south.

This eastern mine would progress southwards to the boundary of any future colliery holding, and subject to the granting of necessary authorities, possibly to the boundary of the Mount Arthur South Colliery holding, the location of which has not yet been fixed. Similarly, southerly extensions of the Glen Munro mine could be developed in the longer term future. Such future developments are subject to further exploration and mine planning studies which will be carried out during the life of the Glen Munro mine. It is expected,

TABLE 4.7 - MINE EQUIPMENT SCHEDULE

RAMROD CREEK MINE

Item	1983	1984	1985	1986	1988	1990
Scraper	1	1	1	1	2	2
Dragline (43 m^3)	1	1	2	2	2	2
Overburden drill	2	3	4	4	4	4
Overburden shovel	1	2	2	2	3	3
Overburden truck (110 tonne)	4	8	8	8	12	12
Front end loader	1	1	1	1	2	2
Tracked dozer (D9)	2	2	4	4	4	4
Tracked dozer (D10)	1	1	1	1	1	1
Rubber tyred dozer	1	1	1	1	1	1
Coal drill	1	1	1	2	3	3
Coal shovel	1	1	1	1	1	1
Coal truck (80 tonne)	2	4	7	7	7	7
Coal crusher					1	1
Coal conveyor					1	1
Grader	1	1	1	2	2	2
Water truck	1	1	2	2	2	2
Explosives truck	1	1	2	2	2	2
Mobile crane (45 tonne)	1	1	1	1	1	1
Hydraulic crane (12 tonne)	1	1	1	1	1	1
Low loader	1	1	1	1	1	1
Tyre handler	1	1	1	1	1	1
Fuel trucks	1	1	2	2	2	2
Supply and maintenance trucks	6	6	8	8	8	8
Light trucks	3	3	3	3	3	3
Utility vehicles	21	21	21	21	21	21
Ambulance	1	1	1	1	1	1
Personnel buses	1	1	2	2	2	2
Portable light plant	2	4	4	6	6	6

TABLE 4.7 - MINE EQUIPMENT SCHEDULE - Continued

WHITES CREEK MINE

Item	1984	1985	1986	1987	1988	1990	1994	2000
Scraper	1	1	1	1	1	2	2	2
Overburden drill	1	2	4	5	6	8	9	9
Overburden shovel (22 m^3)	2	2	3	4	4	4	5	5
Overburden truck (150 tonne)	7	15	16	25	30	30	33	33
Tracked dozer	5	5	7	9	10	16	17	18
Overburden crusher (in pit)				1	1	1	2	2
Overburden conveyor				1	1	1	2	2
Coal drill	1	1	3	4	4	5	6	7
Coal shovel	1	1	1	2	2	2	2	2
Coal trucks (150 tonne)	2	2	3	4	4	5	6	6
Rubber tyred dozer	1	1	2	2	2	2	2	2
Coal crusher (in pit)	1	1	1	1	1	1	2	2
Coal conveyor	1	1	1	1	1	1	2	2
Grader	1	1	2	2	2	2	2	2
Water truck	1	2	3	3	3	3	3	3
Explosives truck	1	1	1	2	2	2	3	3
Mobile crane (45 tonne)	1	1	1	1	1	1	1	1
Hydraulic crane (12 tonne)	1	1	1	1	1	1	1	1
Low loader	1	1	1	1	1	1	1	1
Tyre handler	1	1	1	1	1	1	1	1
Fuel trucks	1	1	2	2	3	3	3	3
Supply and maintenance trucks	6	6	6	6	10	10	10	10
Light trucks	3	3	3	3	4	4	4	4
Utility vehicles	26	26	26	26	31	31	31	31
Personnel buses	1	1	2	2	3	3	4	4
Ambulance	1	1	1	1	1	1	1	1
Fire tender (fuel & electrical)	1	1	1	1	1	1	1	1
Portable light plant	4	4	6	8	8	8	9	9

however, that the Glen Munro mine operation will progress into Stage 2 and the Stage 2 Environmental Impact Statement will discuss these proposals and the reinstatement of any final void.

Open cut mining will ensure that no coal within the area of the Whites Creek and Ramrod Creek mines will be sterilised. Coal that cannot be recovered by open cut mining does however exist along the edge of the Hunter River alluvium and under the steeper slopes of Mount Arthur.

For the Glen Munro mine the seam beneath the lower seam that will be mined (the Woodlands Hill seam) has been intruded by a volcanic sill. Only two to three metres of the original 5 metre coal seam remains, some of which is cindered with the remainder having lost a large proportion of its volatile content. It is currently not economic to remove this coal but by the time mining starts in 1992, the possibility of mining some of this coal will be reviewed in the light of data available at that time.

Greta Coal Measures most likely exist beneath the coal processing area but at depths in excess of 200 metres. They can therefore not be mined by open cut methods but may be considered for underground mining at some later time. Underground mining techniques are also likely to be considered for coal located beneath the Glen Munro mine and for coal under Mount Arthur.

4.4 COAL HANDLING AND PREPARATION FACILITIES

4.4.1 General

This section describes the coal handling and coal preparation facilities and covers all operations between the raw coal receival area and the train loading facility. The facilities include:

. dump stations
. breaker stations
. ROM stockyard and bypass conveyor
. coal washery plant including feed bins, thickeners and reject handling plant
. final product stockyard
. train loading bin.

The preliminary design and layout of the coal handling and preparation facilities have been subject of a separate study (**Reference 9**). Design of these facilities involved consideration of:

. the need for a flexible plant which is able to cope with the production from three multiseam mine operations and the requirement to produce coal to three specifications
. the most suitable location
. the integration of the coal preparation and handling facilities with the rail system, overburden disposal and tailings dam
. the environmental impact of the facility.

It was appreciated from the outset that the Mount Arthur North coal mine will be among the largest in Australia, that the coal handling equipment must be capable of moving 11 million tonnes per annum of ROM coal and that the traditional approach to mine stockpiles and handling might be inadequate.

4.4.2 Siting of Facilities

The coal preparation facilities and coal handling system are located in the north east corner of the proposed lease area, adjacent to the Mitchell Line of Road and just south of the Muswellbrook Shire Council industrial estate, as shown on **Exhibit 4.1, Site Development Plan.** The rail balloon loop lies between the public road and the facilities.

From the Mitchell Line of Road the land falls away gradually to the west towards Whites Creek. The plant site area will be levelled by a cut and fill operation to a level of 187 metres above sea level. The balloon loop will be constructed with a rail level that is between 190 and 197 metres. **Exhibit 4.12, Coal Processing Site Layout,** shows the proposed layout of facilities. **Exhibits 4.13 to 4.15, Coal Processing Plant Details, Sheets 1, 2 and 3,** respectively, show in detail the various components of the coal processing system. The tallest structure at the site will be approximately 35 metres above base level.

The siting of the industrial facilities and rail balloon loop has been determined by considerations of the access for the rail spur and, more importantly, to ensure that the siting would not sterilise any coal reserve. The subcrop line of the lowest Wittingham Coal Measure seam determines the eastern boundary of both the Ramrod Creek and Whites Creek mines. Therefore the facilities had to be located between the subcrop line and the eastern Authorisation boundary. This area is underlain by the Greta Coal Measures at a depth of in excess of 200 metres. A limited percentage of the coal could be extracted in the future by use of underground mining techniques.

Other factors which determined the site of the coal processing facilities were:

- centrally located to receive ROM coal from all three mines
- sufficiently clear of the disposal area from excess out-of-pit spoil from the Whites Creek mine
- good access to the Mitchell Line of Road for general off-site access
- visual aesthetics from the Denman Road and Muswellbrook
- other environmental considerations related to noise, dust, and drainage control.

A schematic view of the total coal processing and load out area is given in **Exhibit 4.16, Artist's Impression, Coal Processing Area.**

4.4.3 Plant Objectives

The facilities will be designed to process a maximum rate of 11 million tonnes of ROM coal. The plant will receive coal from at least two mines at any one time and produce the following products at full production:

- 7.7 million tonnes per annum of high ash steaming coal for conveyor transport to Bayswater and Liddell Power Stations
- one million tonnes per annum of soft coking coal for transport by rail to Newcastle for export
- approximately one million tonnes per annum of steaming coal for railing to distant power stations in NSW.

The ROM coal will be divided into two classifications. The first will be high ash coal suitable as a source of 22 percent ash washed steaming coal. The second classification will be for coals suitable for processing to produce washed soft coking coal and/or 15 percent ash washed steaming coal.

Anticipated production figures in million tonnes per annum for the initial development years of the project are given in **Table 4.8, Coal Production Schedule.**

As the coal is produced in two mines, each working a multi seam face, the processing plant has to be flexible in operation. The stockpiles must also meet the various anticipated demands from the local and distant power stations and random shipping arrivals. The washery will be expanded in modules in line with the stated production build up. **Exhibit 4.17, Coal Processing Flow Sheet,** describes the flow streams through the coal processing facilities. The percentage breakup of output from the coal preparation plant is given in **Table 4.9, Coal Preparation Plant Yields.**

TABLE 4.8 - COAL PRODUCTION SCHEDULE (mpta)

Year	Steaming Coal 20-22% Ash	Steaming Coal 14-15% Ash	Coking Coal 7.5% Ash	Total ROM Coal	Stockpile Capacity (mill. tonnes.)
1983	0	0	0	0.8	0
1984	0.5	0.7	0.3	2.6	1.44
1985	3.0	1.4	0.6	5.4	0.82
1986	4.4	1.0	1.0	7.5	1.16
1987	7.2	1.0	1.0	10.0	1.12
1988	7.7	1.0	1.0	10.5	0.86
1989	7.7	1.0	1.0	11.0	1.14
1990	7.7	1.0	1.0	11.0	0.99

TABLE 4.9 - COAL PREPARATION PLANT YIELDS (for production of coking coal)

Production	Percentage Yield	Percentage Ash
Coking Coal	28.0	7.5
Steaming Coal	55.3	18.0
Coarse Rejects	13.0	63.7
Tailings	3.7	55.6

4.4.4 Raw Coal Handling

Receiving and Breaking Plant

Raw coal will be transported from the two mines in operation by either coal haulers and/or pit conveyors, to the coal receival area. The average raw coal receival rate at full mine production will be 3 600 tonnes per hour. Two independent receival systems are provided, each capable of handling 2 500 tonnes per hour. This allows the simultaneous mining of different quality coals, or the blending of two seams to provide homogenised raw coal feed to the coal preparation plant. A degree of redundancy is also provided.

Raw coal will be delivered to the road hoppers or dump stations which consist of 500 tonne dump hoppers capable of handling a 1.25 metre maximum lump size. Each of the two dump station/breaker stations will have a nominal capacity of 2 500 tonnes per hour. The hoppers are sufficient to handle surges caused by trucks dumping at close intervals. The hoppered section will permit a bulldozer to load the hopper from an emergency stockpile.

From each dump station, the raw coal will be transported by conveyor to the breaker station which consists of twin rotary breakers where the coal will be reduced to a maximum particle size of 150 mm nominal. Oversize reject material consisting of rock and high ash coal is delivered to a ground stockpile of 2 000 tonne capacity for disposal by front-end loader and trucks. For the staging of construction during the build up of mine production, one dump station/ breaker station is planned for installation at the commencement of production.

The design of the dump station will reflect the very rugged duty of operation and the occasional very large lump sizes expected. Ample provision will be made for access around the base of the hoppers and the variable speed feeders. It will not be enclosed or sheeted. Ample provision will be made for maintenance access and the clean-up of spillage. **Exhibit 4.17, Coal Processing Flow Sheet,** shows the flow sheet for all facilities in the coal processing complex. A vertical section of the receival and rotary breaker plant is shown on **Exhibit 4.14, Coal Processing Plant Details Sheet 2.**

Raw Coal Stockyard
The raw coal stockyard is located between the receival area and the coal preparation plant. The layout is shown on **Exhibit 4.13.** After passing through the breaker stations, the coal may:

- be stacked out onto two raw coal stockpiles
- bypass the washery after passing through the screen station, be stacked out in the final product stockyard, (or pass directly to the power station overland conveyor or directly to the rail loading bin)
- pass directly to the washery and then to either the final product stockyard, the power station overland conveyor, or the rail loading bin.

The stockyard will primarily provide surge capacity between the mines and the wash plant. In doing so it will provide storage for three types of coal - high ash steaming coal for supply directly to the power stations, potential coking coal, and medium ash steaming coal. Only one coal type will be washed at a time. Provision has been made for four stockpiles each of 125 000 tonne capacity with the initial development comprising two stockpiles.

The stockyard equipment must be able to provide redundancy in the stacking and reclaim functions, to handle two types of coal simultaneously and be capable of staged development. Two combined stackers and reclaimers with a capacity of 2 500 tonnes per hour were selected for the following reasons:

- they will provide together with the bypass conveyor, the best combination of low capital cost, equipment redundancy and live stockpile capacity
- the ability to increase the stockpile capacity from 250 000 tonnes to 500 000 tonnes at no extra cost
- the storage is 'live' and requires no additional reclaim equipment (dozers front-end loaders etc). This also applies to the additional storage area
- the facility to blend coal is available
- dust emission is less with the luffing boom stacks
- noise pollution would be minimal compared with the dozer operation required by a tunnel reclaim system.

Exhibit 4.13 shows, in elevation, the raw coal stockpile and stacker/reclaimer system.

Screen House
Crushed coal, 150 mm x 0, direct from the breaker stations or reclaimed from the raw coal stockpiles will be delivered by conveyor to the primary screen house. The main components of the screen house are a 1 500 tonne surge bin

incorporating six hopper outlets for delivering coal to six heavy duty screens which separate the preparation plant feed into plus 12.7 mm and minus 12.7 mm coal streams.

This system enables close control of the tonnage feed to the individual preparation plant feed conveyors, an important process requirement because of the high capacities of the Mount Arthur North plant. There is also provision to preferentially bypass the minus 12.7 mm coal in controlled tonnages direct to Bayswater final product. It is expected that 20 percent of total output will bypass the preparation plant. **Exhibit 4.15, Coal Processing Plant Details Sheet 3**, shows, in outline, the conveyor handling system for coal feed from the raw coal stockyard to the screen house and from the screen house to the coal preparation plant.

Safeguard measures to control dust generation, and water pollution in the area of the coal receival breaking plant, stockyard area and screen house are described in **Chapter 6, Environmental Safeguards.**

4.4.5 Coal Preparation Plant

Raw coal as-mined is contaminated with non-carbonaceous material. This contamination typically comprises sediments from above and below the seam, clays from the coal seam and mineral matter dispersed within the coal. Because of this contamination very few coals are sold as-mined and most have to be cleaned to remove as much as possible of the contamination.

The process of benefication, or coal preparation, is based on the principle of gravity separation. Coal is significantly lighter or lower in specific gravity than the non-carbonaceous material. There are two basic methods of separating the waste material.

A jig washing plant consists of a chamber through which raw coal is passed with water while air is pulsed through the material from below. Agitation by the air pulses has the effect of separating the particles into layers of varying density. The float material, which is the lighter coal, is passed into product drain screens. Reject material is recovered by jig elevators and passes to a reject conveyor.

The other commonly used item of equipment for separation of the small size raw coal fraction is the dense medium cyclone. The dense medium cyclone combines finely ground magnetite with the coal and water stream to increase the density of the fluid to the cut point at which it is desired to separate the rock from the coal or the low quality coal from the higher quality lower density coal. This cut point can be varied depending on the ash content desired for the final product. The separation between clean coal and reject occurs when the water magnetite coal mixture is injected into a cyclone at high velocity. Centrifugal force causes the movement of the higher and lower density products to opposite ends of the chamber. The magnetite is then removed by magnetic separation and reused.

The proposed coal preparation process system has been designed to receive raw coal with a range of properties, and to process this coal to produce low ash coking coal, and two grades of steaming coal. The process flow diagram, **Exhibit 4.18, Coal Preparation Process Flow Sheet**, illustrates the process design and capacities. The preparation plant will consist of separate and independent process systems for the large coal fraction (150 mm x 12.7 mm), and the small coal fraction (12.7 mm x 0).

Large Coal Preparation
The large coal fraction is processed in Baum Jigs. Two jig modules providing a total of four jigs (four loops) have been provided to give a nominal processing capacity of 1 300 tonnes per hour (maximum 1 600 tonnes per hour). Each large coal feed conveyor serves two loops. The coal flow from the feed conveyor is divided to distribute equally between two jigs.

The products are drained on double deck, low-head screens with one per jig. The plus 30 mm sized coal from the top deck passes through a double roll crusher for reduction to 30 mm topsize. The minus 30 mm product from the bottom deck is sent directly to the product conveyor where it is combined with the crushed product in the crusher discharge chute.

Fine clay and coal solids, generated by degradation in the process are recovered by a controlled bleed from the process water. The fine solids are classified at 0.1 mm nominal in classifying cyclones with the minus 0.1 mm sizing passing to the thickener. The plus 0.1 mm sizing is dewatered on a high frequency slurry screen. Screen overflow passes to the product conveyor as Bayswater fuel coal.

Small Coal Preparation
There are two dense medium cyclone modules proposed to wash the small coal fraction (minus 12.7 mm). Each dense medium cyclone plant module consists of three identical process loops, each consisting of two 710 mm primary dense medium cyclones and a single secondary dense medium cyclone.

The main features in each process loop are as follows:

. the distributor feeds to desliming sieve bends and desliming screens which separate material less than 0.5 mm from the larger particles

. the screen oversize, 12.7 mm x 0.5 mm, will have a dense medium, magnetite slurry added and is then pumped to two primary cyclones. By controlling the cut-points in the cyclones the plant can be used to produce either low ash coking coal or medium ash steaming coal. The separate coal and rejects streams will be screened and rinsed to remove all magnetite for recycling.

When steaming coal is being produced, the rejects will pass from the screen directly to the reject conveyor for disposal. When low ash coking coal is being produced in the primary cyclones, the screen overflow is recombined with a dense medium slurry and pumped to a single secondary dense medium cyclone. The product from this cyclone is screened, rinsed, and dewatered by a centrifuge. This product is then combined with Bayswater steaming coal. The rejects from the secondary dense medium cyclone is screened, rinsed and passes to the rejects conveyor for disposal.

The fine coal, minus 0.5 mm, after separation from the larger particles at the desliming screens, is pumped from a sump to classifying cyclones. Size separation at 0.075 mm nominal occurs in the cyclones, with the high ash slimes overflow sent to the tailings thickener and the coarse underflow fraction dewatered for recovery as Bayswater fuel coal.

Preparation Plant Building
The building will be a steel framed structure with multifloor levels for plant and equipment. The external walls will be sheeted to 3.5 metres above ground level. Approximately 20 percent of the sheeting will be translucent. Building steelwork will be substantially proportioned to withstand all design and

erection stresses, and design will ensure that vibrations from screens, crushers and centrifuges are not transferred throughout the building frame. Allowance has been made for a concrete floor to all screen levels for noise and vibration damping and for improved housekeeping. The building and annexes will have reinforced concrete foundations and continuous ground floor slabs which include pits and floor sumps. Floors are sloped and floor sumps and pumps are installed to recover washdown.

An adjacent but separate preparation plant control room building annexe will contain the motor control centre, control room, offices, lunch room and amenities. The annexe will be a concrete block building with concrete floors.

The control room, offices and amenities room will be air conditioned and insulated against heat, dust and noise. Substantial windows will allow natural lighting and views over the raw coal stockyard area as well as into the washery building. A comprehensive fire protection system will be provided. The control room and offices will be situated on the top floor of the control annexe. The preparation plant transformer yard will be situated against the control annexe, and adjacent to the motor control centre housed in the building.

4.4.6 Reject Disposal

Total coal processing rejects will represent approximately 1.3 million tonnes per annum or 12 percent of run-of-mine production when the maximum production of 11 million tonnes per annum is achieved. On a dry weight basis, fine coal tailings represents 350 000 tonnes per annum with the balance being coarse rejects. The average ash content of both coarse and fine rejects will be of the order of 60 percent.

Coarse Rejects
Coarse rejects from the coal preparation plant are delivered by conveyor to a 1 500 tonne reject bin. The rejects are then trucked to the Whites Creek mine spoil disposal face along with rejects from the breaker stations. The rejects will be progressively disposed of in such a manner that they are well covered by non-carbonaceous mine overburden and well dispersed throughout the disposal area. The low level of pyritic sulphur in the coal will not present any problems associated with spontaneous combustion of the reject material or problems of acid leachate drainage.

Fine Coal Tailings
The disposal of fine coal tailings is the subject of a supplementary study and report contained in the report on Coal Preparation Plant and Associated Coal Handling Facilities **(Reference 8).** Initial planning envisaged that tailings would be discharged to a series of dams located in the valley running north of the coal preparation plant between the plant and the Denman Road. The subsequent study showed that a single dam adequately sized would be the most appropriate and economical solution. The potential evaporation loss from the surface of the storage was such as to enable all excess water to be disposed of so that decanting and recycling was unneccessary. The location of the tailings dam is shown on **Exhibit 4.1, Site Development Plan.**

The quantity of tailings produced from the coal processing system makes the application of alternative methods of tailings disposal either impactical or uneconomic. The method of using a number of shallow evaporation basins in rotation to dewater the tailings and allow the tailings to be removed for disposal to the mine pits was not practical. The land area required for such a system, the lack of suitable terrain, and the problems associated with extended wet periods, were the main reasons for rejecting this method. A system of dewatering tailings by centrifuges so that the tailings can be directly disposed to the mine pits is under consideration for a number of existing plants. This particularly could apply to those plants where there is a lack of available area, or process water shortages. Such a system will be kept under review for use at Mount Arthur North. It is proposed, for this reason, that the tailings dam be constructed in a number of stages so that should a plant dewatering system for the tailings be adopted in the future, the dam can be sealed and rehabilitated.

As developed in **Reference 8,** plant tailings, after preliminary dewatering in two 50 metre diameter gravity thickeners, will be discharged to the tailings dam. Based on a fine rejects solids stream of 350 000 tonnes per annum at an inflow 40 percent solids concentration by weight dewatered to a final 70 percent solids concentration, a storage volume of 12 million cubic metres of settled tailings is required for a 20 year design period.

The dam is designed as an earthfill embankment of slightly to moderately weathered sandstone and shale with an impervious clay core. The wall will be raised in three stages at approximately seven year intervals with the option of a fourth stage if required. Stage 3 will provide storage of 12 million cubic metres of settled tailings which is the maximum volume produced over 20 years. Once Stage 3 is complete, the dam will be approximately 100 metres long and 27 metres high with the crest level at 178 metres above sea level. The downstream face will be topsoiled and grassed. **Exhibit 4.28, Tailings Dam,** provides indicative details of the design of the dam.

The dam is designed to dispose of all tailings water and rainwater by evaporation. However, provision will be made for decanting and recyling water to the washery and for providing water for spraying on site haul roads. It is anticipated extensive use of this water can be made for road watering. Use as the main make-up supply to the washery is not proposed because of the problems associated with build up of salinity levels. To prevent downstream pollution, adequate storage capacity has been provided to hold all stormwater runoff. At all stages adequate storage will be provided to ensure that the dam can absorb the Probable Maximum Precipitation (PMP) storm without spillway discharge. Thus it is not anticipated that the dam will ever overflow.

Once the dam is full the tailings will be allowed to dry and harden. The dam will be covered by a layer of fill material and a layer of topsoil with a total thickness of 6 to 8 metres which will bring the finished surface level up to approximately 185 metres. Finally, the dam wall and storage area will be landscaped and revegetated.

4.4.7 Final Product Stockpiling and Load-Out

The final product stockyard is located between the washery and the rail loading bin and consists of four stockpile bays of final product coal. The location and design details are shown on **Exhibit 4.13, Coal Processing Plant Details Sheet 1.**

Based on computer simulation studies which took account of projected mine production rates, shipping movements at Newcastle, unit trains operations and likely constraints and delays, it was established that the following stockpile capacities were required at the site. These capacities are based on a unit train capacity of 3 234 tonnes and maximum ship size of 100 000 DWT.

. coking coal 150 000 tonnes
. power station coal 30 000 tonnes (nominal)
. medium ash coal 300 000 tonnes

Two coal product streams will be despatched from the washery. When either coking coal or medium ash steaming coal is being washed, power station steaming coal is produced as a secondary product. The stockyard equipment consists of two stacker/reclaimers and one stacker. The equipment and conveyor locations are also shown on **Exhibit 4.13** and **Exhibit 4.14, Coal Processing Plant Details Sheet 2.**

From the finished product stockpile, coal will be moved by conveyor to the 3 500 tonne rail loading bin located as shown on the balloon loop or directly through the two overland conveyors to the power station. Each of the conveyors to Bayswater Power Station have a capacity of 2 500 tonnes per hour. The interface between the Mount Arthur North load-out facility and the Bayswater overland conveyor is taken to be at the two 250 tonne surge bins located at the start of the conveyor corridor at the south east corner of the coal processing site. Except when train loading occurs, the stockyard has the ability to reclaim 5 000 tonnes per hour onto the conveyor belts.

The rail loading bin capacity is equivalent to the capacity of a unit train. Trains will be able to be loaded at two hourly intervals for 24 hours per day. Further details of the rail loading facilities are given in **Section 4.10.1, Off-Site Coal Transport.**

4.5 SITE FACILITIES

4.5.1 Office, Workshop and Amenity Facilities

For management reasons, separate administrative, employee and maintenance facilities are to be provided for each mine and the coal processing plant. Four areas within the Authorisation have been allocated for these purposes.

Ramrod Creek Mine Facilities Area
The office, bathhouse, workshop and stores buildings for this mine form a self-contained complex with access provided from the Denman Road. The location, west of the mine site, is shown on **Exhibit 4.20, Site Development 1986.** The offices will be a group of demountable type structures totalling about 500 square metres of floor area.

The workshop will contain a machinery section, spares store and plant repair area capable of maintaining the mobile plant associated with the mine. The workshop building will be a 100 metres long by 22 metres wide steel frame building with metal cladding. Maintenance of semi-mobile plant such as the draglines will be carried out in the field.

It is intended that this facility area would be closed down after cessation of mining in 1992, and most of the buildings and equipment transferred to the Glen Munro mine facilities area.

Central Administration and Coal Processing Plant Amenities Area
This area is to be located between the rail balloon loop and the Mitchell Line of Road. It will contain the administrative offices for the whole project and office and bathhouse for the coal processing plant.

The buildings will be of contemporary architectural design to blend aesthetically with the surrounds. Car parking for office employees and visitors will be provided. The area will be separated by a landscaped zone from the Mitchell Line of Road.

Coal Processing Workshop Area and Whites Creek Mine Facilities Area. The workshop for the coal processing plant, and the offices, bathhouse, and workshop for the Whites Creek mine are to be located in adjacent compounds south of the coal processing plant. A large car park area will be provided for employees at these facilities. Access will be by the main project entrance off the Mitchell Line of Road with the access road crossing the rail line.

The workshop building for the Whites Creek mine will be 200 metres long and 22 metres wide of metal clad steel frame construction. There will be a separate bulk store and enclosed open storeyard. A 1 000 square metre floor area workshop is required for maintenance work associated with the coal processing plant and rail loading facility. A separate 250 square metre bulk store will be located adjacent to the workshop.

The Whites Creek mine office complex including the bathhouse will occupy about 1 000 square metres of floor area. It will be located immediately south of the workshop buildings and have adjacent car parking areas for the employees associated with the workshop and the mine.

Glen Munro Mine Facilities Area
This will be a self contained complex similar to that for the Ramrod Creek mine. Public access will be from the Denman Road via part of the present Edderton Road. An internal site road will connect the facility to the coal processing area. The location, north of the mine site, is shown on **Exhibit 4.22, Site Development 1994.**

4.5.2 Liquid Fuel Storage

Diesel fuel will be required for practically all mobile plant. Relatively small amounts of petrol will be needed for cars and light vehicles used for management and supervision purposes.

Maximum distillate usage is expected to be 100 000 litres per day total for all mining and haulage plant. Provision will be made for on-site storage of 30 days supply or approximately three million litres as a buffer against short term supply problems. Diesel fuel will be stored in three above ground tanks each of approximately 870 000 litres capacity. Tanks sizes will be of the order of 16.5 metres diameter and 13 metres high. Storage facilities, bunding and clearance distances will be in accordance with Australian Standard 1940-1976, Flammable and Combustible Liquids Code. The bunds would be of sufficient height to contain the tank contents in the event of damage. A bulk fuel store at the Ramrod Creek mine will contain two 110 000 litre tanks and two similar tanks will be located at the Whites Creek mine workshop.

Fuel will be transported to site initially by road tankers. At maximum demand four road tanker loads per day would be required. Provision can be made for delivery of fuel by rail at a later stage. The location of the bulk fuel storage area is shown on **Exhibit 4.12, Coal Processing Site Layout.**

4.5.3 Power Reticulation

A zone substation for the supply of power for all operations on the site is to be provided at the eastern boundary of the Authorisation immediately south of the rail loop. Reticulation around the site will be at voltage of 66 kV with separate circuits to each of the mines and the coal processing plant. The major power loads are associated with operation of the draglines, face shovels and conveyors. For this reason the transmission lines will be extended progressively along either side of each mine with temporary connections to the machines, and removed when no longer required. The 66 kV circuits will be carried on single poles about 20 metres high. Details of the maximum power demands for each site operation are given in **Table 4.10, Power Demand.**

4.5.4 Fire Fighting

Water ring mains will be situated around the coal handling plant, administration offices and workshops in accordance with the requirements of the NSW Board of Fire Commissioners. This system will provide for both manual hose outlets and automatic sprinkler operation.

Buildings and plant will also be equipped with suitable fire extinguishers and all personnel will be instructed on their use. Additionally, larger mining plant, such as loaders and trucks will be fitted with permanent chemical fire spray systems which can be triggered automatically or manually.

Water tankers used for dust suppression of haul roads will be capable of acting as fire tenders to provide water at pressure if a fire should occur in a remote unserviced area.

4.5.5 Explosives Transport and Storage

Two types of explosives are to be used at Mount Arthur North - an ammonium nitrate fuel oil mixture (ANFO) and a slurry or molanite type explosive for use in wet holes. During the initial stages of mining, bulk explosives trucks will deliver explosives direct to the drill holes thus avoiding the need for storage on site. At peak mine production a total of about 1 750 tonnes per month of explosives will be required. It is expected that dry ammonium nitrate pellets will be delivered by truck into a bulk store, and later mixed with fuel oil in special purpose tender trucks immediately before delivery to the drill holes.

The relatively small quantities of the slurry type explosive will continue to be delivered direct to the site as required. Small magazines will be required for the storage of cordtex detonating cord and electric detonators. The design and operation of the ammonium nitrate plant and magazines, and transport of explosives, will comply with the relevant sections of the Dangerous Goods Act, 1975 and the Coal Mines Regulation Act, 1912, as amended.

4.5.6 Site Road Network

The haul roads are designed specifically for the movement of the off-highway haul trucks in the 80 to 150 tonne capacity range. These vehicles require a road formation about 20 metres wide for two-way operation. The haul road surface will be a heavy duty gravel construction using oil binders to improve adhesion of the surface layers and reduce dust formation. Bituminous or asphaltic concrete sealed surfaces are not suitable because of the high axle loads. Dust will be controlled by regular water spraying from tanker trucks.

Wherever necessary, the haul roads will be flanked on either side by earth bunds to provide noise attenuation and visual screening. The location and progressive development of the haul roads are shown on **Exhibits 4.20 to 4.23, Site Development, 1986, 1990, 1994 and 2004,** respectively.

TABLE 4.10- POWER DEMAND

Site Operation	Maximum Demand MVA
1. Ramrod Creek and Glen Munro mines - mining equipment, conveyors, pumping equipment and mine facilities.	14.0
2. Coal processing plant - breakers, screening and wash plant, materials handling plant, rail loading facility, office, workshop and amentity facilities.	17.5
3. Whites Creek mine - mining equipment, conveyors, pumping equipment, office workshop and amentity facilities.	12.0
Sub Total	43.5
4. Whites Creek mine - future options for overburden handling.	
(a) crusher - conveyor system: in pit crushers, conveyors and stackers.	17.6
(b) trolley - assist system : maximum demand for 24×170 tonne trolley assist trucks.	40.0
Totals - including 4(a)	61.1
including 4(b)	83.5

Apart from the mine haul trucks there will be a large number of smaller mine vehicles moving around the site plus vehicular traffic entering from the public roads. For both safety and operational reasons, the on-site system of general purpose roads will need to be separate from the main haul road system.

All access roads from public roads to car parks and mine administration, workshop and amenity facilities will be sealed. To prevent unauthorised entry into operational areas, control points will be provided on all roads giving access to the site working areas.

Drainage control measures for all haul roads, access roads and car parking facilities will be provided. For the trafficked areas, not subject to coal spillage, runoff will discharge into the natural drainage system. For dirty areas which will be contaminated by coal spillage, settling ponds will be provided to intercept runoff and settle out the carbonaceous material. Details are provided in **Chapter 6, Environmental Safeguards.**

4.6 MANAGEMENT AND WORKFORCE

4.6.1 Management Structure

The Electricity Commission, through one of its wholly owned subsidiary mining companies, will manage the total operation with staff responsible for:

- integration of the coal production plans and coal preparation with the Commission's requirements
- monitoring the performance of mine operators in all respects
- determination of quality and quantities of products prior to release from the mine site
- operation and maintenance of environmental monitoring systems and recording of environmental data
- liaison with State Government authorities, local government authorities, and the public
- property matters
- off-site infrastructure works

This office will provide overall control of the project under the direction of a resident engineer.

A separate management structure will be provided for each of the two mining operations which will be responsible for the detailed operational control of all activities at each mine, and which will arrange for the efficient production of raw coal from each mine within contractural parameters established by the Commission through the resident engineer. A mine manager will be included in each of these two organisations who will have the normal statutory responsibilities of that position in respect of the mining operations under his control.

It is intended that the mining operations at the Ramrod Creek mine will be carried out by contract, and the management structure of that mine will be provided by the successful tenderer for that contract.

The mining operations at the Whites Creek mine will be carried out under a separate contract. This contract will be carried out by a mining company which may be wholly or partially owned by the Electricity Commission but nevertheless the operations will be subject to a formal contractural relationship under the control of the resident engineer.

The coal delivered to the raw coal receiving system will be the property of the Commission, and the resient engineer will arrange for the stockpiling, coal preparation and coal delivery through the coal handling system. Contractors may be employed in the operations and maintenance of this system.

Any contracts in respect of any activities at the mines or the coal handling system will provide the resident engineer with the necessary authority to limit or suspend operations as may be necessary to ensure compliance with the conditions of mining leases, development consents and licences issued in respect of environmental matters, or for such other reasons as the Commission itself may consider appropriate.

4.6.2 Environmental Management

Environmental matters for the total operation will be under the control of a professional environmental officer responsible to the resident engineer. The environmental officer, supported by necessary subordinate staff, will be responsible for the following matters:

. the operation and maintenance of the site meteorological station which will include equipment to record rainfall, rainfall intensities, evaporation, wind velocities and directions, and temperature. The extent of the site may necessitate the recording of some of the meteorological data at other sites.

. the operation and maintenance of air quality monitoring equipment. This equipment will include both dust deposition gauges, and high volume and continuous samplers

. continuous sampling and monitoring of all water storages, and water flows throughout the site

. continuous monitoring of mine noise, and ground vibration and overpressure effects from blasting

. coordination and supervision of the rehabilitation programmes for all mine areas

. overriding environmental control on all mining operations as regards control of dust generation from haul roads, blast and acoustic control

. compilation of all environmental data and responsibility for compliance with licences issued by the State Pollution Control Commission

. control and management of agricultural and land management practices of lands owned by the Commission and being operated under a leasing arrangement

. liaison with the public on environmental matters

Details on the monitoring programme are contained in **Section 6.16, Monitoring Procedures.**

4.6.3 Operational Workforce

The composition of the workforce will include staff and wages employees. Staff employees will comprise senior managers, professional and supervisory personnel, clerical and service staff. Wages employees include all plant and

TABLE 4.11 - PROJECT WORKFORCE SUMMARY

Job Classifications	Workforce Numbers								
	1983	1984	1986	1988	1990	1992	1994	1998	2000
Whites Creek Mine									
Managers & Professional	5	18	20	20	20	20	20	20	20
Supervisory	8	28	30	32	32	32	32	32	32
Clerical & General	5	16	18	19	19	19	19	19	19
Total Staff	18	62	68	71	71	71	71	71	71
Mine Plant Operators	20	114	177	248	259	277	278	279	279
Tradesmen	10	59	123	190	199	221	231	250	248
Labourers	5	13	35	81	88	100	109	119	108
Total Wages	35	186	335	519	546	598	618	648	635
Total Manning	53	248	403	590	617	669	689	719	706
Absentee allow	-	22	37	56	59	64	66	69	68
Total Workforce	53	270	440	646	676	733	755	788	774
Ramrod Creek/Glen Munro Mine									
Managers & Professional	12	14	16	16	16	16	16	16	16
Supervisory	12	16	16	16	16	16	16	16	16
Clerical & General	9	12	12	12	12	12	12	12	12
Total Staff	33	42	44	44	44	44	44	44	44
Mine Plant Operators	122	146	173	183	183	180	180	180	180
Tradesmen	24	64	72	77	77	77	77	77	77
Labourers	12	12	20	25	25	25	25	25	25
Total Wages	158	222	265	285	285	282	282	282	282
Total Manning	191	264	309	329	329	326	326	326	326
Absentee allow	18	24	29	31	31	31	31	31	31
Total Workforce	209	288	338	360	360	357	357	357	357

TABLE 4.11 PROJECT WORKFORCE SUMMARY - Continued

Job Classifications	Workforce Numbers 1983	1984	1986	1988	1990	1992	1994	1998	2000
Coal Processing Plant									
Managers & Professional									
Supervisory									
Clerical & General									
Total Staff	12	24	33	36	36	36	36	36	36
Production	15	29	50	53	53	53	53	53	53
Maintenance	10	22	35	36	36	36	36	36	36
Total Wages	25	51	85	89	89	89	89	89	89
Total Manning	37	75	118	125	125	125	125	125	125
Absentee	-	6	11	11	11	11	11	11	11
Total Workforce	37	81	129	136	136	136	136	136	136
TOTAL PROJECT WORKFORCE	299	639	907	1142	1172	1226	1248	1281	1267

equipment operators, skilled tradesmen mainly in the electrical and metal industry trades, simi-skilled tradesmen and labourers. The numbers and classifications of employees are shown in **Table 4.11, Project Workforce Summary,** for each of the three operating companies. An allowance has been made for absenteeism, including sickness and regular holidays, in order to estimate actual gross employment compared to actual day to day manning levels. The operational workforce for the Whites Creek mine increases over the period considered, while numbers for the coal processing plant, the Ramrod Creek and Glen Munro mines remain practically constant after the initial build-up.

4.6.4 Construction Workforce

From early 1981 exploration activities will give way to site development. The main construction period for the project will be between 1982 and 1985 when most of the building structures, fixed plant and major field units such as the draglines, will be assembled, erected or installed.

Full details of the construction workforce will not be known until contracts are firm and methods and timing can be detailed. Tentative estimates for total on-site construction phase workforce are given in **Table 4.12, Construction Workforce.**

In addition to the on-site mining related construction activities, there will be construction, associated with external infrastructure, undertaken by Council and Statutory authorities. This will include road reconstruction and relocation, railway construction, conveyor installation, power transmission line construction and other related but indirect activities associated with housing and urban infrastructure.

A construction camp is planned to serve the majority of the on-site workforce. The camp is to be constructed on the site west of the Ramrod Creek mine and will accommodate up to 300 people. A proportion of the construction personnel are expected to be already resident in the district. A further proportion will occupy houses in Muswellbrook or other centres.

TABLE 4.12 - CONSTRUCTION WORKFORCE

Year	Total Workforce
1981	150
1982	400
1983	500
1984	500
1985	300
1986	150

4.7 WATER MANAGEMENT

4.7.1 Study Outline

A separate water management study for the project was undertaken and a synopsis of this study report is contained in VOLUME 2 as Document 10. The terms of reference are summarised below:

- estimation of water demands and quality requirements for all on-site uses
- study of dust generation and suppression measures

. identification of alternative sources of water supply
. estimation of surface water yields, flood flows and groundwater yields
. assessment of site water qualities
. analysis of pollution control and water quality discharge requirements
. control of surface water runoff
. schematic design of structural features of the water management system.

The resultant water management plan is described in the following sections. The water management flow chart and total site water balance is shown in **Exhibit 4.19, Water Management Flow Chart.**

4.7.2 Water Demands

The following water use requirements have been identified:

. coal preparation plant make-up water
. coal preparation plant shut-down losses
. washdown water for coal processing facilities and workshops
. water for dust suppression on haul needs, stockpiles and coal handling equipment
. potable water for bathhouses and amenity facilities
. water for fire fighting
. water for irrigating rehabilitated areas and site landscaped areas.

Table 4.13, Site Water Use, provides details of water uses for all site operations. The various assumptions that have been made in the calculations of the water use totals are set out in Document 10. In **Table 4.13,** two rates of water use have been given. Five day peak demands give the actual rate of supply for design of the supply system. The annual average figures are for development of the site water balance under long term average conditions.

The principal water uses are for make-up water to the coal preparation plant and water for dust suppression on haul roads. The make-up water use figures are based on a rate of 270 cubic metres per hour for the final plant development. The plant has been assumed to operate for 24 hours per day and 175 days per year. This results in a peak rate of 6.48 ML/d and an annual average rate of 3.10 ML/d. Water requirements for dust suppression have been calculated both with and without the use of a chemical additive. Without an additive the actual daily usage is estimated at 6.82 ML/d, which is equivalent to 4.11 ML/d on an annual average basis. With a chemical additive, these figures reduce to 2.73 ML/d and 1.6 ML/d respectively.

The total maximum water demands are estimated as 15.15 ML/d for each operating day and 8.73 ML/d on an annual average basis. The annual volume is 3 190 ML or 2 290 ML with reduced water requirements for dust suppression on haul roads.

A further water use, which at this point in time is only being considered, is the provision of 1 000 ML per annum for irrigation of pasture on rehabilitated areas and special landscaping and bunding features. This amount is based on the provision of an equivalent 22 mm per week for 25 weeks each year to an area of 200 hectares. The possibility of using treated sewage effluent from the Muswellbrook sewage treatment works is also being considered. A similar volume of 1 000 ML per annum is available from this source. Irrigation proposals for landscaping areas and rehabilitation areas are further discussed in **Section 4.8, Rehabilitation Plan.**

TABLE 4.13 - MOUNT ARTHUR NORTH, SITE WATER USE (ML/d)

Water Use	Ramrod Creek Mine		Whites Creek Mine		Coal Processing Area		Total		Total Annual ML
	5 day Peak	Annual Average	5 day Peak	Annual Average	5 day Peak	Annual Average	5 day Peak	Annual Average	
1. Coal Preparation Plant make-up	-	-	-	-	6.48*	3.10	6.48	3.10	1132
2. Coal Preparation Plant shut-down losses								0.27	100
3. Washdown for industrial facilities	0.12	0.07	0.12	0.07	0.23	0.14	0.46	0.28	100
4. Dust suppression.									
. Haul roads	2.27	1.37	4.55	2.74			6.82	4.11	1500
**	(0.91)	(0.55)	(1.82)	(1.10)			(2.73)	(1.64)	(600)
. Stockpiles	-	-	-	-	0.50	0.44	0.50	0.44	162
. Coal handling	-	-	-	-	0.75	0.45	0.75	0.45	165
5. Bathhouses & Amenities	0.05	0.03	0.08	0.05	0.02	0.01	0.14	0.08	30
6. Fire Fighting	-	-	-	-	-	-	-	-	-
TOTALS	2.44	1.47	4.75	2.86	7.98	4.14	15.15	8.73	3190 (2290)
7. Irrigation									1000

Notes: Annual averages based on 220 working days per annum
* Based on make-up of 270 m^3/h for 24 hour day.
** Haul road dust suppression requirements assuming an agglomerating agent is mixed with the water.

4.7.3 Surface Runoff Control

The runoff control system has been designed within the constraints imposed by the proposed mine plan phasing. The harvesting of surface runoff for site use, the diversion of surface water away from mine areas and the control of drainage both within the mine areas and on the overburden disposal areas and the rehabilitation areas are all facets of the system. The system will be progressively developed and modified as the mine development progresses.

The following requirements and principles of surface runoff control were identified and incorporated in the proposed system:

- All water produced by mining activities or affected by mining activities is to be contained within the lease area so as not to contaminate off-site natural watercourses.
- The mine water system is ideally to operate as a closed system with all water produced or affected by mining being recycled within the system or disposed of on-site.
- Runoff from undisturbed areas is to be kept separate from runoff from disturbed areas and diverted around or away from these areas for discharge directly from the site.
- Separate diversion, drainage systems, storage dams and settling ponds are to be provided for water of differing qualities. Two qualities have been identified for on-site water use. The water types are defined as either suitable for coal preparation plant make-up water, or suitable for dust control purposes.
- Settling ponds for runoff from affected areas are to be designed to contain the runoff from a one in 10 year storm of a duration of 24 hours.
- The tailings dam is to be designed to contain the Probable Maximum Precipitation storm runoff and hence prevent any discharge.
- Water discharged from the lease area shall conform to the quality criteria required by the Water Resources Commission of NSW and the State Pollution Control Commission of NSW.

The drainage pattern of the Mount Arthur North site is described in **Section 5.4.1, Catchments.** There are no relatively large external catchment areas contributing to runoff through the proposed lease area. The catchment principally affected by the mining proposals is the Whites Creek catchment. The upper part of the catchment area encompasses all of the Whites Creek mine. The watercourse in the top half of the catchment lies in the overburden disposal area behind the initial box cut line for the Whites Creek mine.

The lower reaches of Whites Creek lie above coal strata and the creek will be intercepted by the Ramrod Creek mine in 1989. Further mining across the lower reaches is likely under Stage 2 mine development.

In the initial stages of mine development, overburden removed from the Whites Creek mine will be placed to the east of Whites Creek and will progressively fill the valley from east to west. A number of temporary settling ponds will be formed along the western toe of the overburden in order to intercept silt laden runoff before entering Whites Creek. Whites Creek, in the early phases of mine development, will therefore remain largely undisturbed. Levee banks will protect the mine area from flooding during high flows in Whites Creek.

Polluted runoff from disturbed areas, construction areas, and roads will be intercepted and retained in settling ponds for use in road watering and construction.

A multi purpose storage dam referred to as the Clean Water Reservoir will be constructed on upper Whites Creek. Runoff from the upper Whites Creek catchment will be impounded, with catchments south of the Whites Creek mine area being diverted to the reservoir by means of a system of diversion channels. The dam has been designed with a total storage volume of 460 ML. The active storage of 230 ML will provide the non-potable water requirements for the infrastructure areas. The balance of 230 ML is a flood storage equivalent to a 1 in 10 year storm of a duration of 24 hours. Larger storm events will discharge with Probable Maximum Precipitation storms providing a surcharge of one metre over the spillway. The dam spillway will discharge into a diversion channel called the east diversion channel to be constructed along the eastern boundary of the Authorisation and then paralleling the Mitchell Line of Road to the east of the tailings dam. Apart from discharging flood flows from the Clean Water Dam, the channel will intercept clean runoff from areas east of the channel and also receive overflow from settling ponds collecting runoff from the Whites Creek mine overburden disposal area. The channel will cross the Denman Road and link in with Ramrod Creek approximately one kilometre upstream of its confluence with the Hunter River. This last reach of Ramrod Creek will be dredged and realigned to ensure that no local flooding problems are created.

Runoff from areas in front of the advancing Whites Creek mine will be intercepted by a second main diversion channel which will discharge into the lower reaches of Whites Creek. This channel will require progressive relocation as mining progresses.

For the receival of contaminated surface flows and groundwater inflows within the confines of the mines, two further storages will be constructed. Detention Pond No 1 will be located between the Whites Creek and Ramrod Creek mines. In the initial stages one of the bulk sample pits will be used. The final capacity required is 75 ML.

Detention Pond No 2 will be constructed to provide additional detention capacity for in-pit runoff after heavy rainfall, will have a capacity of 200 ML and will be located off coal-bearing strata to the west of the final Whites Creek mine highwall. Once mining in the Glen Munro mine commences, this storage will also receive dewatering inflows from this mine. These two storages will provide all water requirements for dust suppression. The location of the major water storages are shown on **Exhibits 4.20, 4.21, 4.22 and 4.23, Site Development 1986, 1990, 1994, 2004,** respectively.

4.7.4 Groundwater Control

From base data developed during a site groundwater investigation study **(Reference 9)** inflows to the proposed mines have been estimated by the use of a numerical aquifer simulation model. The potential inflows increase with development of each mine and peak at approximately 3 ML/d for both the Whites Creek and Ramrod Creek mines.

In order to maintain relatively dry mining conditions and to prevent the contamination of the groundwater that will occur if it is allowed to flow into the mine, it has been proposed that dewatering borefields be installed in advance of each mining operation. The bores will locally draw down the coal seam aquifers in the zone in front of the highwall of each mine. Bores will be spaced at approximately 300 metre centres and a maximum dewatering rate of 3 ML/d and 2 ML/d should be possible from borefields of 15 bores and 18 bores located west of Ramrod Creek and Whites Creek mines respectively. Bores will be relocated as mining progresses. For the purpose of calculating site water balances it has been estimated that an assured net supply from borefields of 3.5 ML/d will be available. Existing water supply boreholes, all of which are outside the area of proposed operations, will be unaffected by the borefield extraction system as they are protected by intervening strata of low permeability.

Close attention has been given to the hydraulic interaction between the Ramrod Creek mine and the Hunter River alluvium as the potential exists for a hydraulic connection between the two. Calculations indicate that low in-flow rates are likely with estimated flows into the pit of 0.03 ML/d. Flows in the reverse direction, once the pit is backfilled could be of the order of 0.24 ML/d. In order to prevent groundwater flows from the disposal areas once mining is complete, it is proposed to place a clay liner along the northern boundary of the pit at the time of backfilling.

4.7.5 Site Water Balance

Maximum average water demand has been estimated in **Section 4.7.2, Water Demands,** at a daily rate of approximately 8.7 ML/d. However, the likely range will be 6 to 9 ML/d depending on the relative economics of reducing water consumption by the addition of a chemical suppressant to water for haul road dust suppression.

The design of the water management system has produced a system which will meet all water demands from sources within the site. No water will be imported to the site with all sources located within the proposed mining area. The single exception is a small supply of potable water for amenity and bathhouse use which will be obtained by an extension of the Muswellbrook Shire Council reticulated town system. Average demand for potable water is less than one percent of total site water requirements. At this stage, it is not proposed to draw any water direct from the Hunter River. However, later consideration may be given to applying for an extraction licence to provide water for irrigation of site landscaping and rehabilitation areas.

Site water sources will yield between 6 and 8 ML/d. The sources can be grouped as follows:

- mine dewatering borefields
- clean water dam
- surface runoff and groundwater sources associated with the operational areas

The principal component will be groundwater extracted from the mine dewatering borefields which have an average estimated reliable yield of 3.5 ML/d. The use of a planned groundwater extraction system has the advantage that drawoffs can be regulated to provide flexibility in meeting total water demands. During extended dry periods groundwater extraction rates can be increased up to 5 ML/d to make-up shortfalls from surface runoff harvesting. Conversely, during periods of excess surface water runoff, groundwater extraction rates can be cut back. Further investigation and site drilling will be necessary to develop the final details for the borefield extraction system. However, from the information available on transmissivities and storativies, the site aquifers have the capabilities to support such a system.

The Clean Water dam has an estimated yield of 1.6 ML/d. The dam will provide the make-up water to the coal preparation plant, the reserve for fire fighting requirements for the coal processing areas, and the supply of all other water requirements for washdown and dust suppression at the coal processing area, and the Ramrod Creek and Whites Creek mine facilities. The average yield of 3.5 ML/d from the borefields will be discharged into the Clean Water dam which will provide the dam with a total safe yield of 5.1 ML/d.

Other site sources, which will generally require, at least, settlement of suspended matter before use, are listed below. The total yield from these sources has been estimated at 3.2 ML/d. All water from the sources will be collected at storages around the site and principally used for dust suppression on haul roads. The sources include:

- mine area surface runoff and groundwater inflow from overburden disposal areas
- surface water runoff from the various mine facilities areas
- washdown waters from the coal processing and workshop areas
- recycled water from the tailings dam
- runoff from overburden disposal areas
- treated wastewater effluent

A proposal which is currently being considered is the provision of a reversible flow pipeline to link the Mount Arthur North mine with the power station complex. The pipeline will provide back-up supplies when required and enable the mine to receive water from the power station cooling water system or the Pikes Gully ash dam. During periods of excess surface runoff, water may be pumped in the reverse direction for use at the power stations. Similarly, during dry periods, water can be pumped from the Mount Arthur North borefields to supplement the power station supplies.

4.7.6 Site Water Qualities

Site water qualities are currently being monitored and the results are contained in **Section 5.4.4, Water Quality,** and Document 2 of VOLUME 2. In general, groundwater from the coal seam aquifers is moderately saline with total dissolved solid (TDS) concentrations of between 3 000 and 5 000 mg/L. Surface water salinity levels have been significantly higher because of the present drought conditions and samples with TDS levels as high as 8 000 mg/L have been recorded. Hunter River levels range between 250 and 500 mg/L.

From discussions with the officers of the State Pollution Control Commission and the Water Resources Commission, no site water releases to the Hunter River will be permitted should the river have in excess of 400 mg/L for TDS and a suspended solids concentration in excess of 50 mg/L. It is proposed that storm runoff from 'mining' areas be contained in settling and detention ponds. As described in **Section 4.7.3, Surface Runoff Control**, ponds are designed for the one in 10 year, 24 hour storm. Overflow for storms in excess of this frequency and duration will be sufficiently dilute to meet discharge standards.

Borefield water from the coal seams will be pumped to the Clean Water dam. Natural runoff into the storage will be of a good quality with low salinity levels. The mixing of the two inflows will result in a water quality acceptable for make-up water to the coal preparation plant but not acceptable for direct release from the site. Discharge from the Clean Water dam to the eastern diversion channel will again only occur for floods caused by rainfall in excess of the one in 10 year return frequency.

Runoff from the coal processing area will pass, with tailings flow, to the tailings dam. Although some limited recycling will be permitted, depending on salinity levels, excess water in this cycle will generally be disposed of by evaporation from the large surface area of the tailings dam storage.

Runoff within the mine areas, together with leachates emerging from the backfill areas, will be pumped to Detention Pond Nos. 1 and 2 from where, after settlement of suspended solids, it will be used for road watering within the mine areas. Runoff from overburden disposal areas, particularly prior to revegetation, will be high in suspended solids and will be retained in settling ponds for irrigation and road watering use.

Vehicle washdown water will contain high levels of fines, some oils and greases and possibly detergents. Washdown water from workshop floors and first flush flows from the facilities areas will be high in oils and greases. Flows will pass to treatment units for removal of oils and suspended material prior to discharge into settling ponds for reuse on roads.

Consumptive and bathhouse water will be obtained from the Muswellbrook Shire Council's town reticulation system. Sewage treatment of office and facility area wastes will be by aerated lagoon systems. The treated effluent will be disposed of on-site by irrigation of adjacent landscaping areas.

The use of site water for the watering required for key landscaped areas, and rehabilitation areas generally, may be problematical. In Document 2, criteria are presented of the potential of using various classes of increasing salinity waters for irrigation. Use of site water for irrigation will only be possible for limited periods and, as discussed in **Section 4.8, Rehabilitation Plan,** it is more likely a separate source will be used for the water for site irrigation.

4.8 REHABILITATION PLAN

4.8.1 Objectives

The rehabilitation plan as defined and as described in this section covers the integrated landscape and visual aesthetics planning for the total project from the initial siting and establishment of site infrastructure through to rehabilitation and restoration of operational areas. The full text of this study is contained as Document 8 of VOLUME 2.

The objectives of the rehabilitation plan were to:

. design a final landform to accommodate the overburden spoil volumes generated over the full mine life and on a year to year basis

. provide visual and acoustic containment of the mining and ancilliary operations

. utilise any flexibility of overburden placement to create a landform consistent in character with the existing visual catchment

. arrange progressive placement and rehabilitation stages such that a minimum of later reshaping or rehabilitation would be needed

. provide a landform suitable for eventual return to agricultural uses

Before the landform plan could be finalised it was necessary to define the size, location and planning of all fixed plant, roads, site facilities and other infrastructure. The rehabilitation plan was thus fully integrated with the mining operations, phasing and preferred final form of the site.

The landform design principles and criteria, set out in Document 8, are intended to reestablish a landscape compatible with the existing. Apart from visual compatibility, preliminary consideration was also given to the long term reuse of the land. The preferred option was to provide a proportion of land potentially suitable for grazing and arable uses, with slopes limited to one in 12, mixed with steeper areas to be planted with tree species. The combination follows preservation of landform character, the essential accommodation of overburden volumes and other site restrictions.

4.8.2 Landform Features

The scheme for progressive rehabilitation of the site is illustrated in **Exhibits 4.20 to 4.23, Site Development** which details the site development in the years 1986, 1990, 1994, 2004, respectively. The exhibits also show the development of the mining operations and site facilities at these years. The anticipated extent of the rehabilitation programme is shown together with the areas remaining substantially undisturbed.

In general terms the new landform extends the slopes of Mount Arthur further north but retains the slope system common to the area. Specific features are as follows:

- **Mount Arthur:** A major knoll and saddle is to be constructed over the middle of the Whites Creek mine before the mine approaches the more visually accessible parts of Mount Arthur so that the Whites Creek mine working face will be screened from view from surrounding areas.

- **Industrial Area and Service Easement:** The ridge running adjacent to the Mitchell Line of Road provides the primary containment of the coal processing area and the associated rail area from Muswellbrook but will require support from localised earth-mounding and vegetation in order to screen views from the road.

- **Haul Roads and Conveyor:** The saddle running between the Whites Creek and Ramrod Creek mines is supported by a major berm and slope south and south west of the tailings dam. These provide lower level screening of the first cuts of the Whites Creek mine and the associated conveyor and haul roads from views from the Denman Road and valley areas.

- **Ramrod Creek Mine:** The mine is screened from low level views from the north by a landform/vegetation easement running along the complete north boundary. Low level views from the town and the Denman/Mitchell Line of Road junction and river flats will be restricted by the retained existing stand of trees and the minor spur and associated planting established in the vicinity of the tailings dam embankment and mine facilities area.

- **Glen Munro Mine:** This mine is screened from the northern view mainly by the existing spur running north west in the middle of the site across the Edderton Road. The only area to be visible will be the cuts into Mount Arthur itself around the year 2004 when the Mount Arthur face will be visible from distant views at similar elevations north west across the flood plain. All local and low level views from the flood plain itself and the Denman Road will be shielded by the existing spur.

Early establishment of finished landform and vegetation to both the Denman Road and Mitchell Line of Road visual catchment is considered critical to effective containment.

Generally new slopes on the peripheral aspects and skyline of new landforms are a maximum of one in 10 in order to be consistent with adjacent existing landforms. Spurs and saddles are designed with slopes of between one in 15 and one in 20 except where they join existing landforms of greater slope and they increase to blend.

Internal temporary faces outside the pits proper have been increased in slope to a maximum one in 4. It is proposed that within the overall one in 10 slopes there may be localised increases in slope on ridgetops and along drainage channels (both of which would be stabilised by revegetation with trees and understorey associations) in order to leave areas of broad slopes at one in 12. These areas would not then be precluded, on the basis of slope, from eventual agricultural use as arable land. The realigned section of the Denman Road will be in cutting for about 50 percent of its length.

4.8.3 Vegetation

Existing vegetation in peripheral areas and to the east of the Ramrod Creek mine has been identified for protection. Generally this includes individual mature trees with the occasional stand, around which new plantings would occur and areas be fenced to encourage regeneration.

The proposed tree planting would intensify that now existing on site so that a more stable long term landscape is established. Planting and regeneration would be supported by native plant seeding and grassing. Broadly the vegetative system may be described in the following categories:

- **Visual, Attenuation and Shelter Belts:** Intensive plantings of Acacias and Eucalypts predominantly to critical boundary easements, haul roads and building areas. These plantings will have priority for use of available irrigation water in their establishment.

- **Drainage Channel Stabilisation:** Plantings of Casuarina and selected Eucalypts and Acacias forming a protective network against erosion in those areas where soil moisture is most available, that is, around dams and along watercourses.

- **Ridge and Spurs Stabilisation:** Intensive planting and seeding of locally steeper ridges similar to those existing with Eucalypts and Acacias.

Any future uses beyond the primary rehabilitation are anticipated as being accommodated within this framework.

The areas of progressive rehabilitation are shown on **Exhibits 4.20 to 4.23, Site Development,** for the years 1986, 1990, 1994 and 2004. The areas have been shaded to specifically define their extent. Parallel drawings are included in Document 8 of VOLUME 2 to define in more detail the vegetation plan for the site rehabilitation. The location of the proposed planting and seeding of native tree species are shown on these drawings for the site area. **Exhibit 4.24, Site Rehabilitation,** shows the extent of site rehabilitation and tree planting as it will exist by the year 2004.

4.8.4 Surface Rehabilitation Techniques

The following techniques are considered the minimum to ensure the realistic and appropriate levels of rehabilitation enabling eventual economic reuse of the land. Sequences for rehabilitation relate to availability of materials and importance of the visual catchment. The surface rehabilitation process will include the following stages, which will be further developed in consultation with the NSW Soil Conservation Service and the Department of Agriculture:

- stripping of topsoil and subsoil for reuse either after stockpiling or for immediate spreading on recently filled areas

- regrading to designed finished landforms of the worked areas and other areas disturbed during construction of the infrastructure at the earliest opportunity, and to profiles which allow for a layer of friable, free draining soil material and topsoil. Surfaces should be contour ploughed to reduce sheet runoff

- distribution of sufficient boulder or rock material to drainage channels or localised increases in grade to assist in surface stabilisation

- stabilisation of regraded surface soil by fertilisation, seeding and plantings. Seeding will include:

  - seeds to provide immediate stabilisation (grasses)
  - seeds of plants with nitrogen fixing capabilities to improve soil nutrients (legumes)
  - seeds of perennial grasses for surface stability (couch, rhodes)
  - seeds of native pioneer species to begin the process of creating an overall vegetative association (acacias)
  - seeds of climax vegetation species to add to the pioneer planting (eucalyptus)
  - the seed mix then would become the bank for longer term vegetative development, selectively developed under the climatic and management conditions available over time.

- fencing and watering of planted areas. All planted areas in critical view catchments and development areas require both fencing for protection and watering to establishment. Proposed methods for watering include a trickle irrigation system using either sewage effluent from the Municipal Treatment Works, water from site storages, water obtained direct by pumping from the Hunter River or any combination of these. The boundary zones, tailings dam and processing areas have priority for this supply. It appears likely, at this stage, that site waters will generally be of a salinity unsuited for regular usage for irrigation purposes. The possibility of using sewage effluent will be pursued, however, at present, a number of nearby property owners are either draining directly from the final maturation pond at the works or drawing from Ramrod Creek immediately downstream. Their supply would cease if use were to be made of this effluent at the Mount Arthur site.

4.9 DEVELOPMENT PROGRAMME

4.9.1 Overview

The period considered in this report covers the mine operation period between 1983 and 2004, and the initial development construction phase occurring mainly over 1981 to 1986. In the overall programme from 1981 to 2004 there are a series of key dates which control the details of the programme. These are shown at the top of **Exhibit 4.25, Development Programme,** and the extent of major operations are indicated below. It can be seen that most construction of buildings and fixed plant occurs by the end of 1983 which marks the start of coal production. The main items of off-site infrastructure will also be constructed by the end of 1983 or early 1984. The coal processing plant will be completed to full capacity by the beginning of 1987. The development of the Glen Munro mine will occur over 1991/92 concurrently with closing down of the Ramrod Creek mine.

4.9.2 Main Construction Phase

The principal activities in the initial development years, which are described on **Exhibit 4.25,** include:

- on-site earthworks for preparation of the coal processing plant and facilities areas, roads, the rail loop, drainage and dam construction
- construction of buildings and fixed plant, mostly in the coal processing area
- installation and commissioning of equipment
- off-site works including roads, railway and power supply
- assembly of certain large mining equipment such as the draglines
- continuing drilling, sampling and other investigations, including environmental monitoring.

4.10 TRANSPORTATION

4.10.1 Off-Site Coal Transport

The transport of coal away from Mount Arthur North site will be by overland conveyor and by rail. The coal conveyor to Bayswater and Liddell Power Stations will commence near the eastern end of the coal processing plant and run south along the eastern boundary of the Authorisation subsequently turning eastward along the southern boundary of the Drayton Co-Venture, A173. This route was referred to in the Environmental Impact Statement for Bayswater Power Station **(Reference 4).** The route is approximately 13 kilometres long. It is shown on **Exhibit 3.3, Coal Developments in the Upper Hunter Region.** Two conveyors are to be built in parallel with a capacity of 2 500 tonnes per hour each. The use of dual conveyors provides a high degree of reliability for the system which is sufficient to transport all of the coal required at the power stations.

The export coking coal and medium ash steaming coal for other power stations will be moved by coal trains from the rail loop to be constructed at Mount Arthur North. A rail spur extension from the proposed Drayton balloon loop is proposed to link the Mount Arthur North site with the Main Northern rail line at the Antiene junction. Export coking coal will be railed to the Port Waratah coal loader in the port of Newcastle at a planned rate of up to one million tonnes per year. The one million tonnes per annum of medium ash steaming coal for other power stations will probably go to the Lake Macquarie district.

The State Railway Authority expects that unit trains of 3 234 tonne capacity will be available by 1984 when the first rail shipments are due. The unit trains will be made up of 42 CHS waggons of 77 tonne capacity drawn by three locomotives. Rail transport of two million tonnes of coal per year will thus require 625 unit train loads per year, or 12 trains per week on average. However, the number of weekly train movements will be influenced by the arrival of ships at Port Waratah, the stockpile inventory at the coal loader, seasonal variations in demand at other power stations, and by railway traffic planning.

Allowing for these factors, the frequency of train movements on the balloon loop have been estimated as shown in **Table 4.14, Frequency of Site Train Movements**

TABLE 4.14 - FREQUENCY OF SITE TRAIN MOVEMENTS

Daily Loading Rate	Frequency (days/year)
Over 2 trains per day	85
Over 5 trains per day	28
Over 8 trains per day	6

The frequency of train movements is based on a unit train capacity of 3 234 and will increase for lower unit capacities as for example, if the present maximum capacity of 2 380 tonnes is retained. Train loading will normally occur during weekdays but will extend over weekends during peak periods.

Road transport of product coal from Mount Arthur is not proposed. However, a 100 000 tonne bulk sample for analysis purposes will be removed by road during 1981 for boiler testing at Liddell Power Station. Details of the design of the rail spur and balloon loop are contained in **Section 4.11, External Infrastructure.** **Exhibit 3.3** also shows the Drayton rail spur from Antiene junction, the Drayton balloon loop, and the extension of the rail spur to Mount Arthur North.

4.10.2 Light Vehicle Traffic Generation

Light vehicle movements to and form the site will form the largest group of total road traffic movements generated by the project. Employees travelling to and from work would make up about 80 percent of the light vehicle movements generated on public roads, the balance being made up of commercial vehicles and goods deliveries associated with the project. The public roads which will provide access to the site are shown on **Exhibit 4.1, Development Plan.**

Estimated vehicle trips in 1985 for the Ramrod Creek mine are 650 trips per day, half inbound and half outbound, and would use the Denman Road for access. In 1995, when the Glen Munro mine is operating, the same number of project-associated trips would occur on the Denman Road. There is a common access point for the Whites Creek mine and coal processing plant from the Mitchell Line of Road and they are therefore considered together. Trips generated in 1985 are estimated at nearly 900 per day rising to 1 700 to 1 800 per day in 1995, half inbound and half outbound. It was assumed that an average of 1.2 persons occupied each vehicle.

Movement rates will vary through the day with small peaks occurring before and after shift change times. About 25 percent of total daily trips would occur at each shift change time, that is 5.30 am to 6.30 am, 1.30 pm to 2.30 pm and 9.30 pm to 10.30 pm. The balance of 25 percent would be spread over the normal business day.

The distribution of project generated trips on the road system depends primarily on the location of employee residences and to a lesser extent on the location of business premises. While Muswellbrook is expected to be the main origin or destination, significant volumes are expected on the Greta Road going to and from the power stations, Singleton and other destinations along the New England Highway. (The Greta Road location and construction proposals are described in **Section 4.11.2, Roads).**

Given the likely distribution of residences and location of employee work places, it is unlikely that significant patronage could be attracted to public transport. However, a company run shuttle bus service could be introduced to serve the more concentrated areas of residence, such as Muswellbrook, with a resultant reduction in the number of employee trips to work.

4.10.3 Truck Movements

For normal operation of the project about 100 truck trips per day are expected at the Whites Creek mine and coal processing plant entrance and a further 20 truck trips per day to the Ramrod Creek and Glen Munro mine facilities areas. Trucks in this context are vehicles over 5 tonnes gross mass. The truck movements represent about 5 percent of all vehicle movements generated by the project on the local road network, which is within the normal range for main road traffic movements.

Truck movements are associated with the supply of fuel, lubricants, some explosives, stores and materials, machine spares and service vehicles. With the possible exception of fuel supplies, it is not practical for these deliveries to be made by rail direct to the Mount Arthur North site. During the major construction stage over 1982 to 1985, higher numbers of truck trips may be generated for short periods. The majority of truck trips are expected from suppliers in the Lower Hunter and would therefore use the Greta Road for access to the site.

4.11 EXTERNAL INFRASTRUCTURE

4.11.1 Railway Branch Line and Balloon Loop

The railway connection to Mount Arthur North is proposed as an extension of the branch line and rail loop planned for the Drayton Co-Venture. The junction with the Main Northern Line occurs at a point south of Antiene. The length of common new line from the Antiene junction to the Drayton loop is 6.5 kilometres. A further 4.9 kilometres of track, together with a 3 kilometre length of balloon loop is proposed for the Mount Arthur North project.

The rail spur line extension from the Drayton loop is located as shown on **Exhibit 4.26, Rail Spur Extension.** The line will generally follow the new road link, known as the Greta Road and described in **Section 4.11.2, Roads,** between the New England Highway and the Mitchell Line of Road. The line then follows the Mitchell Line of Road in a north westerly direction to finish at the balloon loop. This section of the Mitchell Line of Road will be relocated, with construction work being carried out in parallel with the rail line construction.

The final location of the rail spur may be altered slightly from the route shown on **Exhibit 4.26.** The section of rail line paralleling the Mitchell Line of Road lies in the northern part of Authorisation A171 held by the Bayswater Colliery Company. Exploration is currently being carried out to define the extent of the Greta seam measures in this area which are thought to extend from the Black Hill Authorisation (A174) through to Bayswater No 2 Colliery. The location of the remaining section of rail spur and the balloon loop will not be affected as coal in these areas is either at great depths or non-existent.

The main structures on the rail line will be a crossing of Ramrod Creek and a rail underbridge crossing of the Mitchell Line of Road, near the intersection of the Greta Road and Mitchell Line of Road, to maintain road access to Bayswater No 2 Colliery. Earthworks for the line are 600 000 cubic metres with cuts and fills in reasonable balance. The maximum cut is of the order of 21 metres with a number of fills in the range of 12 to 16 metres.

The proposal and design details for the Drayton rail spur are contained in the Environmental Impact Statement for that mine development **(Reference 25).** In general the design of the extension will be in keeping with the design principles of the Drayton spur. The grading of the extension is also shown on **Exhibit 4.26.** The balloon loop commences immediately inside the Authorisation boundary. The loop is of sufficient length to accommodate two empty trains and one loaded train of the maximum size proposed by the State Rail Authority (42 CHS waggons having a pay load of 3 234 tonnes). The loop will also be capable of accommodating loading bins for other mines in the area, should they wish to use the facilities. Diesel electric locomotives will be used on this line but there is provision in the State Rail Authority's forward programme for future electrification and provision will be made for possible future electrification. The design is based on the requirements for heavy haul railways in NSW. A resume of the main criteria is set out below:

. gauge of track	1 435 mm
. track classification	1X or 1XC; heavy duty main line; 25 tonne nominal maximum axle load
. rail section	60 kg/m welded (53 kg/m may be used if 60 kg/m unavailable)
. sleepers	timber for 1X or concrete for 1XC
. ballast	Grade 1; nominal depth of 300 mm under the sleepers; 400 mm shoulder distance
. minimum curve radius	400 m absolute; 800 m where possible
. maximum grade against load	1 in 100 (Grade to be compensated on curves)
. maximum grade against empty train	1 in 50 (Grade to be compensated on curves)
. formation width	8.5 m
. right of way	40 m
. future electrification	clearances are to be provided for future electrification
. bridge design	M270, (approximately equivalent to Coopers E60)
. cross drainage	50 year recurrence interval

4.11.2 Roads

The development of the Mount Arthur North project will require the upgrading or deviation of a number of roads in the immediate vicinity of the site.

Greta Road

The development of Mount Arthur North and other adjacent mines requires that a good standard of road access is provided to the mine sites directly from the New England Highway. Development approval has recently been received for construction of a road, known as the Greta Road, to provide a connection from the highway to a junction with the Mitchell Line of Road just north of Bayswater No 2 Colliery. This road will provide the main means of access to the proposed Black Hill, Bayswater and Mount Arthur North collieries and the Council industrial estate, without the need to travel through South Muswellbrook. The Greta Road development will comprise reconstruction along the eastern section of the present Wireline Road, and construction of a new alignment from a point north of the Drayton balloon loop to the Mitchell Line of Road, generally paralleling the rail spur line route.

Mitchell Line of Road
Part of the Mitchell Line of Road has recently been upgraded by Council as part of the development of the industrial estate. Reconstruction of part of Mitchell Line of Road between the industrial estate and the Greta Road junction will be carried out at the time the rail extension to Mount Arthur North is constructed. This 3 kilometre section of Mitchell Line of Road will be constructed to the same standards as the Greta Road, that is, a pavement width of 7.4 metres with 1.2 metre shoulders and designed for heavy traffic. Road side treatment will be an extension of, and be consistent with, that presently being carried out along Mitchell Line of Road opposite the industrial estate.

Denman Road
Deviation of a section of the Denman to Muswellbrook Road, MR209, will be required over a distance of approximately 5 kilometres. The plan and longitudinal section of the proposed deviation is shown on **Exhibit 4.27, Denman Road Deviation.** In selecting the new alignment the following factors were considered:

- provision of suitable road geometry
- preservation of the historical houses of Edinglassie and Rous-Lench and their surrounds
- retention of the flood plain for agricultural use
- provision of a flood free section of road
- provision for enhancing the views towards the river, but with particular attention to landform and planting to shield views from the road into the mine pits
- consistent with the above, maximising the area for coal extraction.

The deviation will extend from a distance approximately 700 metres west of the Balmoral corner through to the junction with the Edderton Road. Construction will be carried out prior to 1983 when mining operations are scheduled to commence in the Ramrod Creek mine. Provision has been made in the design of the deviation for future mining operations to the west of the Ramrod Creek mine under Stage 2 mine development.

Present pavement standard is poor with the vertical alignment not conforming to current standards. The new section of road has been designed in accordance with NSW Department of Main Roads standards for a nominal design speed of 100 kilometres per hour. The construction would be funded by the Commission and constructed under contract to the Commission. All design details would be subject to approval of the NSW Department of Main Roads.

The road alignment has been set at a minimum of 2 metres above the 1955 Hunter River flood which has been assigned a frequency of one in 100 years. The new alignment is therefore flood free. The existing alignment is potentially flood liable in the vicinity of the Whites Creek crossing. The Whites Creek valley upstream of the road crossing would be protected from flooding by the installation of flood flaps on the Whites Creek culverts under the new road alignment.

The new alignment has placed the road closer to the homesteads of Rous-Lench and Edinglassie. However, it has been possible adjacent to both these homesteads to place the road in cuts of up to 2 metres. The partial shielding provided by the alignment will be reinforced over this section of road by the establishment of an arboreal screen in the road easement between these two properties. On the southern side of the road a bund wall will be established, along the northern boundary of the Ramrod Creek mine site, to screen visual access into the mine site. A typical section of the bund wall and the associated tree screen is shown on **Exhibit 4.27.**

Edderton Road
Development of the Glen Munro mine will require the present Edderton Road to be closed. The road will be relocated along the western boundary of the Authorisation area prior to commencement of mine operations in 1991. A preliminary alignment, about 8 kilometres long, has been established which rejoins the present road at the junction with MacDonalds Road about one kilometre south of the Authorisation boundary. The relocated alignment is shown on **Exhibit 4.1, Site Development Plan.** For the first 3 kilometres south of Denman Road, the grades are relatively flat. The remainder of the route is through rugged country and the road could have grades up to 8 percent. Proposed operations at Mount Arthur South may require the further relocation of the southern section of the Edderton Road to the junction with the road between Jerrys Plains and Denman.

4.11.3 Power Supply

The power demand from Mount Arthur North has been estimated at 61 MVA which is well in excess of the capacity of the present supply system. A new zone substation will be established at the eastern boundary of the Authorisation to be operated by Shortland County Council. The zone substation would serve the Authorisation area, the industrial estate, and other nearby mines as required. Reticulation from the zone substation will be at 66 kV.

To ensure security of supply, two 132 kV transmission lines will serve the zone substation. One line will be located in the service corridor running south along the eastern boundary of the Authorisation and terminate at the Bayswater or Liddell Power Station switch yards. The other line will run east from the zone substation generally following the rail and road alignments to a point in the vicinity of Antiene, thence north along existing transmission easements to connect at a bulk supply point currently under construction east of Muswellbrook. In total, about 28 kilometres of 132 kV transmission is required of which 5 kilometres is within the Authorisation.

The supply of power for the coal conveyor between the coal processing plant and Bayswater Power Station will come directly from the power station. This will require a separate transmission line along the conveyor easement.

4.11.4 Pipelines

Potable water will be supplied to the administrative and facilities areas from the Balmoral water supply scheme, which is an extension of the installed supply system. Initially, it is proposed to draw water from a 100 mm main installed to service the industrial estate. If water demand increases during development, and subject to detail investigation, a larger supply capacity main may be required. It is likely that additional 100 mm diameter mains will be installed from a town main north of Balmoral corner, one line running along the Mitchell Line of Road and the other along the Denman Road to serve the Ramrod Creek mine facilities area and the construction camp.

The use of effluent from the Muswellbrook sewage treatment plant for use in the irrigation of rehabilitation areas was proposed in **Section 4.8.** If adopted, the supply of effluent would require laying a 200 mm pipeline from the treatment plant to the site over a distance of about 1.8 kilometres. A similar diameter pipeline would be required if the alternative scheme of drawing irrigation water from the Hunter is adopted. A proposal for a pipeline is currently being investigated to link the Mount Arthur North site with the Bayswater Power Station. The proposal is outlined in **Section 4.7, Water Management.**

4.12 LAND OWNERSHIP AND MANAGEMENT

The Commission is proceeding with the intention to acquire a sufficient land area for all proposed mining operations both for works under the proposed Stage I development and the outlined future development under Stage 2. **Section 5.9.3, Land Tenure and Ownership,** and **Exhibit 5.6, Land Ownership,** defines the area intended to be acquired.

Within the Authorisation all land is intended to be acquired with the following exceptions:

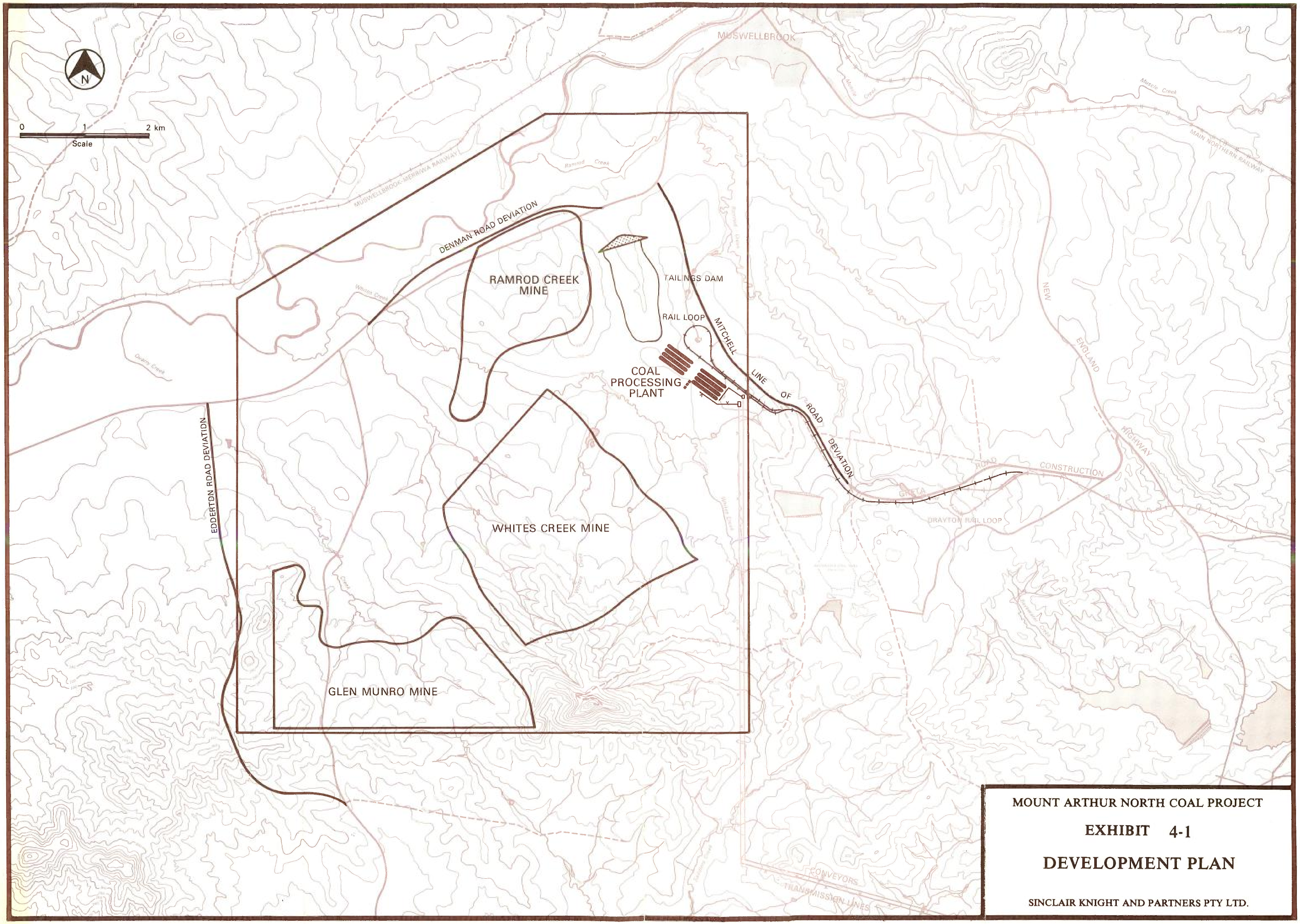
- land to the east of Mitchell Line of Road including the Council industrial estate and a number of smaller holdings fronting onto the Denman Road
- land to the north of the Hunter River
- land between the Denman Road and the Hunter River north of Balmoral Corner
- land either side of the Denman Road in the north west corner of the Authorisation

These land areas are unaffected by direct mining operations and are sufficiently distant from mine areas as to not be affected adversely by the effects of noise, vibration, overpressure or dust. A possible exception is the area in the north west corner of the site which may indirectly be affected under Stage 2 mine development. This position will be considered when mine plans have been developed. However, as discussed in **Section 4.3.6, Future Mine Development,** operations in this area will not occur prior to the year 2004. At this time it will be necessary to seek to acquire an easement along the western boundary of the Authorisation.

It is the Commission's intention that any lands acquired for the development and which are not required or significantly affected by mine operations, will continue in their present usage. To this end lands will be leased, either to their original owner or to some other leasee, for the continuation of existing agricultural uses. Under the terms of any lease, the leasee will be required to maintain the property and existing structures and to continue actively farming the area. This particularly applies to the prime agricultural land areas between the Denman Road and the Hunter River.

The historic buildings located along the edge of the river fats will be included in the lease agreement for their respective properties. The leasee will be responsible for the general up-keep of the buildings under the terms of the lease agreement. Notwithstanding however, the Commission will undertake to accept responsibility for ensuring that these buildings are maintained and preserved in keeping with its position as owner of buildings under National Trust Classification. Limited occupancy will be permitted of any buildings within the Authorisation consistent with mining operations.

With progressive mine development and rehablitation of mined areas, including a period of controlled agricultural or horticultural use, the land will be available for such future use as may be considered appropriate to that time.

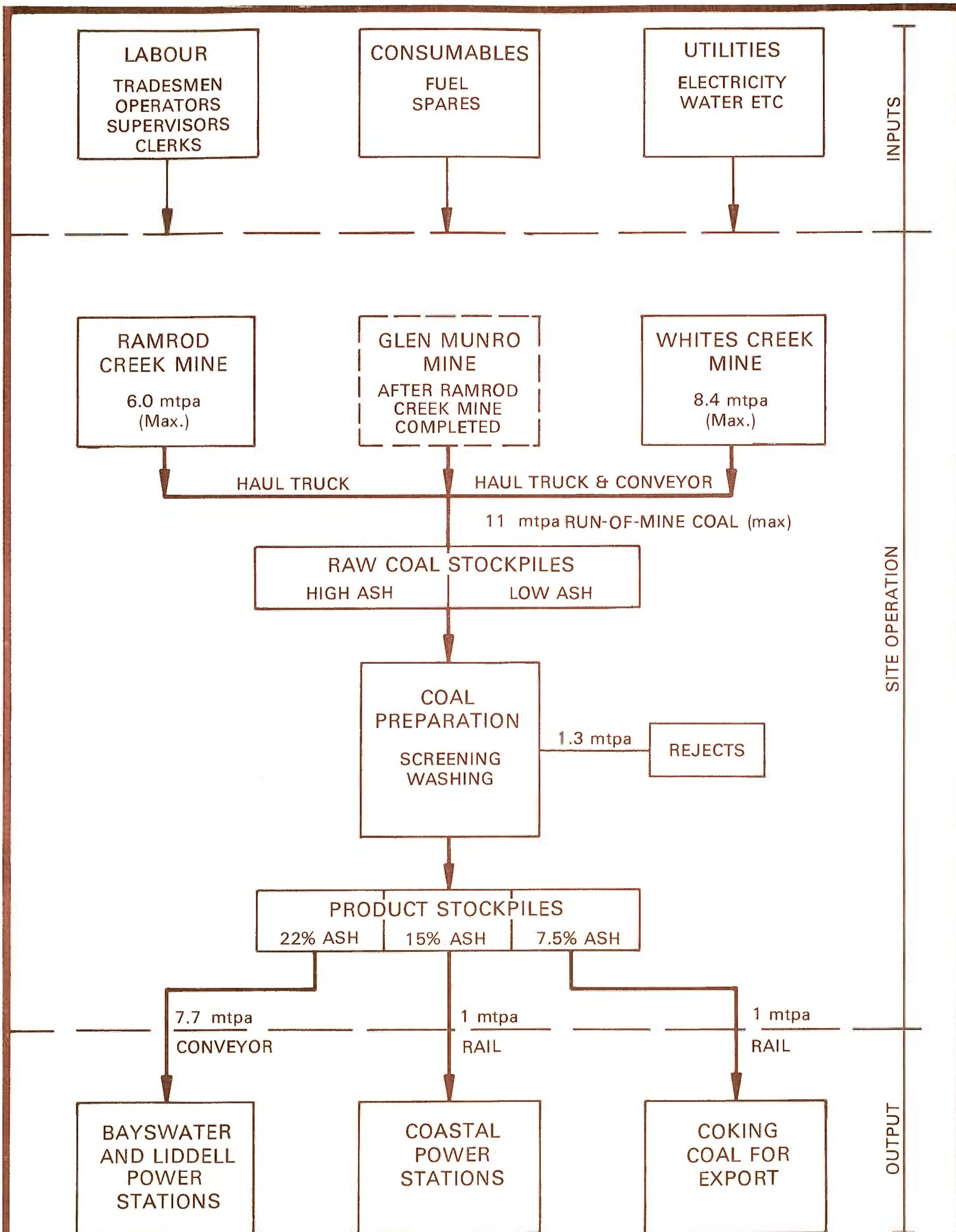


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-1

DEVELOPMENT PLAN

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

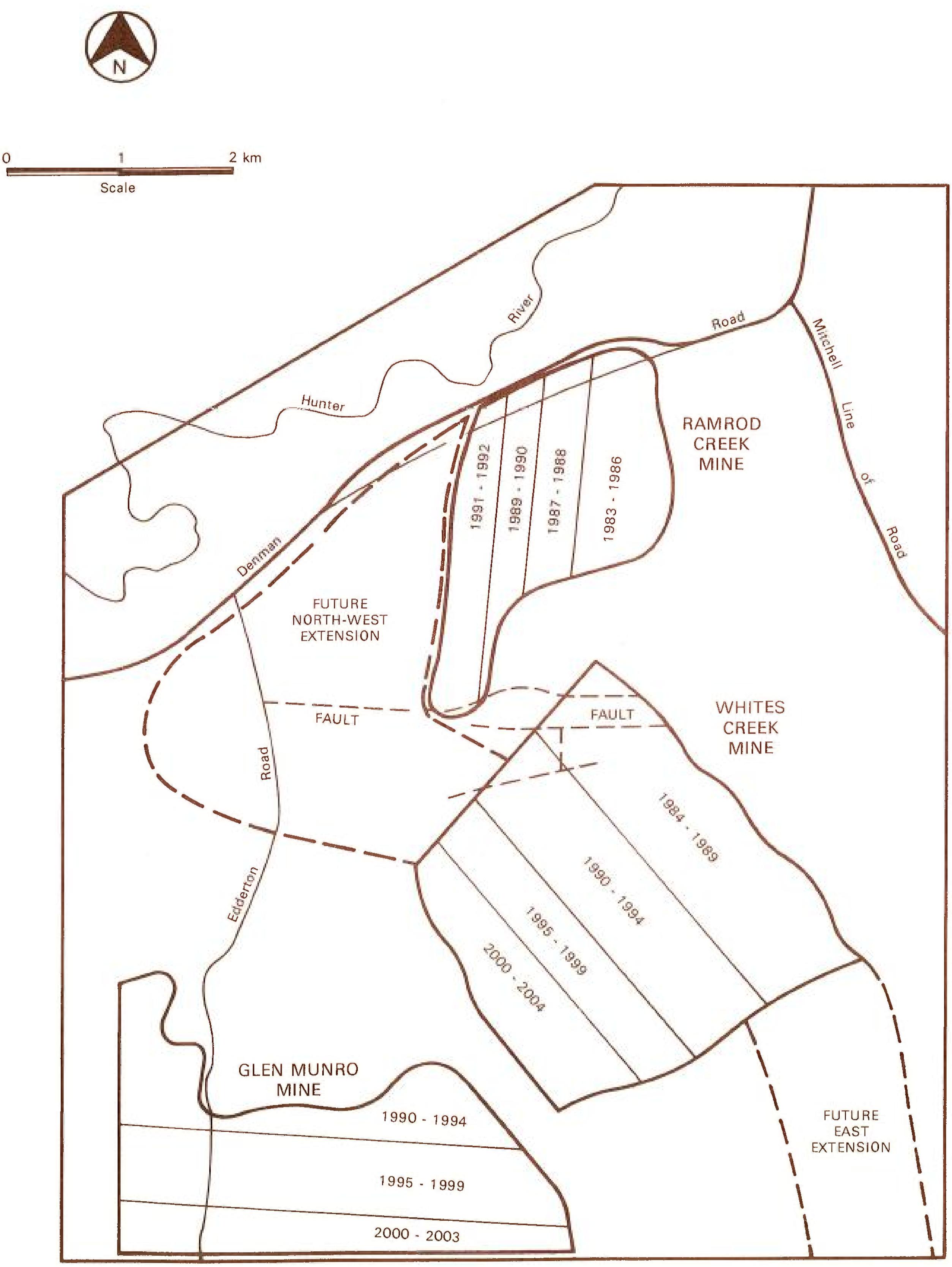


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-2

OPERATIONS FLOW CHART

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

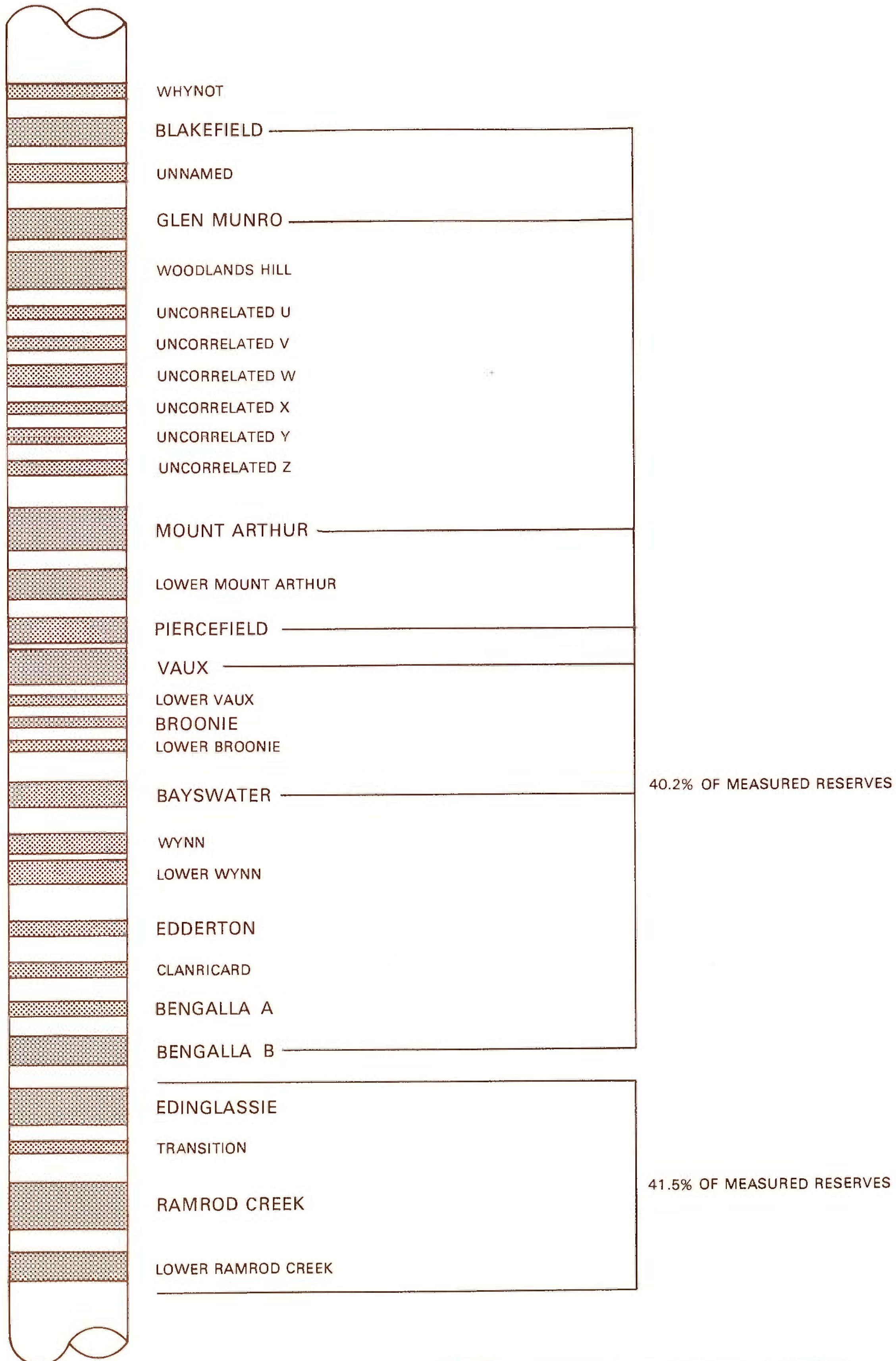


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-3

MINE DEVELOPMENT

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



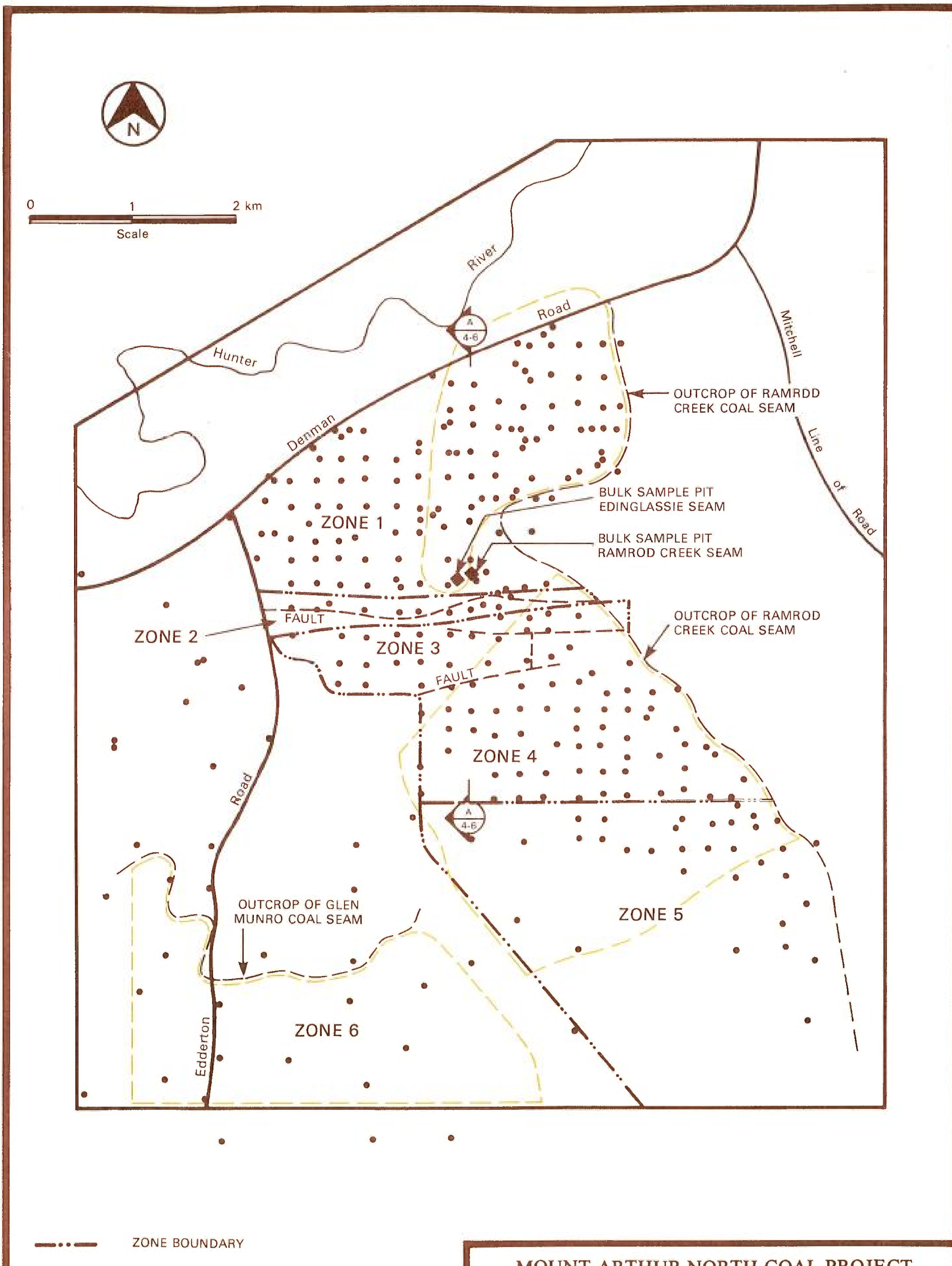
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-4

GENERALIZED STRATIGRAPHIC SECTION

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PAUL WEIR COMPANY



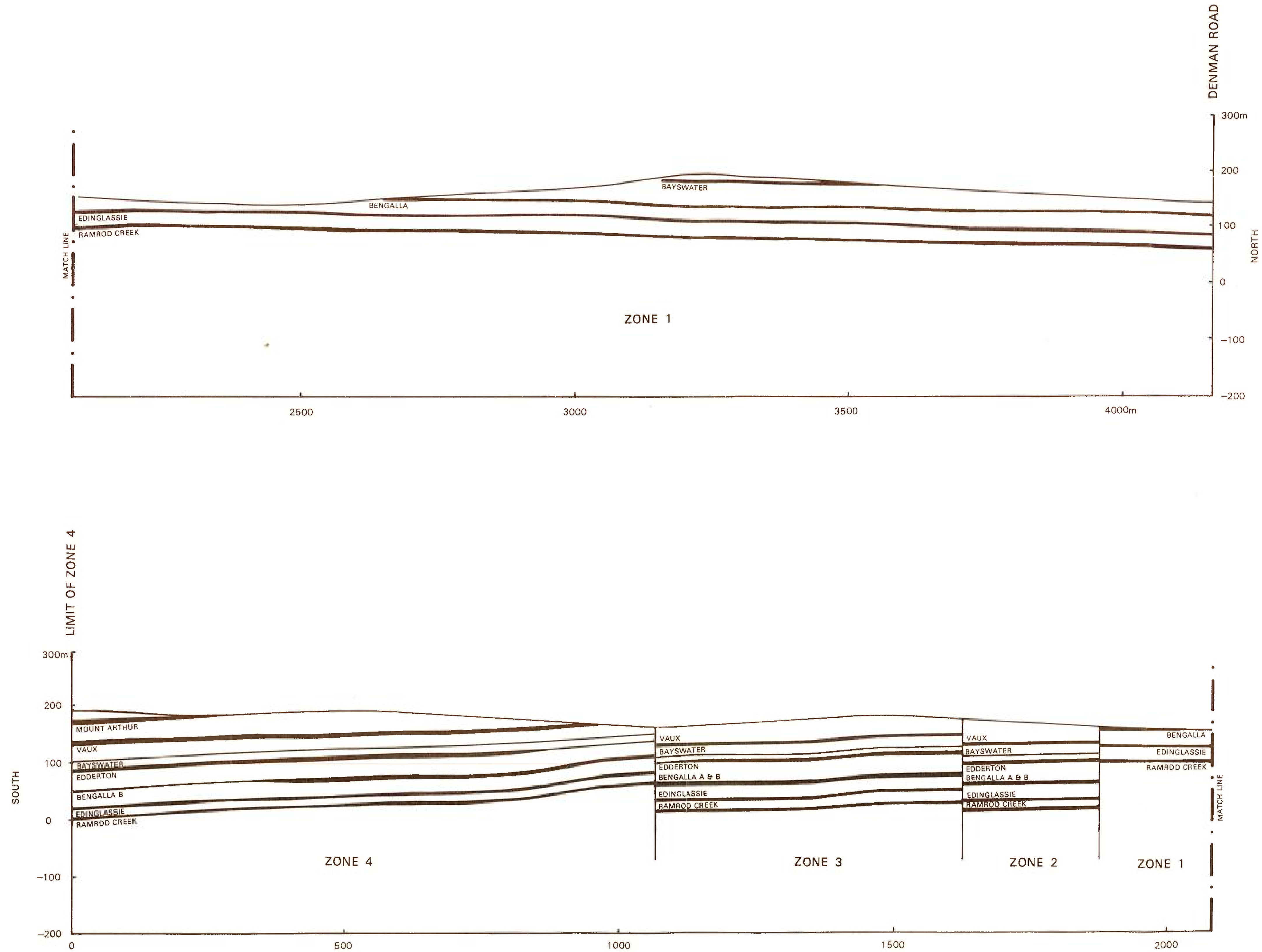
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-5

COAL ZONES OF THE AUTHORISATION

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PAUL WEIR COMPANY



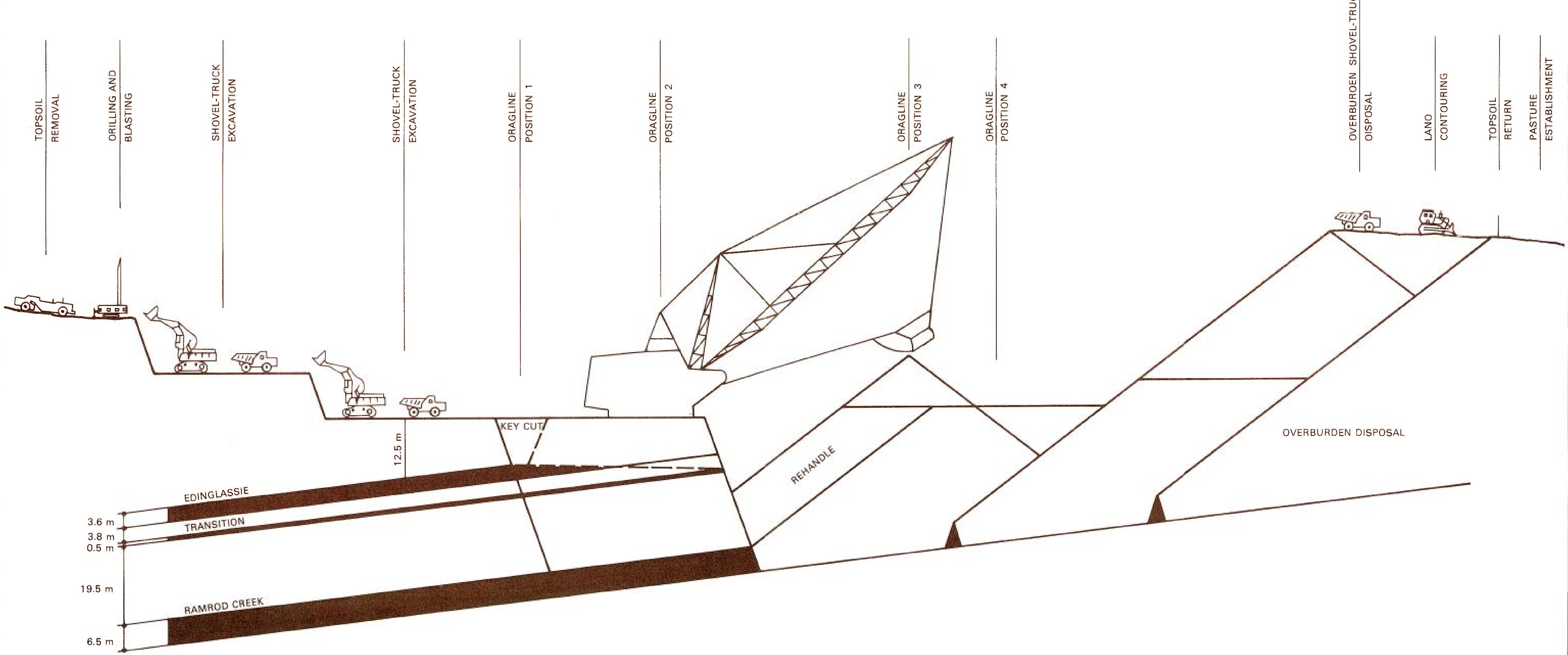
SECTION A / 4-5

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-6

NORTH - SOUTH GEOLOGICAL CROSS-SECTION

SINCLAIR KNIGHT AND PARTNERS PTY. LTD.

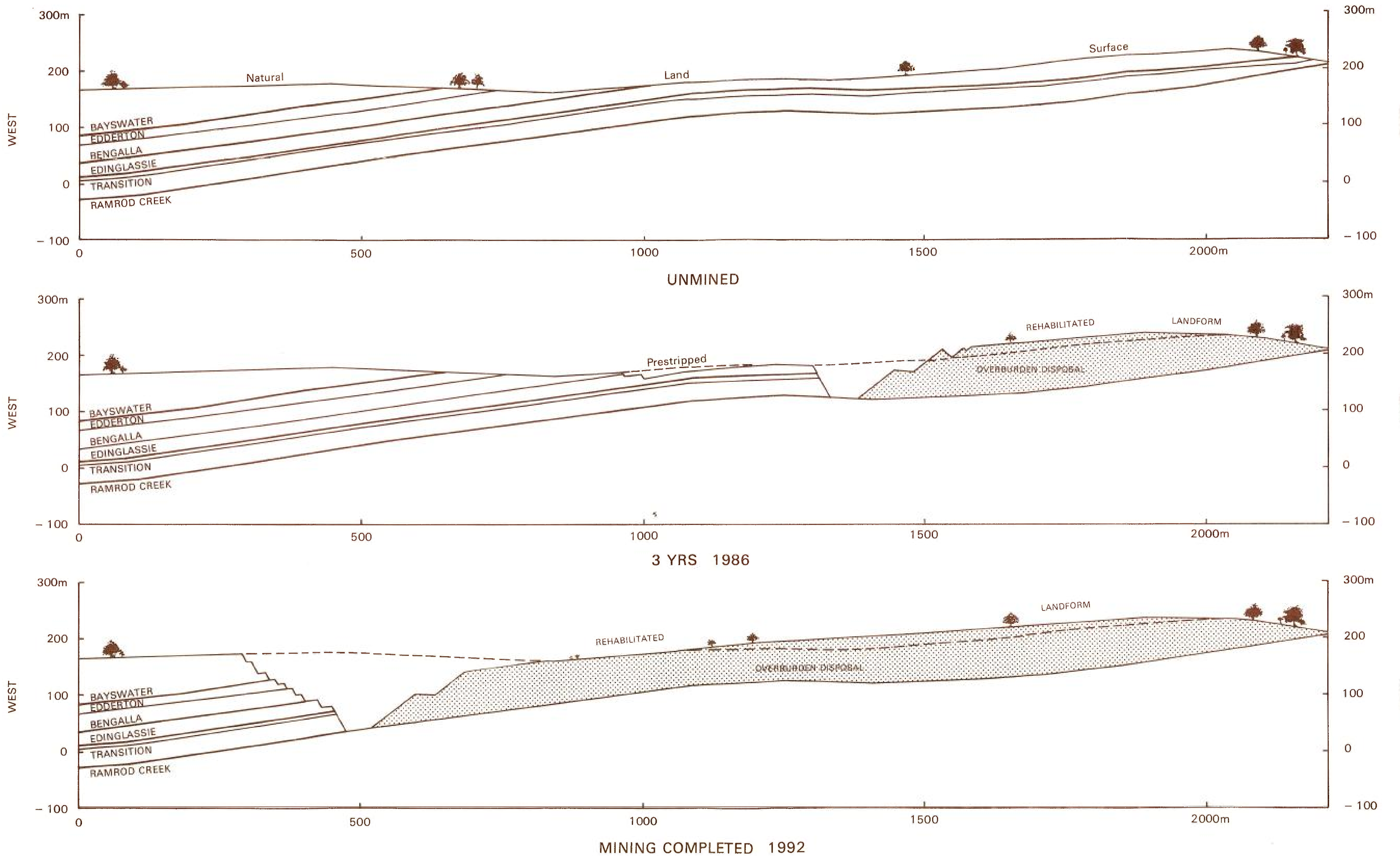


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-7

TYPICAL SECTION RAMROD CREEK MINE

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

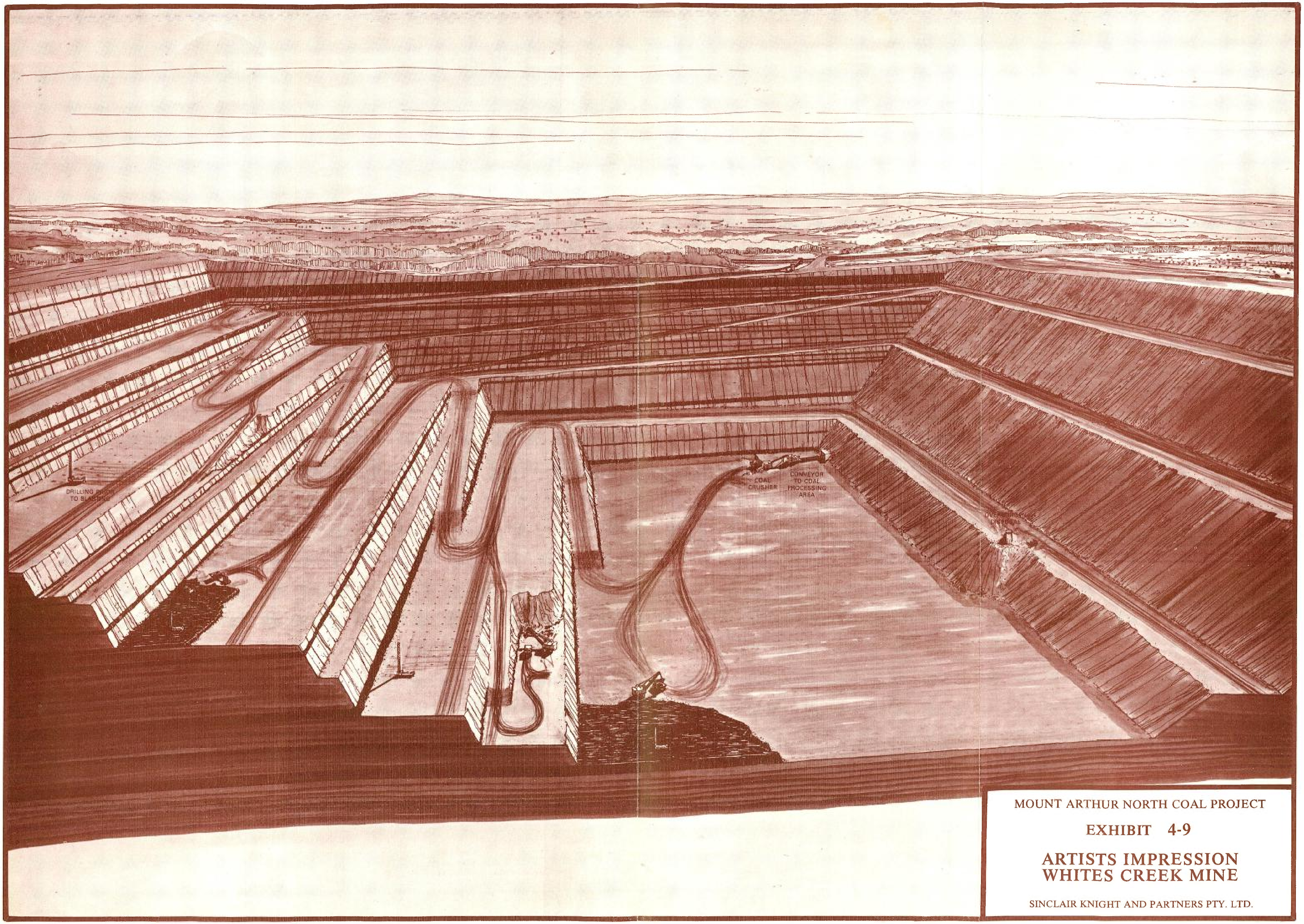


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-8

MINE SEQUENCE RAMROD CREEK MINE

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

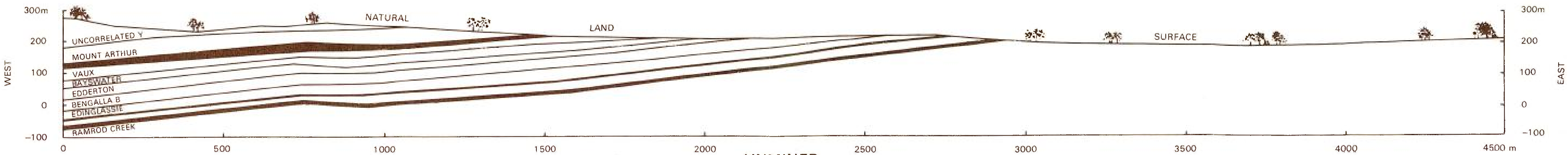


MOUNT ARTHUR NORTH COAL PROJECT

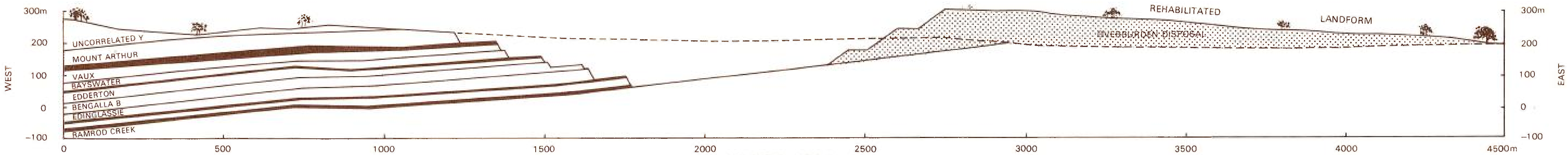
EXHIBIT 4-9

ARTISTS IMPRESSION WHITES CREEK MINE

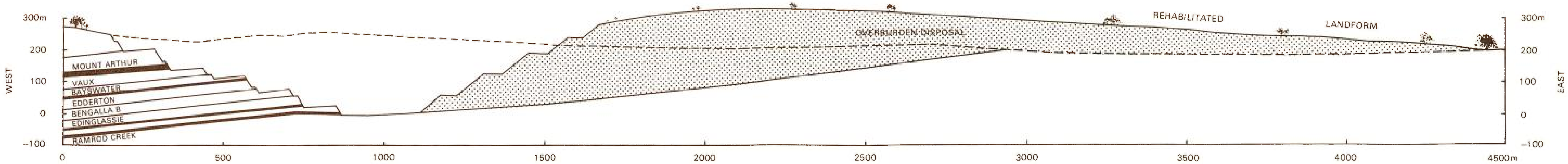
SINCLAIR KNIGHT AND PARTNERS PTY. LTD.



UNMINED



10 YRS 1994



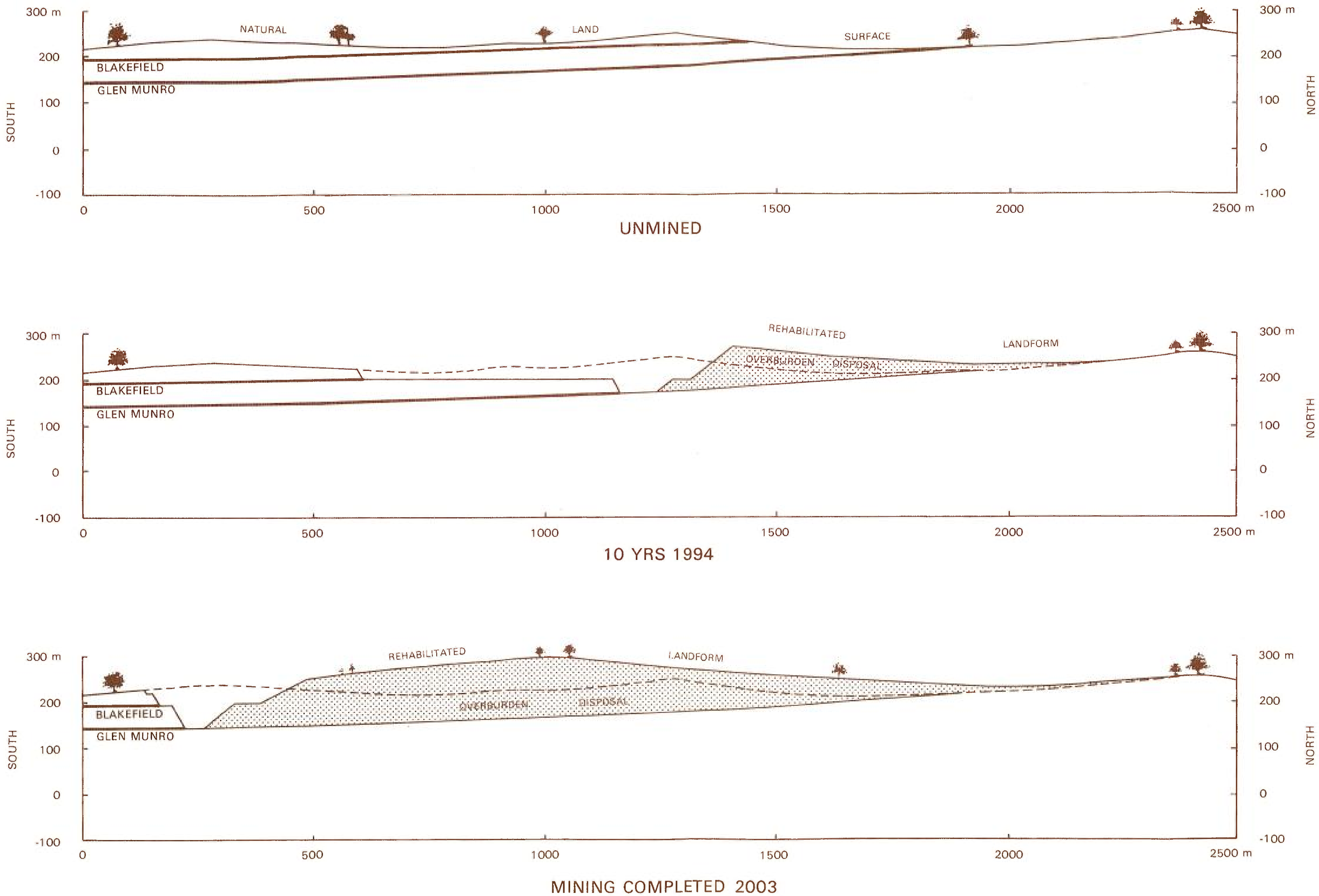
MINING COMPLETED 2004

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-10

MINE SEQUENCE WHITES CREEK MINE

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

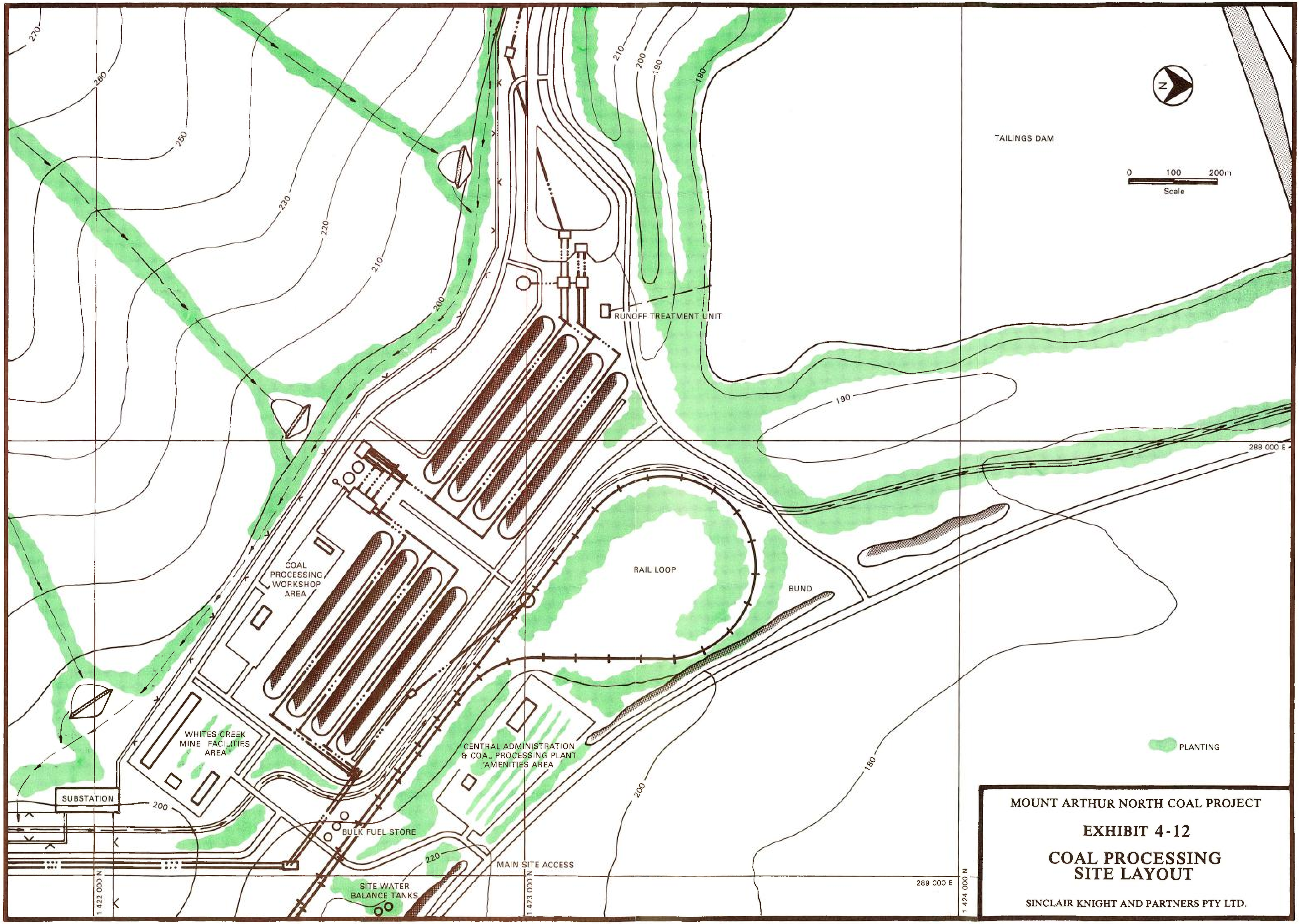


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-11

MINE SEQUENCE GLEN MUNRO MINE

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

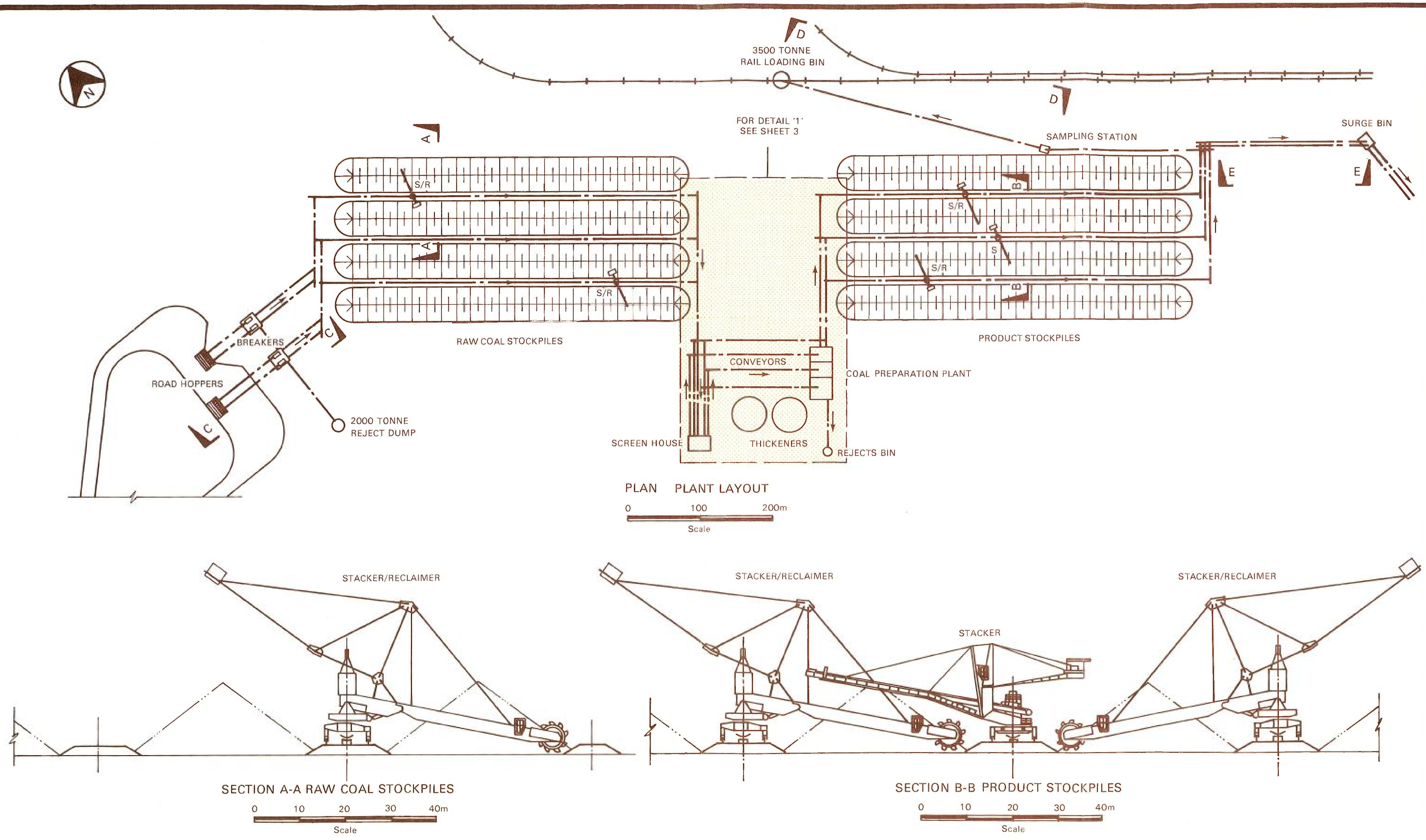


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-12

COAL PROCESSING SITE LAYOUT

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



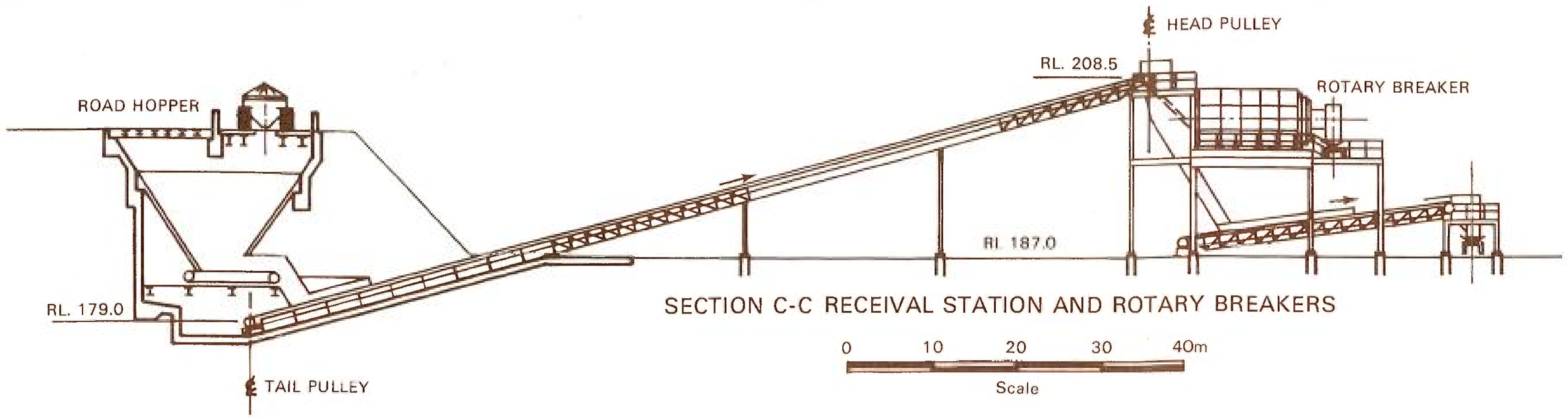
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-13

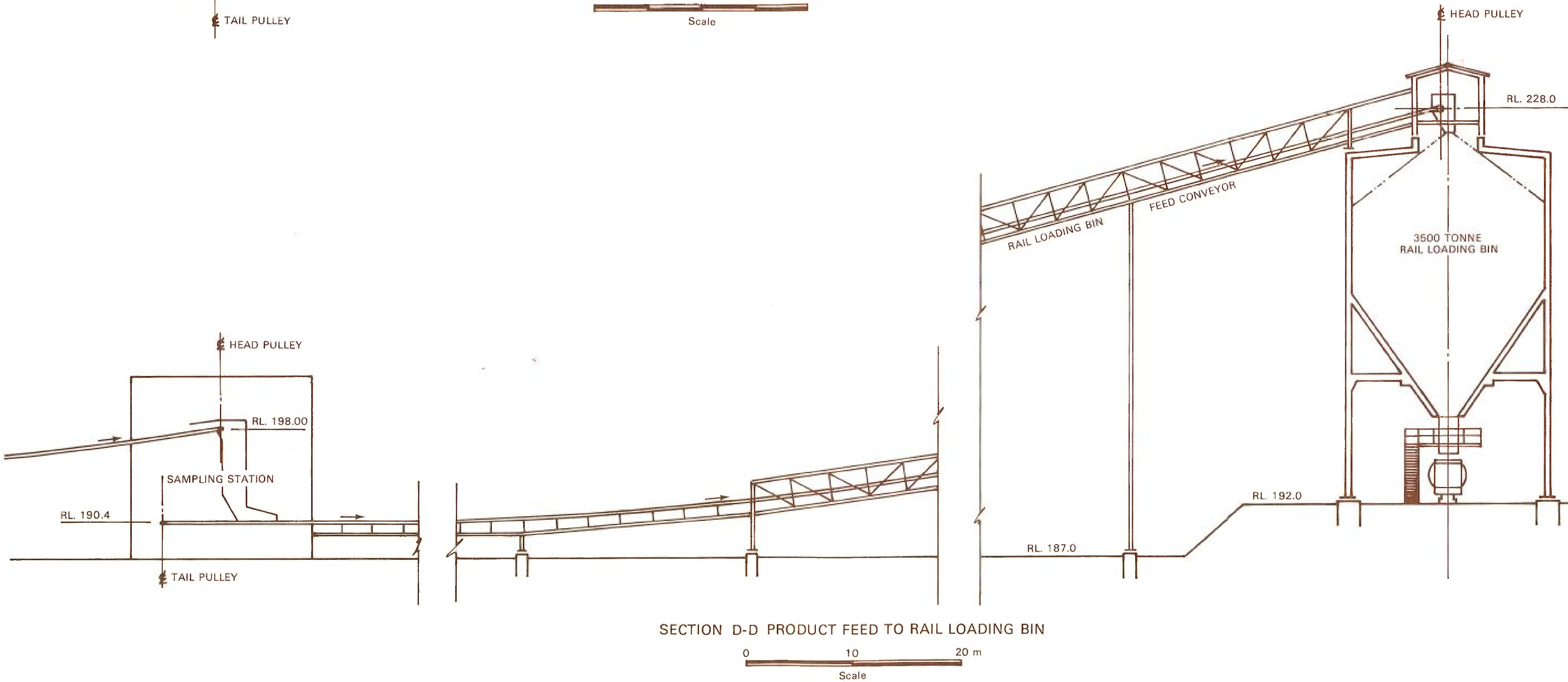
COAL PROCESSING PLANT DETAILS - SHEET 1

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

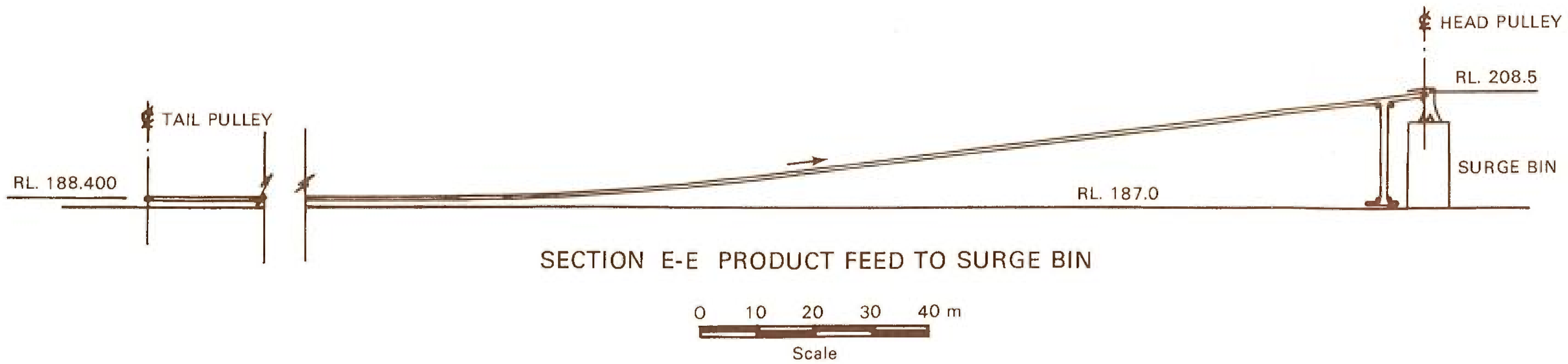
SOURCE: PLANNER WEST PTY LTD



SECTION C-C RECEIVAL STATION AND ROTARY BREAKERS



SECTION D-D PRODUCT FEED TO RAIL LOADING BIN



SECTION E-E PRODUCT FEED TO SURGE BIN

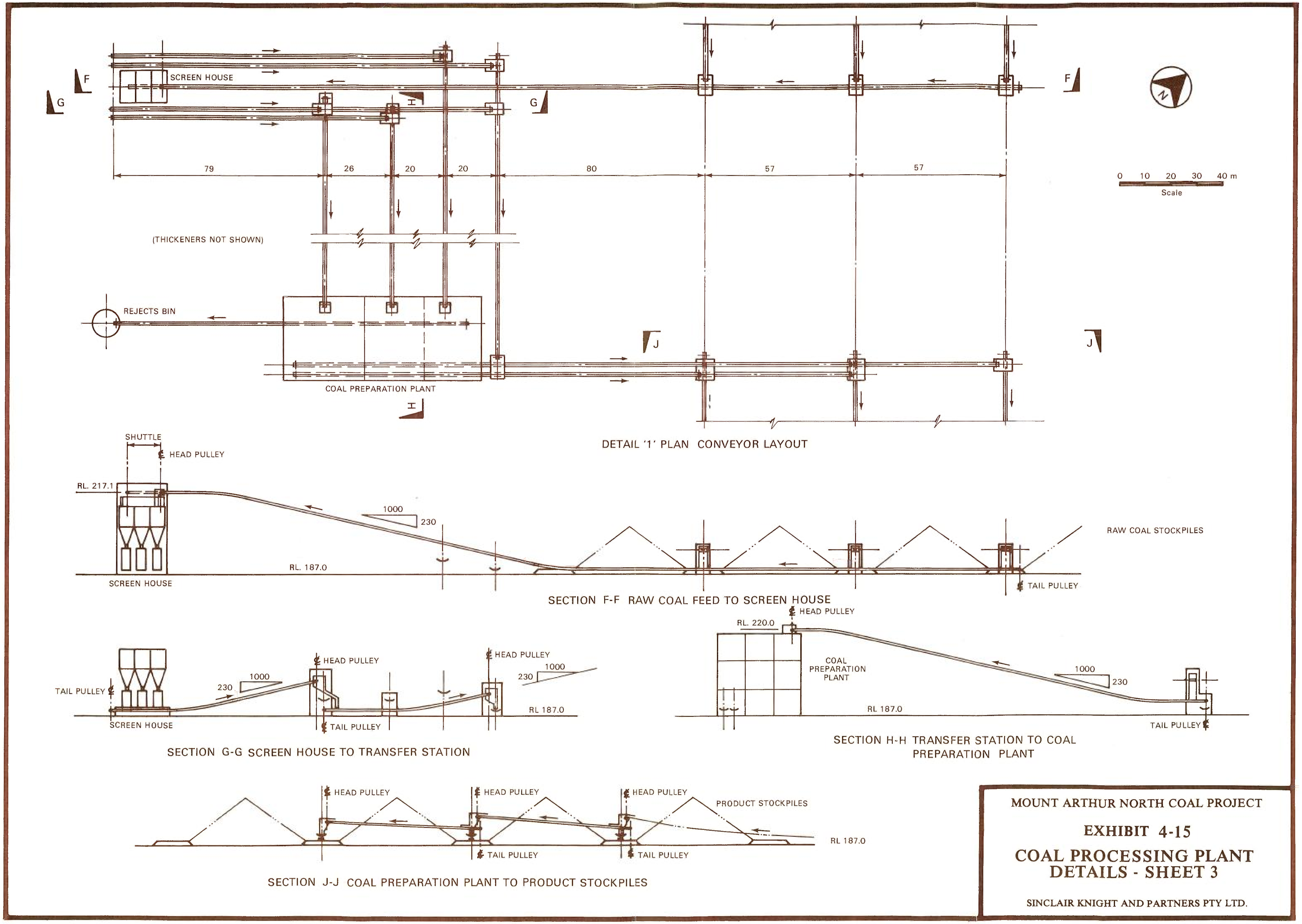
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-14

COAL PROCESSING PLANT DETAILS - SHEET 2

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PLANNER WEST PTY LTD



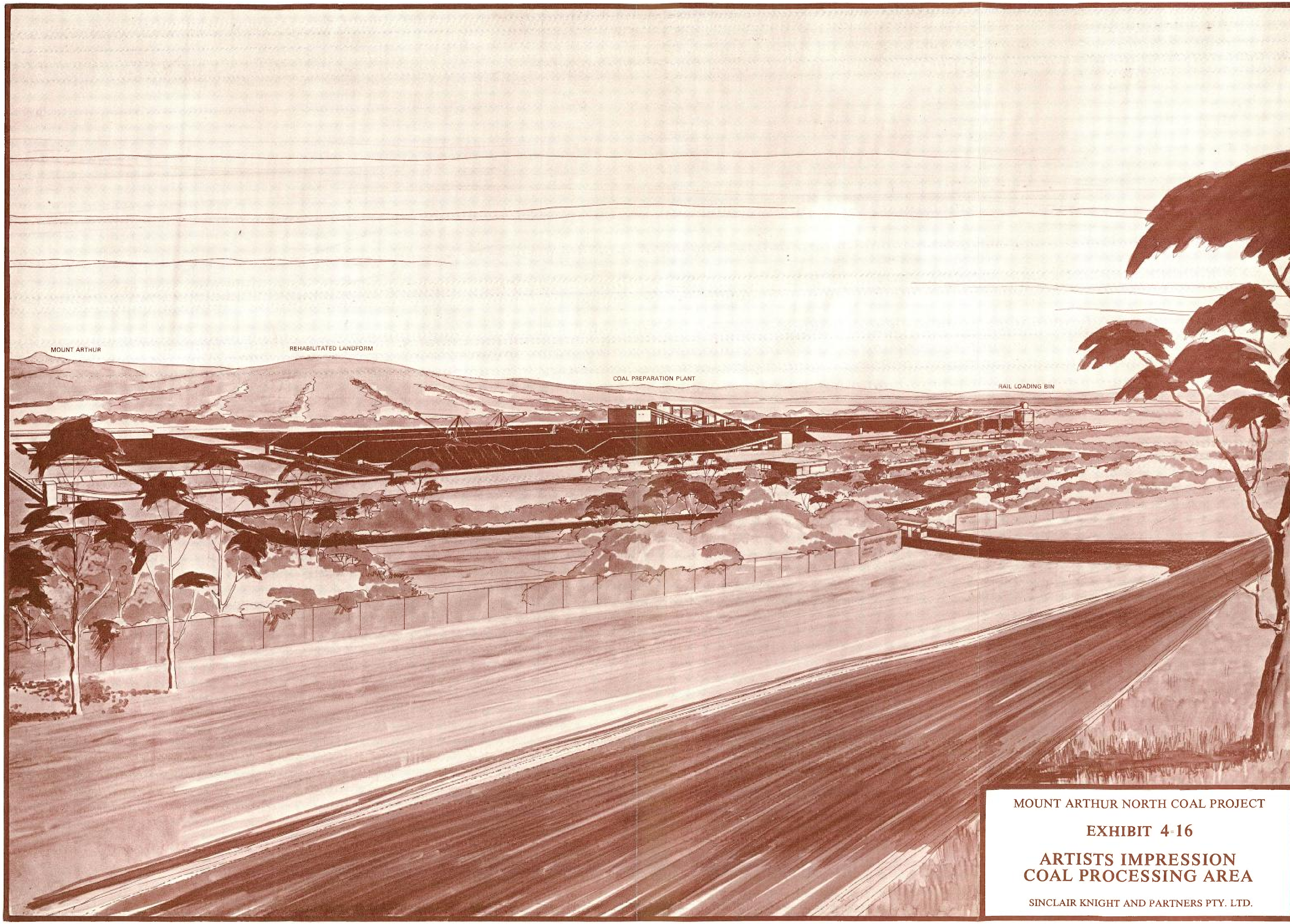
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-15

COAL PROCESSING PLANT DETAILS - SHEET 3

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PLANNER WEST PTY LTD

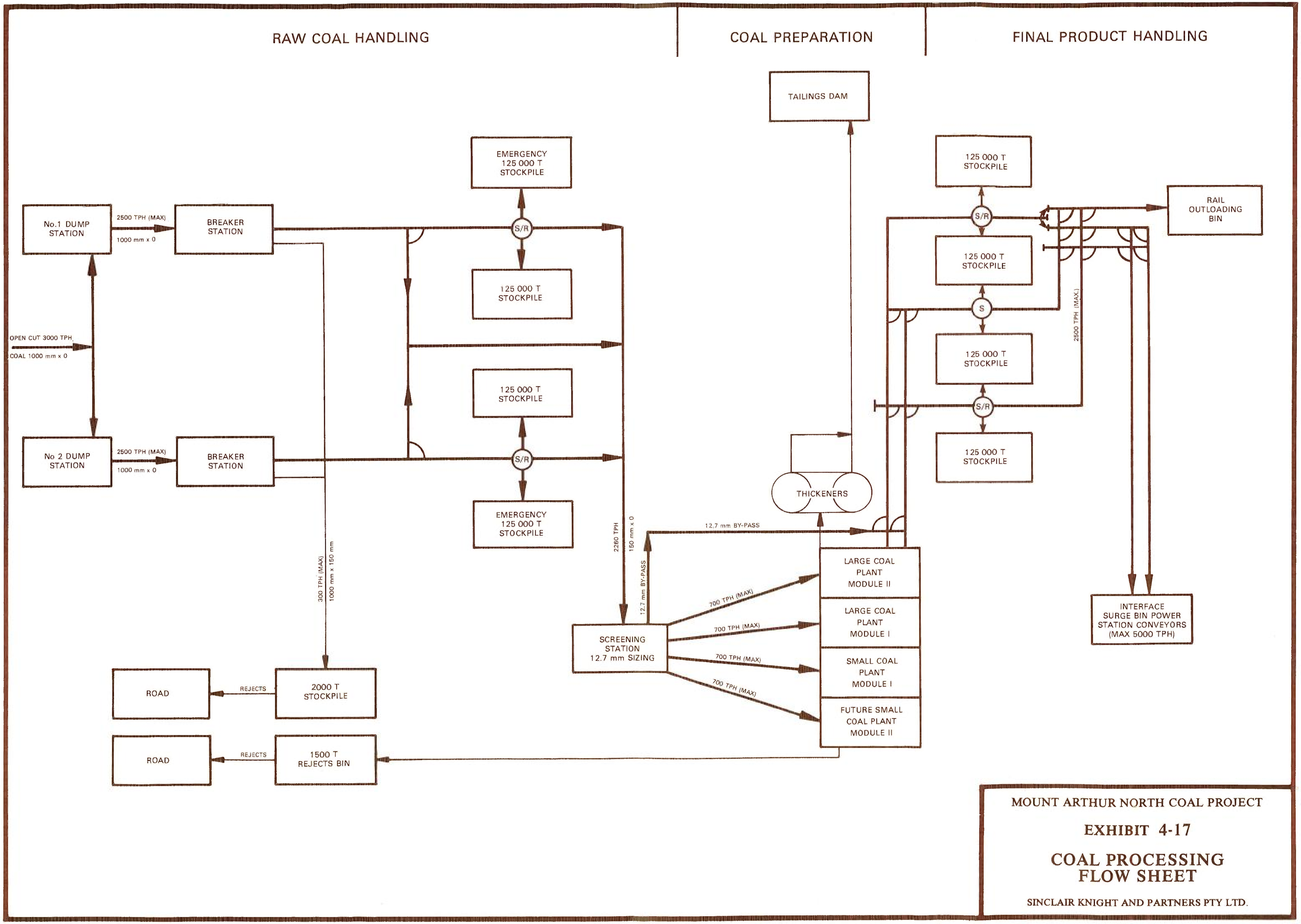


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-16

ARTISTS IMPRESSION
COAL PROCESSING AREA

SINCLAIR KNIGHT AND PARTNERS PTY. LTD.



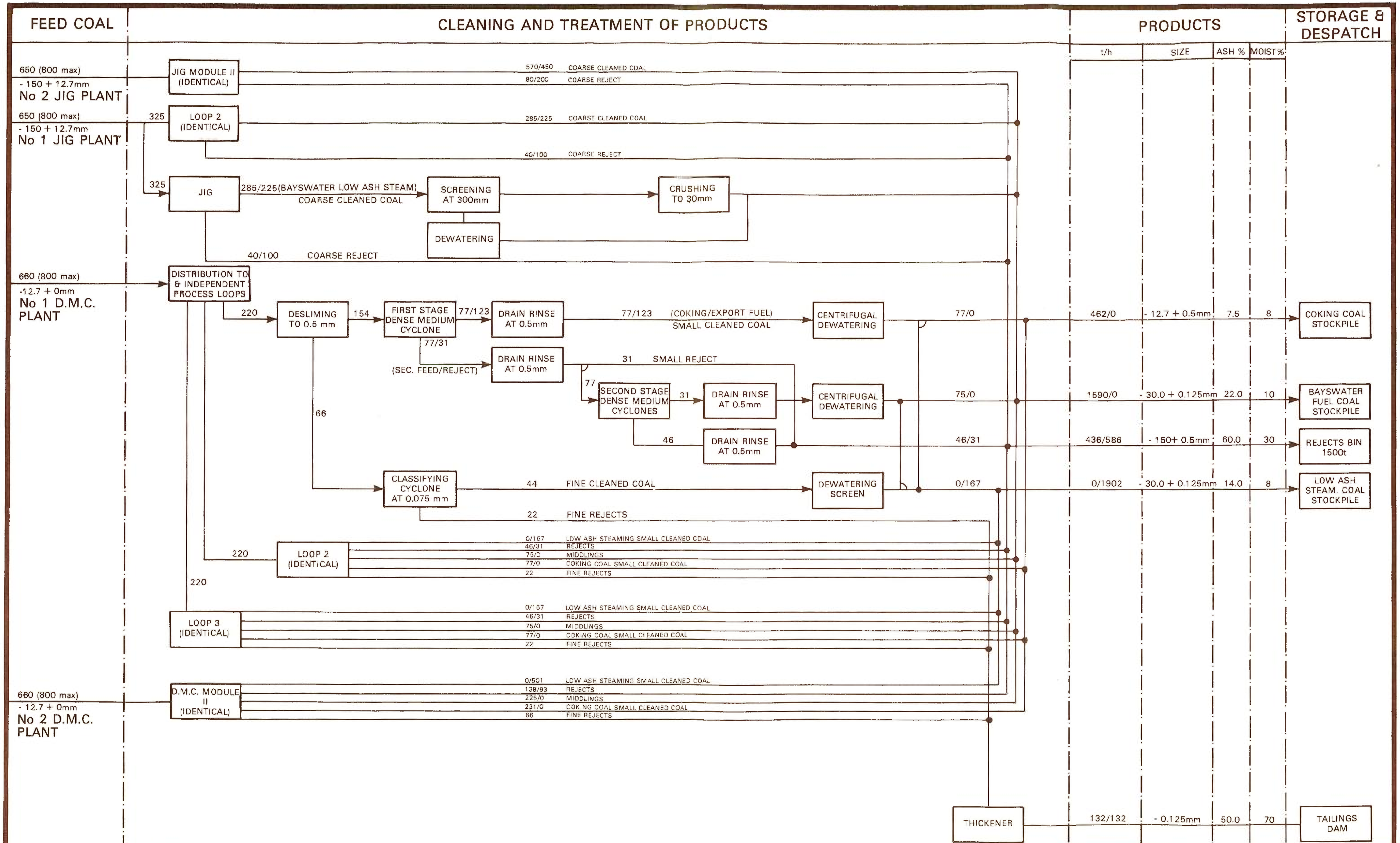
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-17

COAL PROCESSING FLOW SHEET

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PLANNER WEST PTY LTD



NOTE

1. 570/450 REPRESENTS 570 t/h WHEN THE COAL PREPARATION PLANT IS PRODUCING COKING COAL AND 450 t/h WHEN THE COAL PREPARATION PLANT IS PRODUCING LOW ASH STEAMING COAL

2. NO BAYSWATER FUEL COAL IS PRODUCED WHEN LOW ASH STEAMING COAL IS BEING PRODUCED.

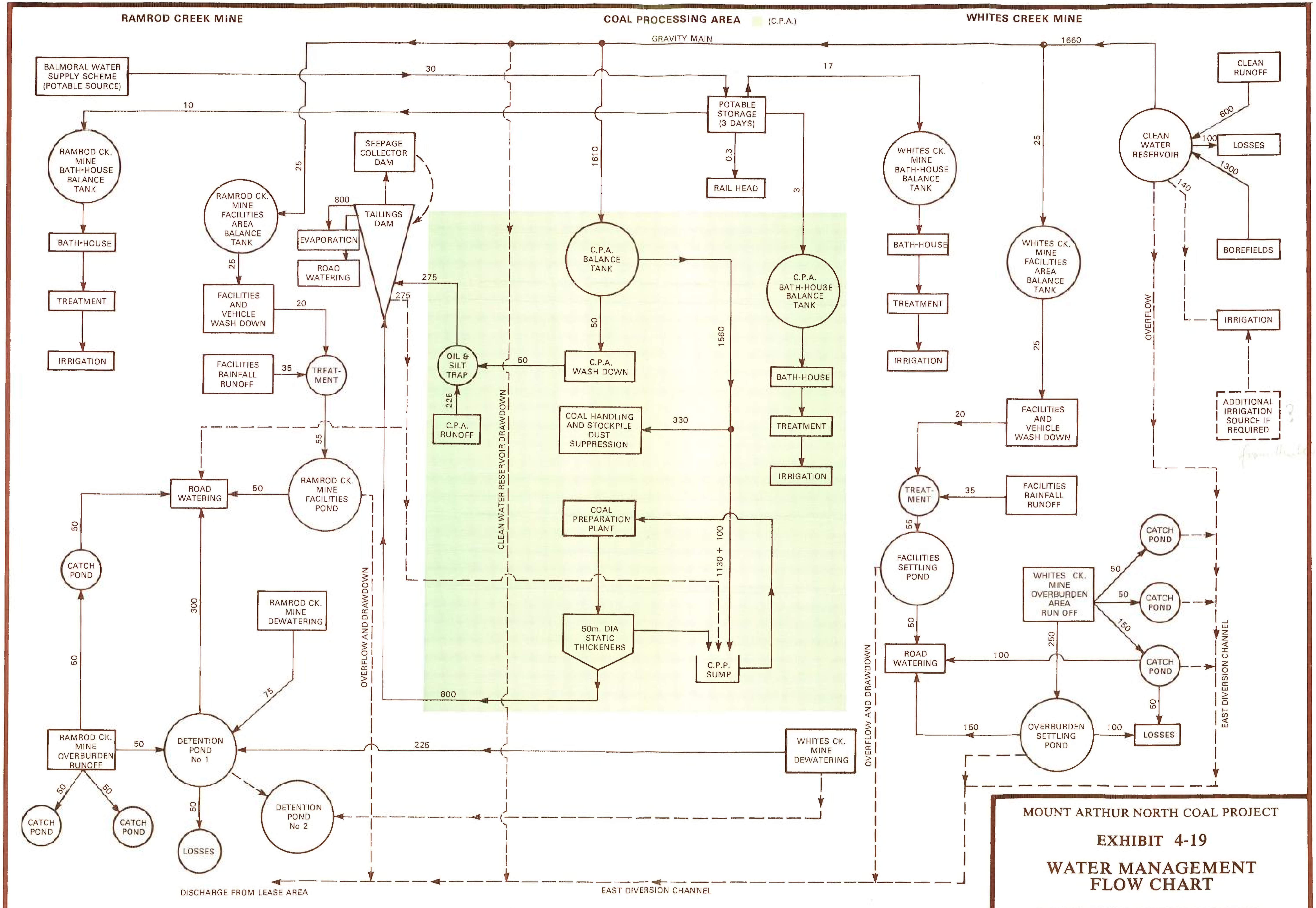
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-18

COAL PREPARATION PROCESS FLOW SHEET

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PLANNER WEST PTY LTD



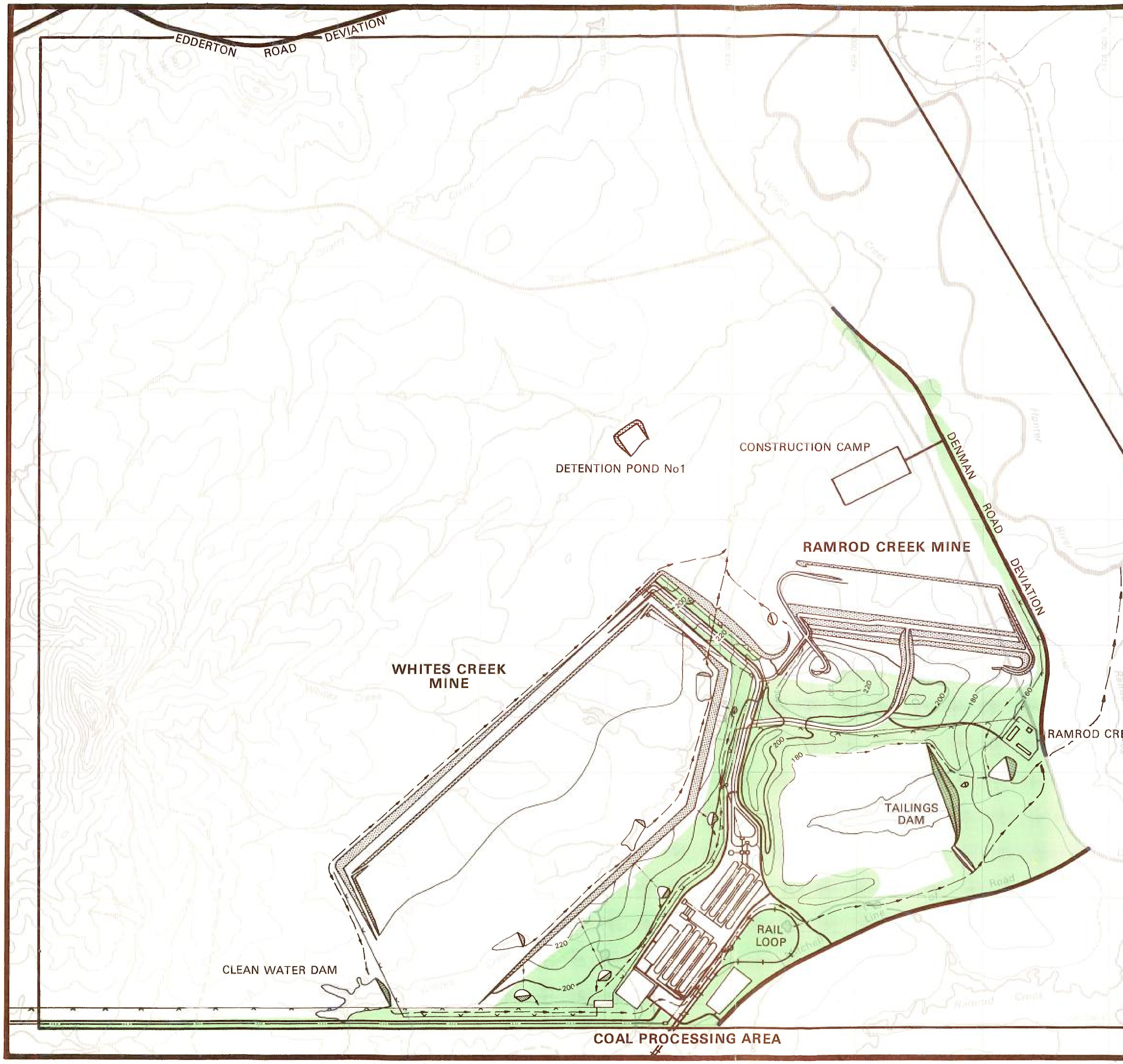
NOTE NUMBERS ARE AVERAGE ANNUAL FLOWS (ML)

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-19

WATER MANAGEMENT FLOW CHART

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

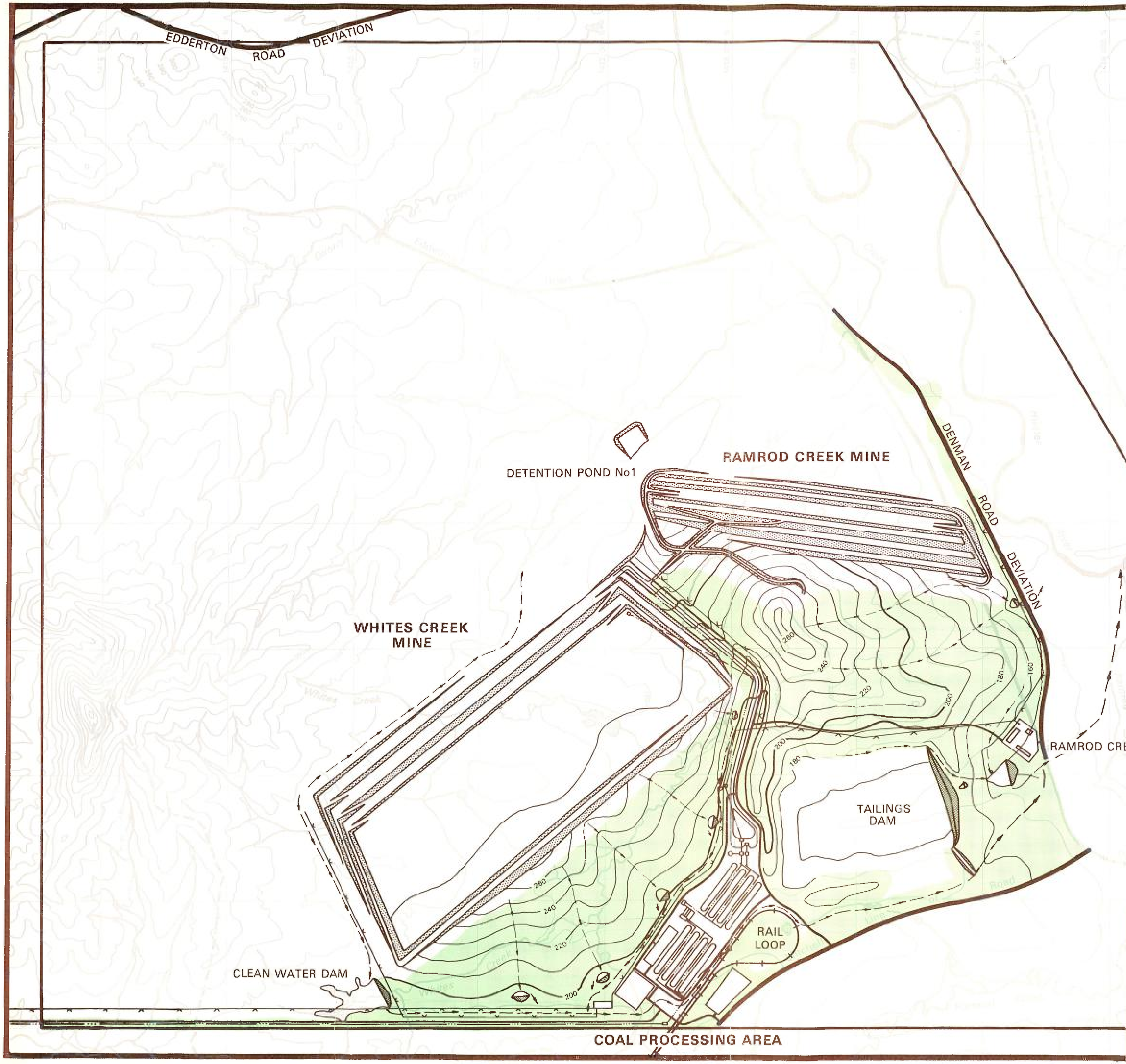


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-20

SITE DEVELOPMENT – 1986

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

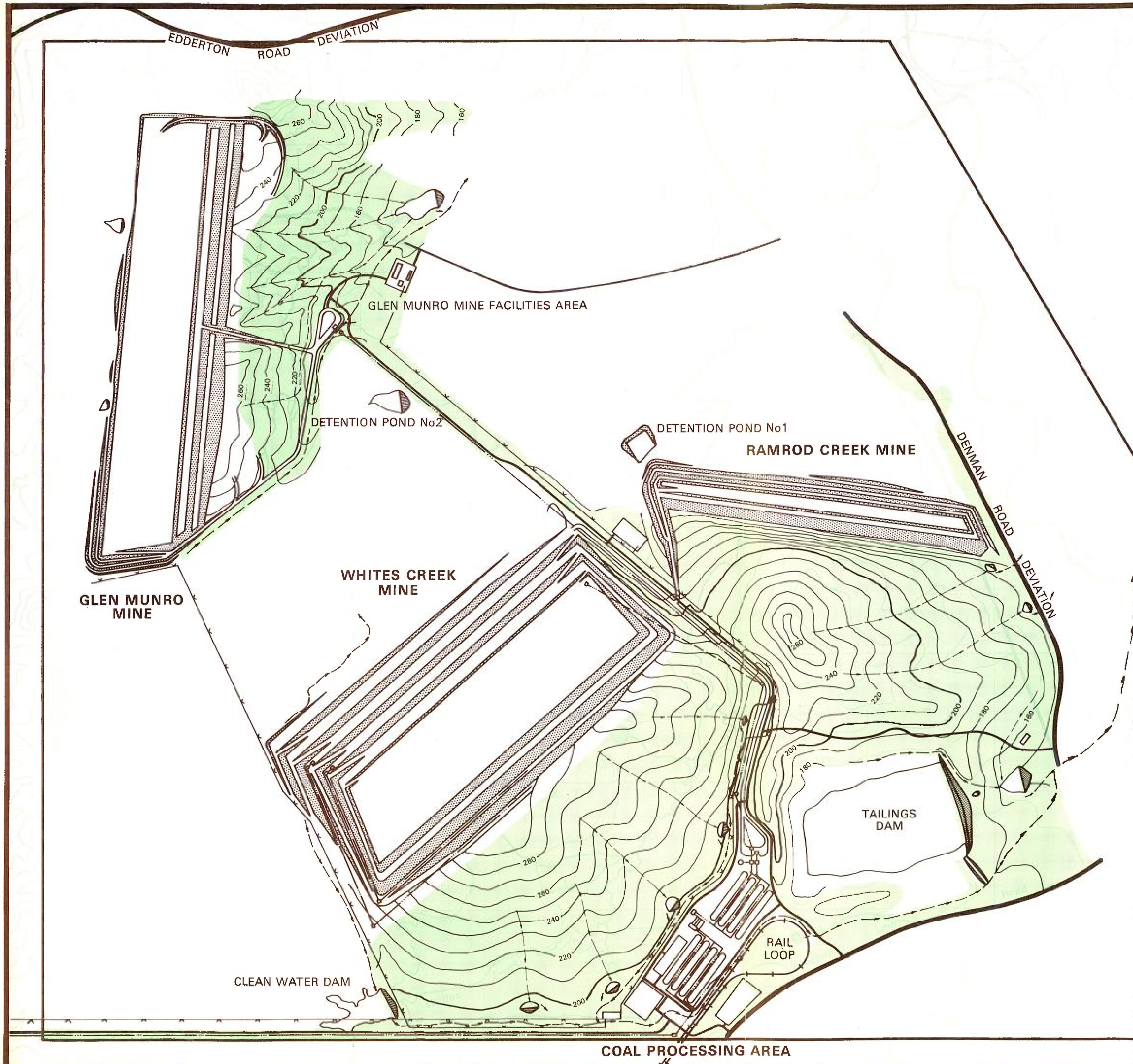


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-21

SITE DEVELOPMENT – 1990

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-22

SITE DEVELOPMENT – 1994

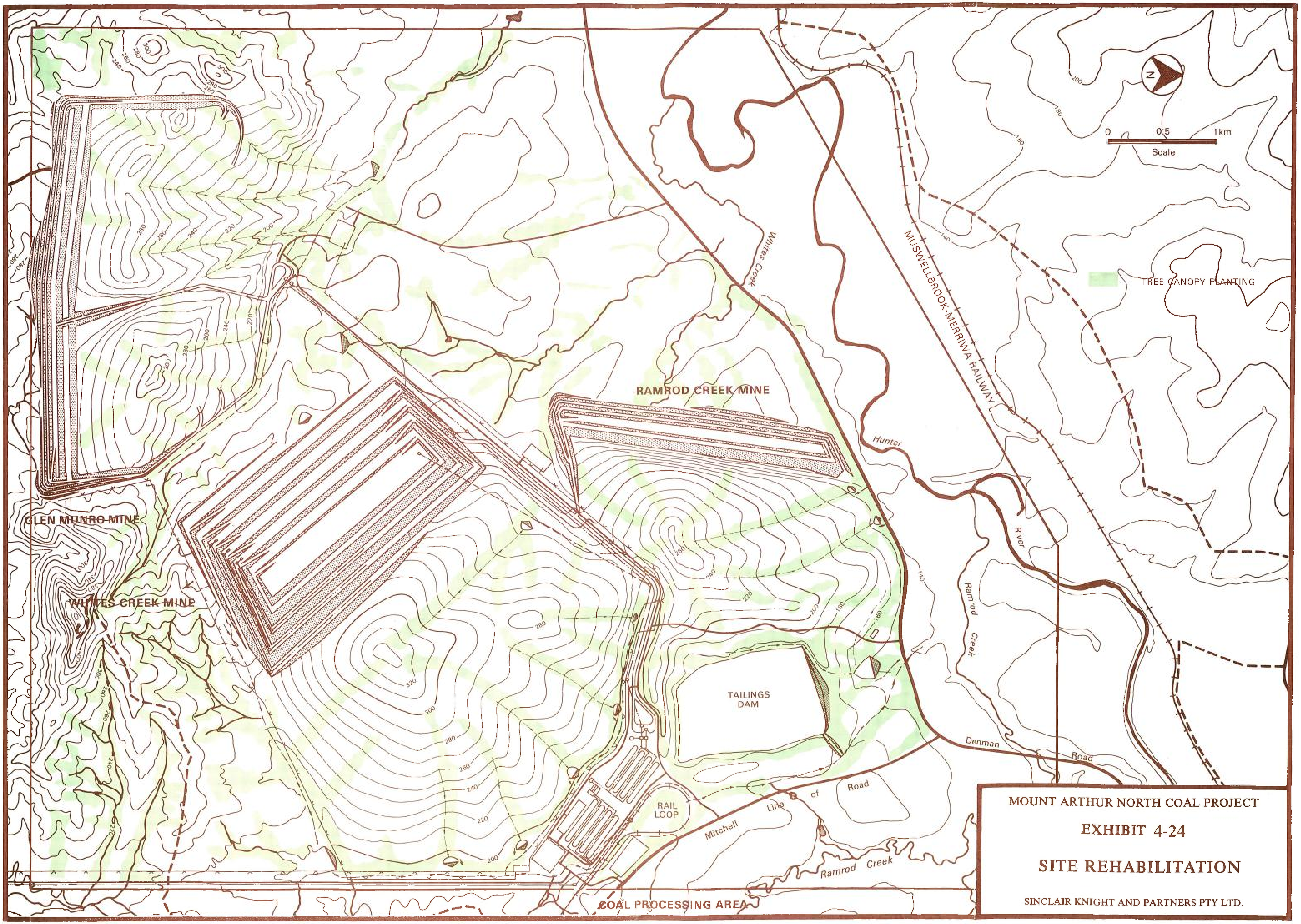
SINCLAIR KNIGHT AND PARTNERS PTY LTD.

MOUNT ARTHUR NORTH COAL PROJECT

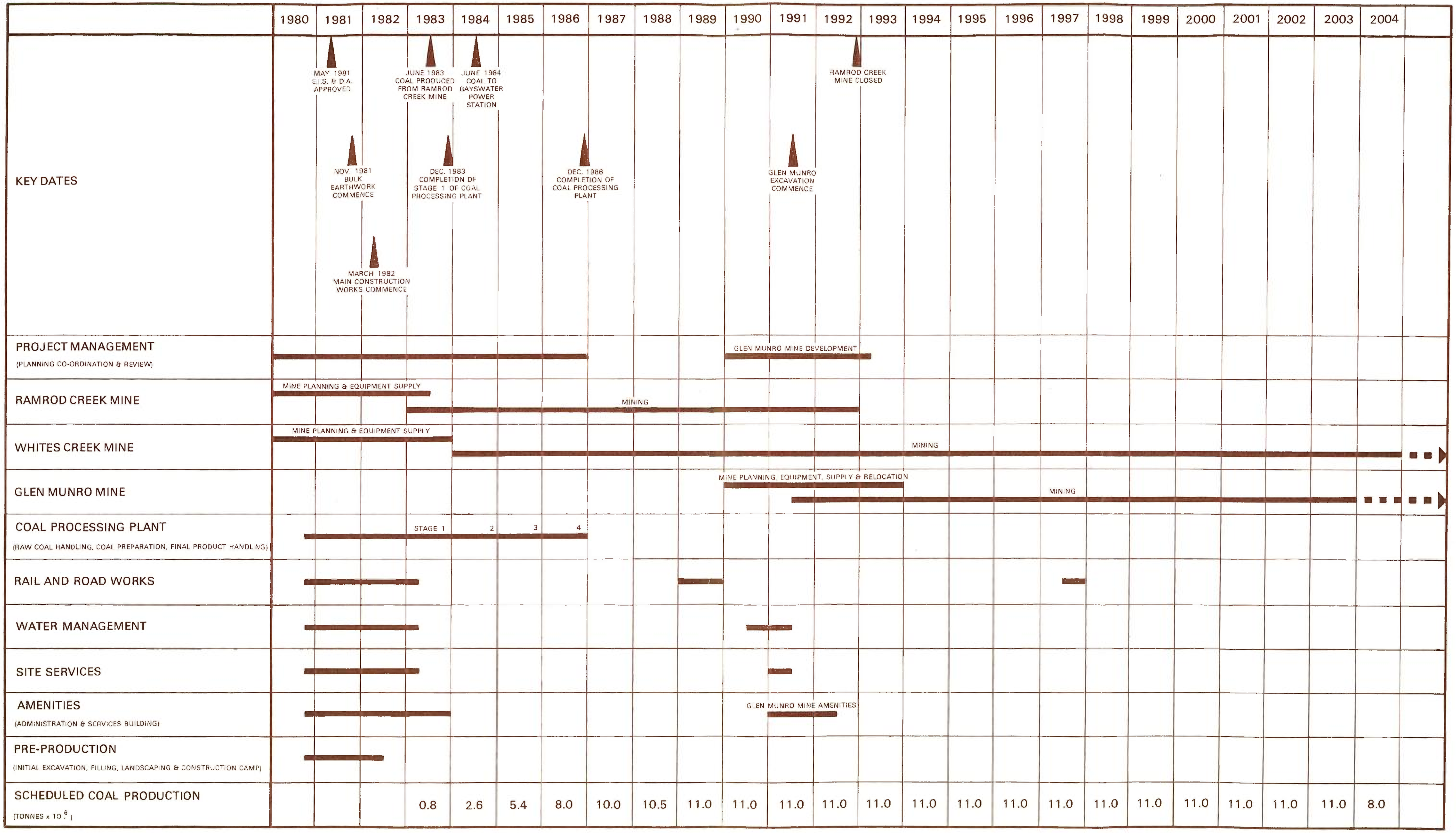
EXHIBIT 4-23

SITE DEVELOPMENT – 2004

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



MOUNT ARTHUR NORTH COAL PROJECT
EXHIBIT 4-24
SITE REHABILITATION
SINCLAIR KNIGHT AND PARTNERS PTY LTD.
TREE CANOPY PLANTING
0
0.5
1km
Scale
N
RAMROD CREEK MINE
GLEN MUNRO MINE
WHITES CREEK MINE
TAILINGS DAM
RAIL LOOP
COAL PROCESSING AREA
MUSWELLBROOK-MERRIWA RAILWAY
Whites Creek
Hunter River
Ramrod Creek
Denman Road
Mitchell Line of Road
Ramrod Creek



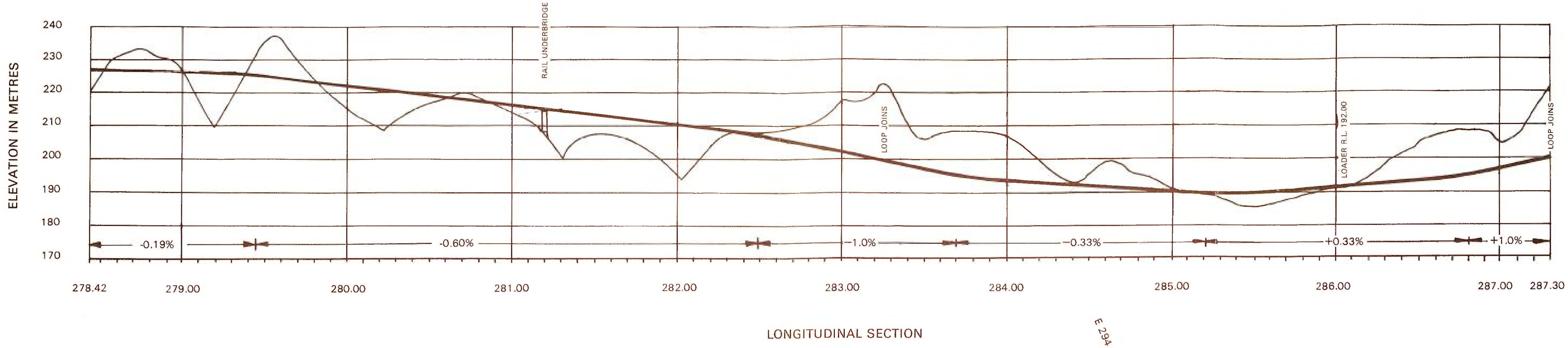
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-25

DEVELOPMENT PROGRAMME

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: GUTTERIDGE HASKINS & DAVEY PTY LTD.



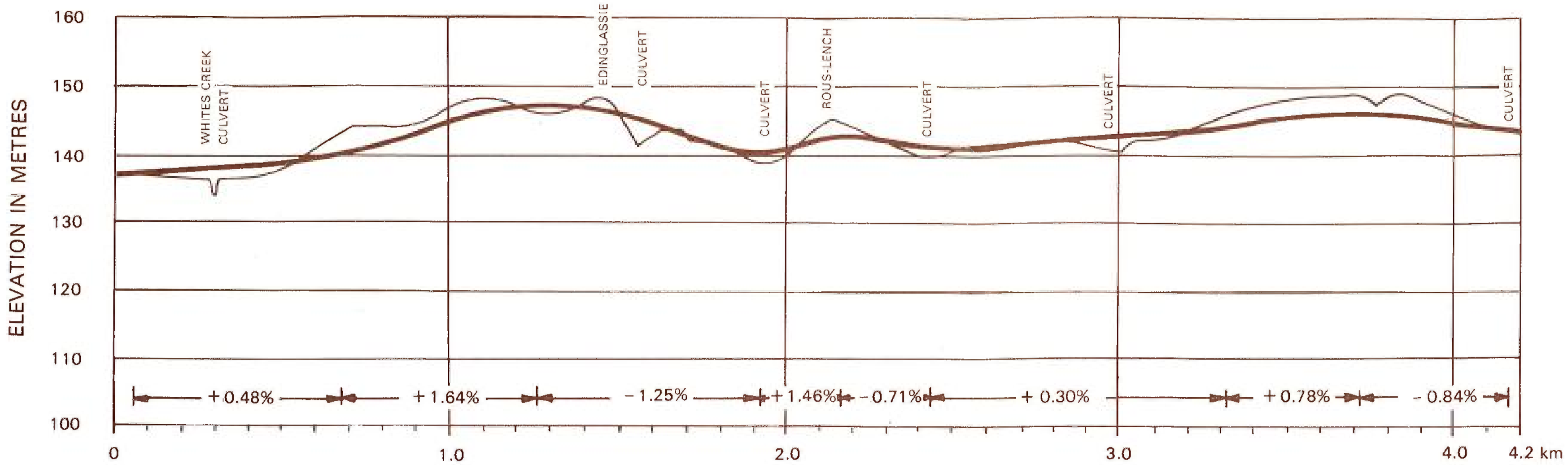
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-26

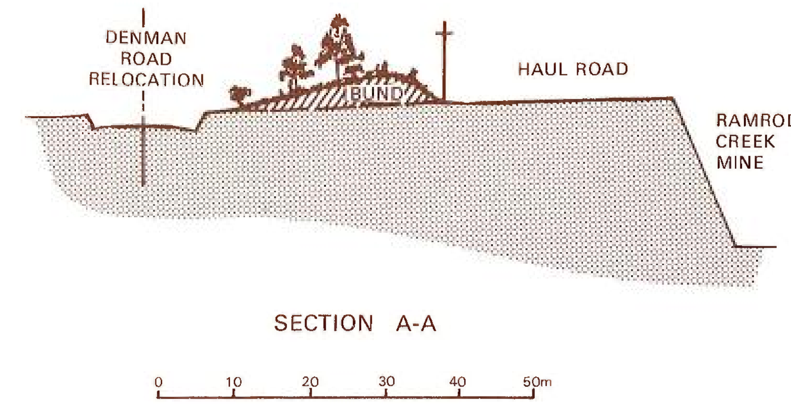
RAIL SPUR EXTENSION

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: GUTTERIDGE HASKINS & DAVEY PTY LTD

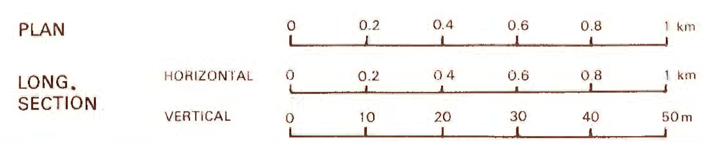


LONGITUDINAL SECTION



SECTION A-A

PLAN



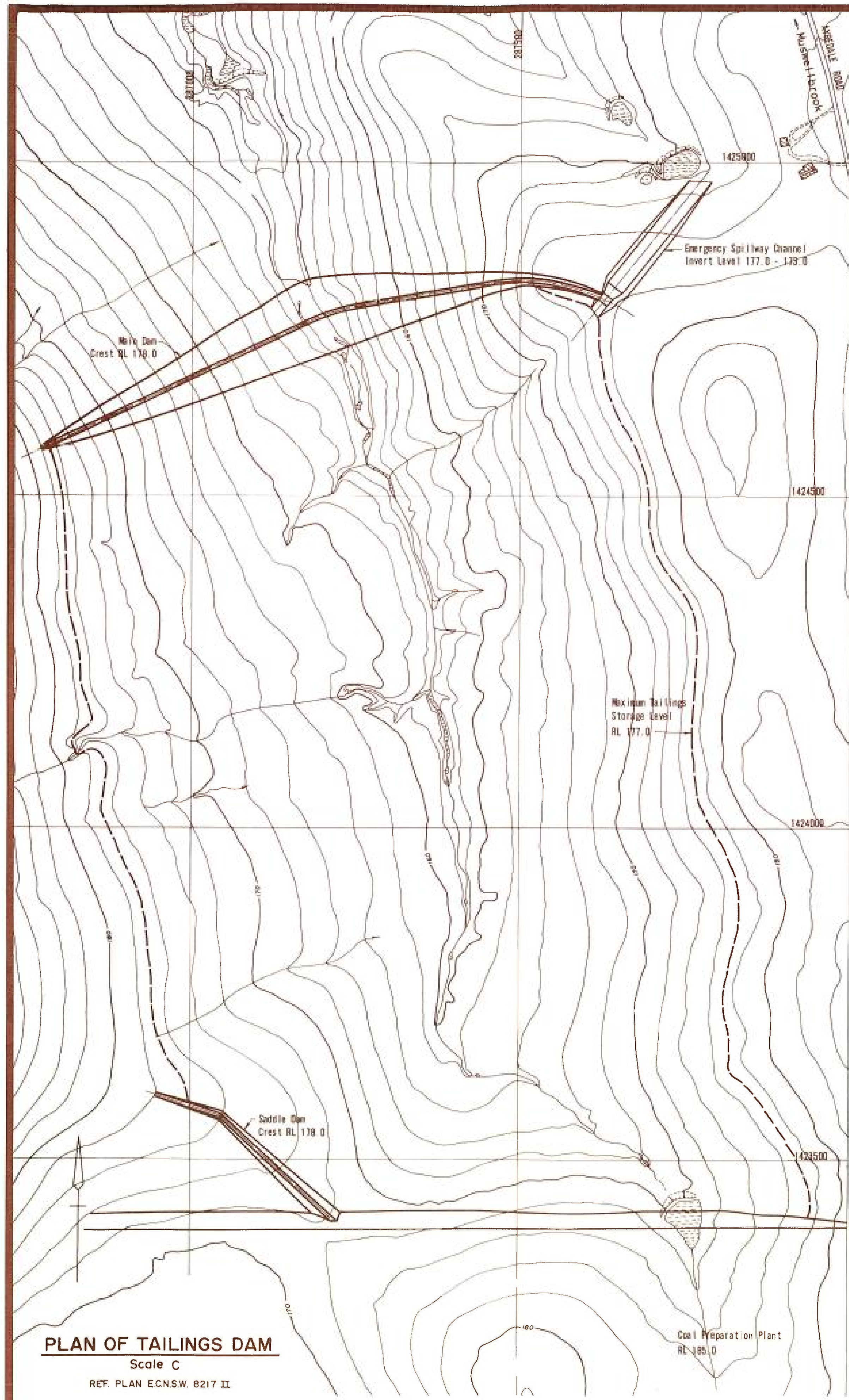
PREPARED BY GUTTERIDGE HASKINS & DAVEY PTY LTD.

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-27

DENMAN ROAD DEVIATION

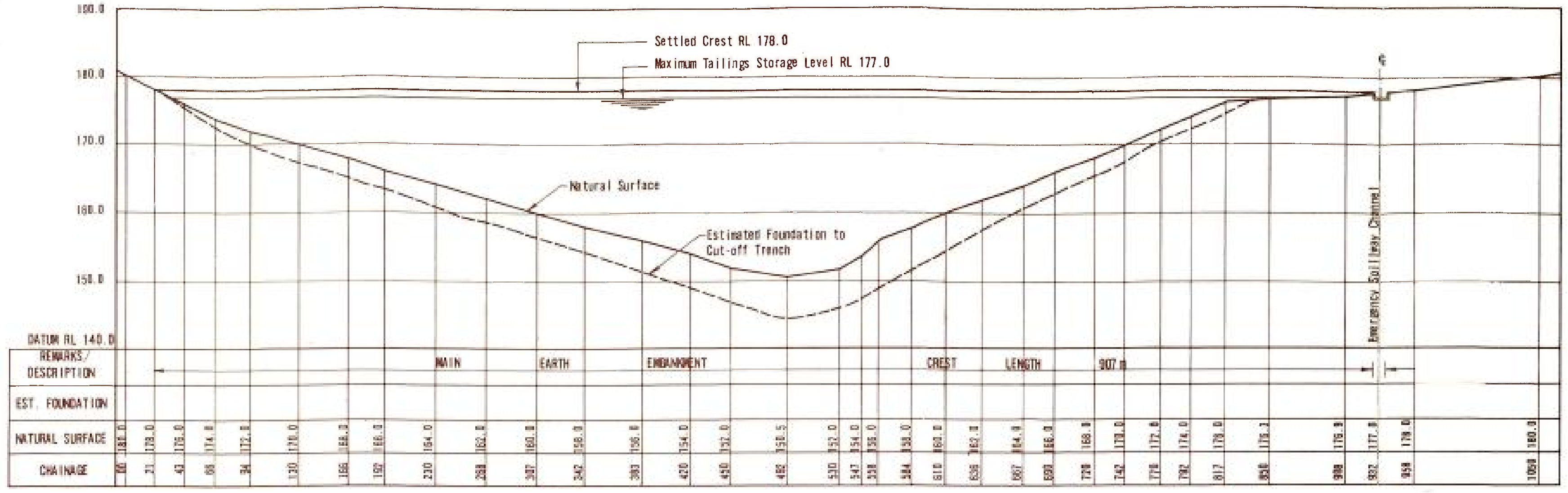
SINCLAIR KNIGHT AND PARTNERS PTY LTD.



PLAN OF TAILINGS DAM

Scale C

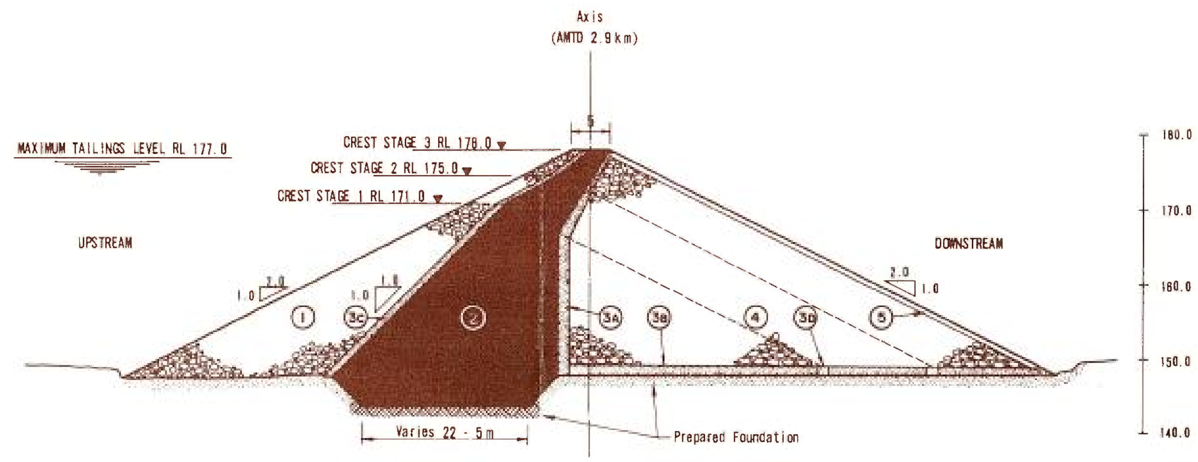
REF. PLAN E.C.N.S.W. 8217 II



LONGITUDINAL SECTION ON AXIS OF DAM

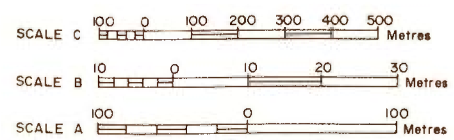
Horizontal Scale A
Vertical Scale B

ZONE	MATERIAL DESCRIPTION
1	Moderately weathered Sandstone and Shale : Random Fill.
2	Impervious Clay : Core
3	Crushed fresh Siltstone or Sandstone : Filters & Drains. (3A & 3C Chimney, 3B & 3C Trench)
4	Moderately - Slightly weathered Siltstone & Sandstone : Random Fill.
5	Topsoil to Grass.



TYPICAL CROSS SECTION FOR STAGE CONSTRUCTION

Scale B



MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 4-28

TAILINGS DAM

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

EXISTING ENVIRONMENT

VIEW FROM MITCHELL LINE OF ROAD OVERLOOKING THE PLANNED COAL PROCESSING AREA

5. EXISTING ENVIRONMENT

The characteristics of the various components that describe the existing environment are set out. The components are described for both the mine site environment and the surrounding region for those aspects which are likely to be subjected to impact from the development. The components may be either local or regional, natural or man made.

The aspects which pose problems and constraints for the development are identified and described fully. Where possible the effects of other proposed developments are discussed to evaluate what modifying effects these developments are likely to create.

5.1 REGIONAL SETTING

The Mount Arthur North Authorisation is situated in the Hunter Valley region of NSW approximately five kilometres south west of the town of Muswellbrook. It is traversed in the northern area by the Muswellbrook to Denman Road and in the west by the Edderton Road, which connects the town of Jerrys Plains to the Denman Road. The Hunter River forms the northern boundary. A locality plan is included as **Exhibit 2.1, Locality Plan.**

The influence of the project will be felt over a much wider area for those aspects of social environment, economics and transportation than it will for direct effects on the local physical environment. As it is expected that the workforce for the development will live in Muswellbrook, Singleton and the smaller settlements of Denman, Scone and Aberdeen, the region of influence that will be described includes the general area of the Upper Hunter Valley from Singleton through to Scone. This region includes part of Muswellbrook Shire and adjacent parts of the Scone and Singleton Shires.

From the early 1800's when the area was first settled, the Upper Hunter developed around a rural and primary industry base. The 1950's and 1960's saw a general rural decline throughout the State which was felt in the Upper Hunter region with decreased productivity and a marked slowing in population growth rates when compared to urban areas. This decline coincided with developments within the district which have added a significant industrial component to its social and economic structure. The 2 000 megawatt electrical power generating station and associated mines at Liddell were the first significant industrial development. Other coal mines have since been established in the district to supply both export and domestic needs with further coal mines currently being planned. In the Shire of Muswellbrook at least four new coal mines will commence production within the next five years.

Development has been greatly assisted by a well established road and rail network. Road and rail services passing through the region serve not only the major urban centres of the Hunter Valley, but also the more distant parts of northern and north western New South Wales. The New England Highway provides direct access to the city of Newcastle on the coast and extends through inland northern NSW to Queensland, acting as an important inland route for transportation between the two States. The Main Northern Railway roughly parallels the New England Highway, with branch lines serving the north western regions and extending to Brisbane.

The Hunter River has long been an important source of livelihood to both the rural population, living along its alluvial valley, and to the urban centres which have developed adjacent to the river. Continuing development is being undertaken with due consideration to the available water resources. Away from the Hunter River agricultural lands are generally of low potential and suitable only for open grazing. The main urban centres are Singleton and Muswellbrook, the latter having developed as the main service centre for the northern part of the Hunter Valley region. Muswellbrook's present population of 8 300 is forecast to double by the year 1990.

5.2 TERRAIN

5.2.1 Topography

The Mount Arthur North site is situated in undulating country between Mount Arthur in the south and the Hunter River in the north.

Mount Arthur is the dominant topographical feature of the area, rising some 280 metres above the surrounding countryside to an elevation of 483 metres above sea level. There are three other less notable features within the Authorisation being Macleans Hill in the north east and two smaller hills in the south west. The lowest part of the site is the Hunter River flood plain at around 140 metres above sea level while the gently undulating topography covering most of the area ranges from 170 metres to 200 metres above sea level. The site relief and main drainage features are shown on **Exhibit 5.1, Site Relief.**

The Hunter River flows south west across the northern edge of the Authorisation. Whites Creek, whose broad valley occupies the central area of the site, originates in the south and east of the site and drains across it in a north westerly direction to the Hunter River. Ramrod Creek, the other major tributary of the Hunter in the area, crosses the very north eastern corner of the site. Quarry Creek runs parallel to Whites Creek from the lower slopes of Mount Arthur in the south. The south eastern corner of the Authorisation drains into Saddlers Creek which flows south west to join the Hunter River further downstream near Jerrys Plains.

Ground slopes vary from near flat along the Whites Creek valley and the Hunter River flood plain to slopes in excess of 30 degrees on the upper reaches of Mount Arthur. On balance the slopes are mainly gentle with 95 percent being less than 10 degrees. Slopes in excess of 10 degrees are associated with the upper reaches of the four features previously identified. **Table 5.1, Distribution of Slopes,** shows the proportion of slopes in the various ranges. The slope analysis was prepared as part of a Terrain Evaluation which was carried out under the geotechnical investigation. The six terrain units identified are also shown in **Table 5.1.**

5.2.2 Soil Types

A survey was undertaken of the Mount Arthur North site by the Soil Conservation Service of NSW to describe the major soil types and to assess their suitability for stockpiling for later rehabilitation work. The report is included as a

Supporting Document I in VOLUME 2. Some 160 sites were examined in the field and 107 of these are described in detail. Each of the major soil types in the area were sampled and subjected to selective chemical analysis.

Seven soil types were identified and classified according to the Unified Soil Classification system (Charman 1978) and the Northcote Key (Northcote 1971). **Table 5.2, Summary of Soil Characteristics,** gives a listing of the basic soil characteristics as determined by the survey.

Of the seven soil types identified, two groups, the Red and Yellow Duplex soils (Group 1), and the Brown Duplex soils (Group 2), cover 72 percent of the total area. The remaining five soil types are either alluvial soils or residual soils confined to ridge tops or other rocky areas.

TABLE 5.1 - DISTRIBUTION OF SLOPES

Terrain Unit	Slope Range (degrees)	Area (hectares)	Proportion of Total Area (percent)
A	0 - 3	2 000	32
L	0 - 3	2 300	34
M	3 - 8	1 600	24
H	8 - 15	600	9
X	15	100	1

Source: Golder Associates **(Reference 6)**

5.2.3 Suitability for Stockpiling

The Duplex soils make up the bulk of those soils suitable for stockpiling. The characteristics of the soils suitable for stockpiling are strong soil structure, high aggregate stability, good soil drainage, low sand or gravel content, the absence of a thick A2 horizon and the absence of a hardsetting impermeable soil surface.

High sand content and weak structure render all soils in Groups 3, 5, 6 and 7 unsuitable for stockpiling. Only a small portion of Group 4 soils are suitable for stockpiling and this represents a very small portion of the total soil on the site. Groups 1 and 2 are generally suitable for stockpiling with only 18 percent of Group 1 and 33 percent of Group 2 too sandy or weak structured to be suitable.

The distribution of the various soil types and the location of those soils suitable for stockpiling are shown on the exhibits in Supporting Document 1. Of the soils physically suitable for stockpiling, distinction is made regarding thickness of the total horizon to more or less than 0.4 metres.

Eleven soils samples were analysed for pH, conductivity, Ca, Mg, Na, K, SO_4, Cl, Se, B, neutralisation potential and HCO_3. The results indicate that the soils have soluble salts, predominantly sodium chloride, in the subsoil. The salt levels will restrict the growth of many plants. The sodium absorption ratio indicates the materials are chemically stable and will not disperse. The calcium and magnesium ratios are satisfactory for plant growth although the absolute levels of calcium are low. Potassium levels are very low.

On the basis of these results, the soils suitable for topsoiling based on their physical suitability will require the application of a complete fertiliser to

TABLE 5.2 - SUMMARY OF SOIL CHARACTERISTICS

SOIL	SOIL TYPE	DISTRIBUTION	HORIZON A				HORIZON B			
			COMPOSITION	PH	AVG DEPTH	STRUCTURE	COMPOSITION	PH	AVG DEPTH	STRUCTURE
1	Red & Yellow Duplex	48% of site	brown loam to clay loam	6.0	12 cm	weak moderate	red - brown light clay	5.5	75 cm	moderate strong
2	Brown Duplex	24% of site along drainage routes	brown loam to clay loam	5.5	7 cm	weak moderate	brown light medium clay	5.5	88 cm	moderate strong
3	Brown and Yellow Massive	1% of site near drainage routes	brown sandy clay loam	-	13 cm	weak	variable brown sandy loam clay	-	70 cm	weak
4	Grey & Black Structured	3% of site along drainage routes	brown sandy clay loam	-	63 cm	weak	brownish grey light clay	6.0	148 cm	strong
5	Skeletal	3% of site small pockets on steep slopes	brown sandy loam	5.0	15 cm	weak	dark brown sandy loam	5.5	30 cm	weak
6	Hunter Alluvial	19% of site Hunter floodplain	dark brown loam	6.5	20 cm	weak	brownish black clay loam	7.0	60 cm	weak
7	Mt Arthur Alluvial	2% of site lower Mt Arthur slopes	brown loamy sands	-	8 cm	weak	brown sandy loam	5.0	44cm	weak

Source: Soil Conservation Service of NSW (Reference 13) aid plant growth. The low soil nutrient levels of the site are common with most of the soils in the region. Fertility levels have not been determined because they are likely to change between the time the soils are stockpiled and the time they are respread. Fertility levels should be measured prior to respreading. A plan of the site showing the location of both unsuitable soils and soils which will be suitable for stockpiling is included in Document 1 as Map 1.

5.2.4 Erosion Potential

Soil erosion within the Hunter Valley can be traced to over-clearing and over-grazing that has occurred over the last 150 years with European settlement. Extensive clearing of indigenous flora has resulted in widespread sheet erosion and scouring of valleys. The Mount Arthur site has been extensively cleared for agricultural pursuits. Minor erosion occurs on most of the side slope terrain. Many of the drainage lines are affected by minor gully erosion with gullies of less than 1.5 metres deep. Along Whites Creek and the upper reaches of Quarry Creek gullies up to 2.0 metres deep occur.

Potentially Group 3 and 4 soils are susceptible to erosion at both the A and B horizons. The A horizons of Groups 1, 2, 5 and 7 show minor sheet erosion. All of these Groups have a very shallow horizon. The B horizon, however, has a very low erosion potential, having a greater depth and a higher cohesive strength. Group 6 soils are resistant to erosion.

5.3 OVERBURDEN PROPERTIES

5.3.1 Rock Types

The geological strata of the Mount Arthur North area is comprised of a series of sediments deposited in the Upper Hunter region of the Sydney Basin during the Permian Period. Eighteen coal seams representing the basal members of the Wittingham Coal Measures of the Singleton Super Group have been identified. The strata generally dip to the west being on the western flank of the Muswellbrook anticline. There has been some local faulting and minor igneous activity within the Authorisation. A thin layer of Cainozoic alluvium occurs in the valleys particularly along Whites Creek. This alluvium underlies the flood plain of the Hunter River. A detailed description of the coal bearing strata is given in **Section 4.2, Mount Arthur North Coal Resource.**

The geology is that of a typical coal measure sequence with coal seams enclosed in generally fine grained sediments with sandstones forming a high proportion of the inter-seam strata. However, considering the general uniformity of the coal seams, there is a surprising variability in both thickness and composition of the inter-seam strata.

Rock types can be generally classified into the following major varieties:

- Sandstone (including sandstone with siltstone)
- interbedded sandstone/siltstone
- mudstone/claystone

A significant feature of the inter-seam strata is the presence of hard, massive, sandstone layers with bed thicknesses exceeding one or two metres. Mudstones although representing only a small proportion of the total strata, do exhibit significant disintegration in many cases. Localised areas of sandstone exhibit similar characteristics.

Six of the cored drillholes completed for the purpose of coal resource evaluation were selected for analysis of the physical and chemical characteristics of the overburden/interburden material. Seven stratigraphic intervals were chosen for sampling. Information on location of holes and stratigraphic location of samples is given in Supporting Document 9 of VOLUME 2. The physical and chemical characteristics of the rock interburden are also given in the subject document.

5.3.2 Physical Characteristics

Hard, massive sandstone layers with bed thicknesses exceeding one to two metres are common, particularly between the lower seams in the succession. Although the measured compressive strength of the sandstone is not particularly high, the stability conditions in natural slopes is high due to the high proportion of hard sandstone and the absence of weak seams which could lead to sliding failures. Other sandstones often contain silty or carbonaceous bands which allow the sandstone to fragment more readily than the massive sandstone.

The interbedded fine grained sediments of mudstone and siltstone exhibit a much higher fracture frequency and bedding plane breaks than the sandstones. The mudstones, particularly, exhibit rapid deterioration following excavation and exposure. These mudstone layers are seldom continuous and are of variable thickness.

The weathered zone extends from the surface to a maximum depth of 25 metres. However, the weathered material is generally quite competent insitu with only a few localised areas of mudstone and sandstone which are softened and deteriorated.

The material in the rock overburden dumps will vary in its physical stability. The massive sandstones should generally remain stable but the finer grained sandstones and the bedded sandstones will disintegrate rapidly under the initial highly porous and permeable conditions of the dumps, to form silty and sandy clays.

5.3.3 Chemical Characteristics

Chemical analysis of interburden rocks was undertaken to identify any potential for concentration of pollutants by leaching. Chemical analysis would also determine if there exists any potential problems which might affect the use of spoil as a soil for rehabilitation of the site. Eight interburden rock samples were subjected to chemical analysis and each sample was analysed for the major cations and anions as well as boron, selenium and total sulphur.

The chemical data suggests that any leachate from overburden disposal areas will be saline, high in iron and slightly acidic. The leachate salinity however will be less than the general groundwater salinity levels which originates from the aquifers associated with the more saline coal seams. Acid leachate emanating from pyritic sulphur in the interburden rocks will not occur.

In common with the site soils, the low nutrient states of the interburden rocks indicate that nitrogen and phosphorus fertiliser applications will be necessary if a soil derived from spoil is to sustain successful plant growth. Sodium levels are below threshold levels at which difficulties may be experienced with surface crusting and low under infiltration. Potentially toxic metallic ions are not indicated.

5.3.4 Properties of Oxidised Coal

Oxidised coal contained within the oxidation zone which extends down to a maximum depth of 25 metres from the surface, will be disposed of with spoil from the overburden removal. Seams within this zone have been weathered from a coal to a carboniferous soil of no commercial value.

Chemical analyses of the oxidised coal have not been carried out. However, it is to be expected that the chemical properties will in general be similar to those of the unoxidised coal although weathering and leaching will have reduced parameters such as total soluble salts.

The relatively small volumes of oxidised coal compared to total overburden quantities should result in insignificant changes to leachate quality from the overburden spoil disposal areas. Nevertheless, it is proposed that samples of the oxidised coal will be analysed prior to prestrip operations with a view to determining any possible toxic constituents which could adversely affect leachate qualities. In general, the coal will be disposed of in a similar manner to wash plant rejects, being buried at a sufficient depth in the disposal areas and well dispersed.

5.4 HYDROLOGY

5.4.1 Catchments

Exhibit 5.2, Drainage Catchments, shows the principal catchments which make up the drainage pattern of the site. All creeks drain in a north west direction into the Hunter River, with the one exception being Saddlers Creek which drains to the south. The principal catchments are described as follows:

Ramrod Creek Catchment: Although a significant water shed which drains areas back to the Lake Liddell catchment boundary and east to the New England Highway only the last downstream reaches are contained within the Authorisation area. The creek drains into the Hunter River in the north east corner of the Authorisation.

Whites Creek Catchment: This is the principal drainage basin contained within the Authorisation. The watershed extends to the slopes of Mount Arthur and the creek discharges into the Hunter River near the junction of the Edderton and Denman Roads. The catchment is essentially divided into two, Whites Creek and Fairford Creek, with the confluence point immediately upstream of the confluence of Whites Creek and the Hunter River.

Quarry Creek Catchment: This catchment encompasses the foothills on the west side of Mount Arthur. The lower reaches are situated outside the Authorisation.

Saddlers Creek Catchment: The catchment which drains the southern and eastern foothills of Mount Arthur. In contrast to all the other creeks, Saddlers Creek flows to the south to join the Hunter River near Jerrys Plains. A very small portion of the catchment is within the Authorisation area. Saddlers Creek is the principal drainage system for the Mount Arthur South area.

Three minor catchments to the north and east of Macleans Hill have also been identified.

5.4.2 Surface Water Hydrology

The Hunter River is the major watercourse within the Authorisation and flows just inside the north west boundary. Average daily flows for the period 1961 to 1979 were 1030 megalitres per day (ML/d) with a wide variation in annual average flows ranging from 2450 ML/d in 1963 to 230 ML/d in 1966. The one in 100 year flood level opposite Balmoral Corner is approximately 142.0 metres on the Australian Height Datum dropping to 137.5 metres adjacent to Edinglassie. The flood of 1955 has been assigned a frequency of one in 100 years.

The hydrological characteristics of the principal drainage catchments in the vicinity of Mount Arthur North are given in **Table 5.3, Hydrological Characteristics.** Total catchment areas have been measured to the Denman Road with the exception of Saddlers Creek which has a catchment extending south to meet the Hunter River below Denman.

TABLE 5.3 - HYDROLOGICAL CHARACTERISTICS

Drainage Catchment	Catchment Area (sq.km)	Catchment Area Within Authorisation (sq.km)	Average Annual Runoff (ML)
Whites Creek	21.1	18.6	1 950
Fairford Creek	10.0	10.0	1 140
Quarry Creek	22.5	14.3	2 040
Ramrod Creek	39.4	3.8	3 050
Saddlers Creek	120.0	3.6	11 000
Minor Catchments	6.0	6.0	790

Drainage Catchment	Catchment Area (sq.km)	Flood Flows (cumecs) 1 in 10 yr	1 in 100 yr
Whites Creek (at S1)	16.0	10.9	22.2
Fairford Creek (at S2)	6.0	6.7	11.5

Flood flows have been calculated using a flow synthesis method (refer Supporting Document 9) and annual average runoffs have been calculated using the following formula which is based on a regression equation developed by Mr G Wright of the Water Resources Commission from data collected in the Hunter Valley (refer Document 10 of VOLUME 2). Wright's unmodified formula with Ko = 6.593×10^{-9} has been used for Saddlers Creek because of the large catchment area.

$Q = K'o\ I^{K2}\ A^{K1}$ where:

where:

Q = average annual runoff (1 000 ML)
I = average annual rainfall (mm)
A = catchment area (sq.km)
$K'o$ = $0.6\ (6.593 \times 10^{-9})$
K_1 = 0.716
K_2 = 2.774

All the creeks are intermittent and cease to flow for long periods of the year. During low flow times creek flows are supplemented by inflow from groundwater which has the effect of increasing the salinity levels. Floods will rise quickly because of the rapid runoff from steep upper catchment areas but actual creek level rises in the lower reaches of the creeks will be small because of the large overbank storage.

Significant modifications will occur, particularly to the Whites Creek catchment, because of the proposed mining operations. Modifications to the drainage patterns of the site and the proposals for creek diversions around the open cut mining sites are fully discussed in the Water Management Report (Document 10 of VOLUME 2) and outlined in **Section 4.7, Water Management.**

5.4.3 Groundwater

A number of test bores have been drilled in the northern area of the site in order to gain information about the existing groundwater system and to enable a more detailed assessment to be made of the influence of mining on the system.

The groundwater system at Mount Arthur consists of a series of confined or semi-confined aquifers. Groundwater occurs in both the coal seams and in the thin recent alluvium along the stream channels. However, the most significant quantities of groundwater occur in the coal seams particularly the Ramrod, Edinglassie, Bayswater, Vaux and Mount Arthur seams. The coal itself has very low primary porosity and permeability but numerous closely spaced and interconnected joints and fractures give it a well developed secondary permeability. The intervening siltstones and sandstones between the various coal seams have low permeabilities except in the surface weathered zones and along open fracture zones associated with faults.

Aquifer pumping has been carried out in Zone 1 north of Whites Creek and inflow predictions have been made for both the Ramrod Creek Mine and Whites Creek Mine. Further field tests will be carried out in both Zone 4/5 for the Whites Creek Mine and Zone 6 for the Glen Munro Mine. In general, both the Edinglassie and Ramrod Creek seams slope gently to the west and their saturated levels do not rise much above a level of 140 to 145 metres. The seams receive little recharge and are sufficiently permeable to dissipate minor recharge without significant rises in the potentiometric surfaces. Since the potentiometric surfaces slope to the west the seams probably discharge into the Hunter River alluvium and also, to a limited extent, into Whites Creek. The salinity of Whites Creek increases downstream suggesting that the creek is receiving discharge from the coal aquifers.

Tests indicate that the fault zone to the south of Whites Creek acts as an impermeable barrier to lateral groundwater flow and hydraulic heads and flow directions of groundwater on the south side of the fault could vary significantly from those investigated on the north side. However, the geology and hence the hydrological environment is sufficiently similar to allow a reasonable extrapolation of data from Zone 1. Hydrogeological conditions in Zone 6 cannot be extrapolated because the geological sequence in this area is stratigraphically higher than the other areas.

The thin Cainozoic alluvium in the major stream channels has a low permeability which is due to the clayey nature of much of the alluvium. Zones and channels of more permeable sandy material may occur but these are unlikely to be extensive. The alluvium along Whites Creek is saturated two metres below ground level. The alluvium under the Hunter River flood plain is a coarse grained sandy loam with channels of highly permeable sand and gravel. The depth of saturated alluvium in the flood plain and its water bearing characteristics have not been investigated. The inter-relationship between the coal seam aquifers and the Hunter River alluvium and the effects resulting from mining are discussed in **Section 4.7, Water Management.**

References to the groundwater studies for the Mount Arthur North site are contained in Document 9 of VOLUME 2.

5.4.4 Water Quality

Salinity levels of the Hunter River are normally in the range of 250 to 500 milligrams per litre (mg/L) while water from the alluvium is slightly more saline and salinities are higher again in the alluvium in the contributory creeks.

A considerable number of samples, of both surface and groundwater have been taken at various locations around the site since mid 1979. Water quality data is scheduled in Document 2 of VOLUME 2. From the monitoring, total dissolved solids (TDS) of surface water samples have varied from 400 mg/L to as high as 8 000 mg/L. Salinity is particularly high during periods of low flow reflecting the contribution of saline inflows from the marine sediments and probably the coal seams as well.

Water quality tests performed on samples taken from the Edinglassie and Ramrod Creek coal seams indicate that the salinity is high with a TDS of between 3 000 and 5 000 mg/L. Surface water monitoring is continuing on a regular basis. **Section 6.16, Monitoring Procedures,** outlines the environmental monitoring that is being presently carried out and that which is further proposed. **Exhibit 5.3, Monitoring Stations,** locate the monitoring points for the water quality data presented in Document 2.

5.5 CLIMATIC ASPECTS

5.5.1 Climate Description and Sources of Data

A warm temperate climate characterises the Upper Hunter Valley region due to its elevation, latitude and location relative to the western ranges and the coastal lowlands. The temperature and rainfall are seasonal with the heaviest rainfalls occurring in summer. The summers are hot while winters are cool to mild with occasional severe frosts.

Climatic data has been obtained from three weather stations in the area. The station at the Liddell Power Station has been operating for 10 years on a five day per week basis. It is located approximately 12 kilometres to the south east of the site. Data for 102 years prior to 1972 is available from the Muswellbrook Weather Station which is located about 11 kilometres north east of the centre of the site. The Soil Conservation Service's station at Scone, approximately 28 kilometres to the north, is the nearest station providing data on air and ground frost. **Table 5.4, Climatic Data - Liddell Power Station,** summarises the climatic data from the Liddell Climatic Station which has been adopted as the principal data source.

The Liddell data is contained in 'Liddell Climatic Dataset', Electricity Commission of NSW, 1979 **(Reference 13)** and the Muswellbrook data is best

TABLE 5.4 - CLIMATIC DATA, LIDDELL POWER STATION

Month	Temperature (°C)			Average Humidity (%)			Rainfall		Evaporation
	Mean	Mean Max	Mean Min	Mean	Mean Max.	Mean Min	Mean (mm)	Raindays	Mean (mm)
Jan	22.9	30.8	17.0	60.4	70.8	51.7	117.3	8.0	171.2
Feb	22.3	29.4	16.6	63.0	70.1	52.2	80.2	6.8	119.8
March	20.6	27.9	15.8	63.9	73.2	40.3	86.2	5.6	121.2
April	17.3	24.9	12.2	62.1	75.8	37.1	37.4	5.3	75.5
May	13.6	21.0	8.6	66.4	74.4	46.0	48.7	4.8	54.5
June	11.3	17.8	6.9	71.3	74.5	67.4	41.7	6.3	62.6
July	10.5	17.2	5.2	65.2	75.8	59.3	20.1	4.7	70.8
Aug	11.7	19.0	5.6	61.2	64.9	55.9	25.6	5.2	76.4
Sept	14.1	21.7	8.7	61.2	66.1	54.2	43.7	7.0	100.7
Oct	16.9	25.2	11.5	60.2	66.4	53.4	59.8	6.8	129.6
Nov	19.5	27.6	13.0	57.2	65.6	53.7	55.7	7.2	151.3
Dec	22.7	30.9	16.1	52.8	59.6	44.6	57.2	4.9	161.5
ANNUAL	16.4	24.4	11.4	62.1			673.7	72.6	1295.1

presented in 'Water Resources of the Upper Hunter Valley', Water Resources Commission Report No 15, September 1969 **(Reference 12).** Statistical climatic data is included as Document 3 of VOLUME 2.

5.5.2 Rainfall

The annual median rainfall for Muswellbrook is 645 mm and for Liddell, 674 mm. The highest rainfall is generally experienced from January to March while the months June to September tend to be the drier months. Monthly median rainfall for Muswellbrook generally exceeds 25 mm in all months of the year. Similarly, for Liddell, the mean value of rainfall generally exceeds 25 mm per month.

Low rainfall periods lasting six months or more do occur on occasions throughout the Hunter Valley region as indicated in **Table 3(c)** of Document 3 of VOLUME 2.

Precipitation intensity/duration/return period figures are included in **Table 3(e)** of Document 3 for recordings taken in Muswellbrook. These figures have been used for the calculations of flood runoffs. Rainfall intensity is highest in the summer months when thunderstorm activity is at its peak.

5.5.3 Temperature

The mean temperature for the area ranges from about 10°C in July to 23°C in February. Hot weather is experienced from October to April, usually as a result of north westerly winds bringing hot dry air from the west, and temperatures above 33°C commonly occur at this time of the year.

During the winter months, especially when light winds and clear skies prevail, low overnight temperatures occur. In July temperatures lower than -2°C are occasionally experienced.

Both air and ground frosts occur in this region, the former being more frequent and severe. Over a period of 24 years the annual mean number of frost days was 27 with most of these occurring in the months from May to September and the most severe in July. The frost free period beginning in October is also the period of highest rainfall for the district and produces the new season growth. Traditionally the major growing season in the region extends from October through to April.

5.5.4 Evaporation

The average annual evaporation at Liddell is 1 295.1 mm with the highest average monthly evaporation being 171.2 mm in January and the lowest being 54.5 mm in May. In general, the highest monthly evaporation occurs in the months of November, December and January with the lowest evaporation being in May and June.

There is a 'water deficit' in the region in all months of the year. The largest deficit occurs from October through to April which although the wettest months also have the highest temperatures and highest potential evaporation. The annual water deficit curve is shown in Document 3, VOLUME 2. The water deficit calculation is based on a free water surface. For a determination of soil moisture deficits a water balance is required which incorporates all the relevant factors of rainfall, potential evaporation, soil storage and actual evaporation. This calculation would indicate when there is a zero moisture deficit, that is, when the soil is suitable for seeding without irrigation. This season is typically of 20 to 25 weeks during the winter months.

5.5.5 Wind

Wind records from Liddell Power Station and Muswellbrook were examined. The wind roses for Liddell Power Station for each of the four seasons are included in Document 3. The Muswellbrook data is only based on four years of record and is also suspect because of local topographical effects.

The principal wind directions are from the east and south east in summer, and from the north west and west during winter. Winds from the north and south west and north and north east are very infrequent although occasional high gusts have been recorded associated with southerly changes. The maximum wind speeds are associated with the west and north west directions which can occur all through the year. Calms occur for about 12 percent of the time.

Mount Arthur is likely to have a modifying effect on the winds from the south and south east. As mentioned previously winds from the south west, the direction that would carry particulate matter from the site towards Muswellbrook, occur less than 5 percent of the time during summer, winter and spring. The winds when they do occur are generally less than 20 kilometres per hour. This fact is relevant to later dust modelling structures.

5.5.6 Inversions

Although the effects of inversions are commonly observed in the Upper Hunter Valley, measured data on the development, duration, frequency, persistence and height of these phenomena are not available. The nearest meteorological station which has a radiosonde needed for these determinations is the Williamtown Air Base and extrapolation from that site is not valid because of the intervening distance and topography. A study of inversions for the Hunter Valley has recently been commissioned by the State Pollution Control Commission. The Department of Geography, University of Newcastle, is carrying out the study and preliminary results will not be available until mid 1981.

Inversion development is dependent upon the stability of the dry adiabatic lapse rate, the cooling of the ground surface and moisture conditions. Both surface level and upper air inversions will occur in the Upper Hunter Valley.

Surface level inversions develop because of the different rates of cooling between the land surface and the air at night. As the land cools more rapidly than the overlying air, the blanket of air in contact with the ground is also cooled. Consequently on calm clear nights, a temperature inversion will develop 90 percent of the time. The surface inversions will exist between 100 and 500 metres from the ground. They are broken up by the reheating of the land surface, one to two hours after sunrise.

Because fog is a characteristic of a surface inversion, where condensation of moisture has occurred, the number of fog days can be taken as a minimum indication. **Table 5.5, Minimum Number of Inversion Days**, presents data from fog recording stations at Williamtown and Jerrys Plains.

The effect of surface inversions is to prohibit the dispersion of gases and particulate matter into higher levels of the atmosphere. The introduction of pollutants such as smoke and dust may cause the inversion to persist longer as the incoming solar radiation after sunrise is scattered and absorbed by the foreign matter in the air. Surface inversions also affect noise transmissions.

TABLE 5.5 - MINIMUM NUMBER OF INVERSION DAYS

Locality	Number of Fog Days
Jerrys Plains	29 per year
Williamtown	35 per year

Upper air inversions can last for a number of days depending upon the meteorological conditions. Their geographical distribution is wider and more pronounced than the surface inversions.

5.5.7 Air Quality

Based on local observation, air quality in the Upper Hunter Valley is affected by discharges from Liddell Power Station, coal mining operations, road and rail transport and other activities including fires at burn off times, sawmills, land ploughing, and aerial applications of fertilizers and weedicides.

The SPCC, through Muswellbrook Shire Council, monitors dust fallout at three locations within the town area. The Electricity Commission has, for the last 10 years, sampled particulate deposition levels at 36 locations within a radius of approximately 25 kilometres from Liddell Power Station. The location of gauges of relevance to the Mount Arthur North site are shown on **Exhibit 5.3, Monitoring Stations.** Data is presented in Document 3, **Table 3(i),** of VOLUME 2.

The mean rate of deposition over a period of two years for Muswellbrook is 3.5 grams per square metre per month ($gm/m^2/month$) while the figures for gauges away from the urban area are less. Electricity Commission gauge numbers 10, 11, 12, 13, 16, 17 and 18 are located on, or in the vicinity of, the Mount Arthur North Authorisation area. Of these, Nos 16, 17 and 18 have significantly higher deposition rates probably explained by the fact that 16 is in an urban area and 17 and 18 are adjacent to partially unsealed roads. The remaining gauges, 10, 11, 12 and 13, are thus the most suitable for ascertaining overall background dust levels.

However, deposition gauges monitored at monthly intervals do not necessarily reflect average conditions throughout the monitoring period and a few extreme events raise the mean value considerably. It is therefore considered that the median value provides a better indicator of background conditions.

Gauges 10, 11, 12 and 13 give a median deposition rate of 0.7 $gm/m^2/month$ and it is considered that this figure should be adopted as the prevailing background level for the site. It is proposed to establish additional deposition gauges on the site and its immediate surrounds to monitor ambient conditions prior to the commencement of mining operations.

As the winds generally tend to come from the north west and south east directions, it is expected that dust gauges located north and south of the site would record the greater deposition rates during the mining operations. The urban areas of Muswellbrook will be generally unaffected by dust fallout emenating from the Mount Arthur North operations.

5.5.8 Microclimatic Influences

The local characteristics of the site such as relief, vegetation, slope, drainage and elevation modify the regional climatic pattern. The effects of these factors are little known in the Upper Hunter Valley but observations suggest that they have an important influence on local climate.

For example, since the northerly facing slopes receive more solar radiation than the southerly exposed slopes, the benefits of greater warmth in winter and earlier spring growth tend to be offset by the moisture stress imposed on the vegetation in the summer.

The substitution of pasture or the bare ground of eroded areas, for a woodland community, affects the microclimate by modifying the energy transfers, humidity and thermal environments. Thus, in periods of high solar radiation, temperature gradients are induced which produce convection cells that transport dust into higher levels in the atmosphere. The presence of the so called 'willy willys' is common in the cleared areas of the Upper Hunter Valley and is expected to increase as vegetation is further removed.

Wind movement is influenced locally by topographical relief which produces areas of calm or areas of higher wind velocities in wind funnels.

The mining development is expected to alter the microclimate because of changes in the physiography, surface configuration, roughness and atmospheric composition. The extent of any impacts from these changes are assessed in **Chapter 7, Interactions and Impacts.**

5.6 FLORA AND FAUNA

5.6.1 Flora

Surveys of the flora of the Authorisation area were carried out during field investigations associated with the landscape and agricultural studies.

Most of the original timber has been removed from the area, except in the vicinity of Mount Arthur where a substantial area of native vegetation remains, and most of the area is under unimproved pasture with scattered trees remaining. Intensive cropping and pasture uses occur along the Hunter River flats which are under irrigation. The original vegetation may be deduced from the correspondence of the duplex soil areas south of the river with the Glendower and Killarney land systems described by Storey **(Reference 20).** The vegetation comprised savannah woodland dominated by Eucalyptus species such as ironbark, box and grey gum in association with Angophora and Casuarina.

The present vegetation comprises pasture grasses, crops and scattered timber. The principal grass species are spear grass, wire grass and red grass. The remaining stands of trees show the following typical associations. A complete list of major plant species is given in Document 7 of VOLUME 2.

Lower Slopes
Angophora floribunda (Rough Barked Apple)
Eucalyptus woollsiana (Narrow Leaved Box)
Eucalyptus dives (Peppermint)

Water Courses
Casuarina cunninghamiana (River She-Oak)
Eucalyptus blakalyi (Blakely's Red Gum)

Upper Slopes
Casuarina torulosa (Forest Oak)
Eucalyptus punctata (Grey Gum)
Eucalyptus dives (Peppermint)

Nearby Ridgetop Forests
Eucalyptus sideroxylon (Iron Bark)
Angophora costata (Red Gum)
Eucalyptus melluodena (Yellow Box)

The distribution of existing site vegetation is shown on **Exhibit 5.4, Site Vegetation.**

5.6.2 Fauna

A fauna survey of the Authorisation area was undertaken in September 1980. The full report of the survey and findings is given in Document 4 of VOLUME 2 and includes a full list of species.

The survey involved the sampling of mammal, bird and reptile populations at a number of sites and in different vegetation types. Mammals and birds were observed during the day and night and some small mammal trapping was attempted.

The survey was supplemented by examination of predator scats, reference to fauna surveys of nearby areas and sightings reported by local residents. The survey results were influenced by the exceptionally dry conditions prevailing at the time.

The area has been highly modified by man's activities and much of it has lost most species of native mammals, many species of birds and probably also many species of reptiles and frogs that would orginally have occurred in the area. The least disturbed area is in the immediate vicinity of Mount Arthur which covers about 60 hectares within the Authorisation. The nearby foothills provide daytime shelter for many of the Grey Kangaroos observed. The vegetation of the mountain provides a range of habitats not found elsewhere in the area. It is likely that more species of fauna occur than were detected during the survey. All the species recorded in the area are relatively common and widespread in New South Wales.

The mammal fauna over the greater part of the area consists of introduced domestic animals and introduced wild animals including Rabbit. Few native mammals occur over most of the area. The Eastern Grey Kangaroo was observed in mobs of 20 to 30 animals during the daytime in the more heavily timbered foothills of Mount Arthur. The Common Brushtail Possum was observed in two areas, one at Mount Arthur and the other along Ramrod Creek, while the Red-Necked Wallaby was observed on Mount Arthur. Echidna diggings have been recorded in termite mounds in the area and it is likely that this relatively common species is found in wooded parts of the area.

No small mammal was trapped, although what were probably House Mice were observed close to the Hunter River on two occasions. Other surveys of nearby areas have recorded the Black Rat which is also likely to be found in the area. A local farmer has reported the presence near the Hunter River of what are thought to be Water Rats, and there are reports of Platypus sightings on a number of occasions near where Whites Creek joins the Hunter River.

A number of other mammals (including bats) may be present in the Authorisation area. Suitable habitat for many species is largely restricted to Mount Arthur. The presence of feral cats and rabbits at Mount Arthur and the small size of the area make doubtful the presence of native marsupial carnivores, bandicoots and some wallabies.

Of the 164 species of birds that could be expected in the area, 68 species were observed during the four day survey. Bird populations were most dense along the Hunter River, its banks and on nearby wet pastures, and at Mount Arthur. Both these areas supported a number of birds not found in other parts of the Authorisation. Many of the woodland and forest species were only found in a few localities and in smaller numbers than would be expected in less disturbed habitats. It appears that much of the area is only a marginally suitable habitat for many of these thinly scattered populations. The most commonly observed waterbirds were the Straw-Necked Ibis, Black Duck and the Maned Duck. The most common species on grassland and cropland were the Galah and Starling. Common open-woodland and woodland species were the Magpie, Jacky Winter and Eastern Rosella.

A number of species of reptiles were observed in the area. These species are all common, widespread species. No amphibians were collected due to the dry conditions, although a range of species could be expected.

The Hunter River provides the main permanent aquatic habitat within the Authorisation area. Tributary streams including Quarry Creek, Whites Creek and Ramrod Creek have intermittent flows and were dry or almost dry during the survey. Flows in the Hunter River are influenced by releases of water from Glenbawn Dam. These releases cause unnatural variation in water levels and a slightly lower water temperature, both factors being likely to affect the aquatic biota and breeding cycles of animals and consequently the abundance and species composition of fish populations in the river. Previous surveys in nearby areas of the catchment and discussions with farmers have provided a list indicative of the species of fish found in the river. The species listed in Document 2 are relatively widespread and common.

5.7 ACOUSTIC ENVIRONMENT

Background noise levels were measured at three locations within the area to the north and north east of the proposed Ramrod Creek mine site. It is this area that will be most directly affected by the project. The locations were:

Location 1: Thompson Street, South Muswellbrook
Location 2: Balmoral
Location 3: Bengalla

The three sites have been selected to represent three typical situations. The South Muswellbrook location is typically urban, Balmoral is rural but affected by nearby traffic noise, and Bengalla is distant rural. **Exhibit 5.3, Monitoring Stations,** shows the location of each of the sites.

The equipment used was a Bruel & Kjaer Noise Level Analyser Type 4426, checked against a Bruel & Kjaer Calibrator Type 4230. Noise at the chosen sites was sampled for a period of five to 10 minutes on various occasions and the levels read out from the memory system of the instrument. The values L1 to L95 are those noise levels exceeded for one to 95 percent of the sampling time. The value Leq is the mean time-weighted level, calculated logarithmically. The L90 value is regarded as the most reliable descriptor of background noise and is used in this study.

The tests were carried out at times when the weather conditions were calm and when it seemed likely that the lowest background noise would be obtained. The noises observed were generated on most occasions by road traffic, with some contribution by rail operations. Natural noise sources, such as animals and birds, were also present at times.

A summary of the recorded noise levels are given in **Table 5.6, Background Noise Levels.**

TABLE 5.6 - BACKGROUND NOISE LEVELS

Site	Day	Evening (L90 in dBA)	Night
1. South Muswellbrook (suburban)	39	40	29-39
2. Balmoral (rural, next to busy road)	42-45	34	31
3. Bengalla (distant rural)	28	-	26-27

Atmospheric temperature inversions were likely to have been present at the time of these tests and could have been the reason for the relatively low rate of noise attenuation with distance, in spite of some topographic shielding.

The full text of the acoustic and blasting study including details of all background monitoring results, is included as Document 11 of VOLUME 2.

The existing probable minimum night-time background noise level in the suburban area, and in rural areas near to busy roads has been found to be about 30 dBA, with distant rural areas a little lower. The daytime background level for suburban sites and those near busy roads is about 40 dBA, though an appreciably lower level was found at the distant rural site.

The selection of the 'reference' ambient noise levels should, to some extent, take into account the future changes in character of the whole Muswellbrook area. If only those developments which predate the Mount Arthur North development are considered, ambient levels in this vicinity at the time of commencement of operations on this project will be appreciably higher. The considerably higher number of train movements on the Muswellbrook to Merriwa rail line resulting from the development of the Sandy Hollow rail line will raise levels particularly at Bengalla (Location 3). Muswellbrook Shire Council's industrial estate on the Mitchell Line of Road which will be extensively developed prior to 1983/84 will establish a higher noise environment in the north east corner of the Mount Arthur North site.

Considering only these effects, it is considered that background levels of 30 to 35 dBA at night and 40 to 45 dBA by day may be reasonably assumed with somewhat higher levels within the suburban area. If a higher level of intrusive noise of 5 dBA above background levels is assumed, the absolute level becomes 35 to 40 dBA at night and 45 to 50 dBA by day at potentially affected residences. It is these levels which are the limiting levels for site generated noise. The acoustic study is further discussed in **Chapter 6, Environmental Safeguards.**

5.8 EARLY HISTORY AND SETTLEMENT

5.8.1 Pre-European Occupation

Archaeological surveys of the Mount Arthur North Authorisation area were undertaken in 1976 and a more detailed survey has been undertaken for this study by Professor L K Dyall. The consolidated findings of the surveys are contained in Document 5 of VOLUME 2.

The recent survey found that while there are a substantial number of former Aboriginal camps within the Authorisation area, their importance lies more in their location than in the material present at them. The Australian Museum holds a substantial number of items collected from this and earlier surveys of the Mount Arthur region. There are no records of any Aboriginal art, sacred sites or burial grounds in the area. Evidence of former Aboriginal occupation within the Authorisation area is set out in full in Document 5 and is summarised as follows:

. Camp sites: 14 principal sites, with over 50 stone flakes per 1 000 square metres, and 6 minor sites,
. Axe sharpening grooves at two locations,
. Edge ground axes: four items at three camp sites,
. Basalt hand axes: five items at camp sites and two isolated finds.

Several verbal reports are recorded of artefacts and Aboriginal events. The survey explored all the main creek lines within the Authorisation area as well as an area around the summit of Mount Arthur. As expected, most camp sites were found at elevations below 200 metres along the creeks although a minor site was noted at an elevation of 280 metres. In summary, there are no sites known which warrant preservation within the Authorisation area.

5.8.2 Historical Background

The discovery of the Upper Hunter Valley has been credited to Henry Dangar who, in 1824, reached the Muscle Brook, a tributary of the Hunter River. He found no evidence that any white man had ever been in that part of the valley before him and the behaviour of the Aborigines indicated that they had not come into contact with whites before. Following Dangar's expedition there was a scramble for land in the area and by 1825 all river frontages in the Muswellbrook district were taken. Thus the granting and reserving of land along the Hunter's alluvial flood plain gave rise to large pastoral estates. Later settlement developed away from the river.

In 1829 the first overland road was constructed up the Hunter Valley. The road crossed the river at Muswellbrook, which became established as a river crossing settlement and a service centre for the homesteads established a few years earlier. The land on which Muswellbrook was built was part of a 1 600 hectare church school estate, part of which had been reserved for a village. The town was gazetted in 1833 and a street plan drawn up at the same time and it thus originated as a Government town. In 1842 a private town was built on the southern side of Muscle Creek by the sons of Chief Justice Forbes (owner of Skellatar) and connected to the Government town by a bridge. Both settlements were amalgamated a few years later.

In 1853 the town of Denman (named after Judge Denman) was established on the village reserve beside the Hunter River. During the 1860's communications between Muswellbrook and other centres was greatly improved, firstly with the opening of the telegraph office in 1861, but more importantly when the Main Northern Railway Line reached the town from Singleton in 1869. The advent of the railway accounts for the high population of the town at this time and its decline in later years when the railway construction moved north towards Scone.

The proclamation of the Municipality of Muswellbrook occurred on 13 April 1870. Edward Bowman of 'Balmoral' became the first mayor of the new Municipal Council. Throughout the remainder of the nineteenth century the town continued to grow steadily. Muswellbrook Shire was established in 1907 covering a larger area and in 1929 a Municipality was re-established which now included South Muswellbrook.

The first deposits of coal to be mined in the district appears to be that mined by Arthur Cox at the turn of the century at Kayuga. The coal was first used to provide power for a creamery and later for a butter factory established at 'Overton'. The main Muswellbrook coal seams were opened in 1908 following their discovery by H J Jeans whilst drilling for water on the Town Common. In 1909 the Muswellbrook Coal Company was formed. By 1923 John Loader had discovered coal on 'St Heliers' and in the same year the St Heliers Coal Co Ltd was formed and a colliery was opened. This company was amalgamated with the reformed Muswellbrook Coal Co Ltd in 1933 and their collieries became designated No 2 and No 1 respectively. A privately owned power station was built adjacent to the Muswellbrook No 1 colliery in the 1920's. In 1944 the Muswellbrook No 2, an open cut, was established on the Town Common halfway between the two original underground mines. For many years this open cut was the largest in Australia with some 16 million cubic metres of overburden removed to extract approximately 9 million tonnes of coal.

5.8.3 Heritage

Throughout Muswellbrook Shire's early development there was a marked settlement pattern of historic properties along the Hunter River corridor. Historic settlement relates closely to the river flats as early settlers sought the most attractive elevated ground which overlooked the fertile river flats. **Exhibit 5.5, Historic Buildings of the Upper Hunter,** illustrates the location of these historic buildings. As the National Trust lists are incomplete, a detailed inventory of individual buildings has been prepared and included in Document 6 of VOLUME 2.

The first property developed near Muswellbrook was 'Edinglassie' which was settled in 1826 and comprised a holding of some 12 000 hectares covering much of the Mount Arthur North Authorisation. Adjoining properties averaging 8 000 to 12 000 hectares developed around 'Edinglassie' on both sides of the Hunter River to establish what was to become a nucleus of unusually elegant and large homesteads. More than one homestead has been built on each of the original land grants.

Most of the buildings are Victorian constructed around the 1880's, although there is evidence of earlier colonial buildings from the 1820's on these properties. The former 'Edinglassie' now known as 'Rous-Lench' shows the more typical architectural style of buildings constructed during the 1820's and 1830's. These buildings and their sitings on the high terraces overlooking the rich alluvial Hunter River flats form quite a coherent and relatively uninterrupted rural grouping. Although they have not all been closely examined, they appear generally to be in good condition. They may not individually qualify for classified listing but should certainly be regarded as an important historic group of buildings typifying the early pattern of rural settlement in the Shire.

Thus the 'Edinglassie Group' comprising 'Edinglassie', 'Piercefield', 'Negoa', Bengalla' and 'Skellatar' and their associated outbuildings are a significant element of the total historic rural heritage outside individual townships in the Shire. Their presence as part of the rural texture of the valley, contributes to the rich man-made pastoral image of the valley that can be found only in a few agriculturally rich pockets in NSW.

The town of Muswellbrook contains many fine buildings and streetscapes. The main streets show a high collective quality of urban design and town wallscape coherence while residential areas are characterised by interesting topographic form, mature street tree planting and Victorian residential buildings mostly with galvanised roofs and details. Main Street and the Railway Station precinct warrant special consideration for conservation and other precincts may be revealed by an urban conservation study.

Further historical information regarding early settlement within the Muswellbrook district is contained in Document 6 of VOLUME 2.

5.9 LAND FABRIC

5.9.1 District Land Use

The traditional land use pattern of the Upper Hunter region in general and the Muswellbrook District in particular has typically reflected its historical origins and the long dominance that the agricultural sector has had on the area's economy. In more recent times however, due mainly to structural changes and an overall decline in the agricultural industries and from increased investments in coal mining and other related industries, namely power generation, the traditional land uses have given way in localised areas to resource/energy activities. Whilst agriculture still dominates the area's economy this situation is changing as more industrial developments related to the region's vast black coal resources become established. Similarly, the traditional rural service towns in this vicinity such as Muswellbrook, Denman and Aberdeen are experiencing changes to their physical, social and economic functions.

The main land use within the Muswellrook district is mixed agriculture ranging from beef-cattle grazing on native pasture to intensive cultivation and dairying on the irrigated flats. The district around Muswellbrook is practically entirely man-modified and cleared. The nearest substantial area of natural vegetation is in the Wollemi National Park, about 20 kilometres south west of Muswellbrook.

The rapidly changing character of the region from traditional agricultural land practices to coal resource and energy development can be clearly seen in **Exhibit 3.3, Coal Developments in the Upper Hunter Region.** As discussed in **Section 3.4, Mining Operations in the Muswellbrook Area,** it is likely that as many as seven new coal mines will be developed in the Muswellbrook Shire over the next ten years along with expansion at the two currently operating collieries. Further possibility of other major industrial developments in the longer term must also be considered.

5.9.2 Site Land Use

Land uses within the Authorisation area have been almost entirely agricultural until very recently. The exceptions have been small areas of residential land on the outskirts of Muswellbrook along the Denman Road and the racecourse and the Muswellbrook sewage treatment works. Recent non-agricultural uses include a large garage and motor workshop on the Denman Road, a regional office of the Shortland County Council and the Muswellbrook Council industrial estate extending southward along the Mitchell Line of Road. These uses are shown on **Exhibit 5.10, Town Planning Zones.** Agricultural activity within the Authorisation area is described in **Section 5.10, Agriculture.**

5.9.3 Land Tenure and Ownership

The land within the Authorisation area has been progressively subdivided from the original land grants into a larger number of land parcels under freehold title. Reservations to the Crown include land for public roads, stock routes and the Hunter River waterway.

Land to the north of the Hunter River lies in the Parish of Clanricard, County of Brisbane. The rest of the Authorisation area is within the County of Durham and includes part of the Parish of Vaux on the western side, the Parish of Wynn in the south east and the remainder lies in the Parish of Brougham.

Reservations from the leasing provisions of the Mining Act 1906 were proclaimed over parts of the Authorisation area intermittently from 1964. A proclamation in the Government Gazette of June 1971 reserved 16 500 hectares in the Mount Arthur area for future power generation purposes and the Electricity Commission was authorised to continue prospecting. In August 1979 the boundaries of the early coal Authorisation area were altered and redefined into two parts, A168 (Mount Arthur North) and A169 (Mount Arthur South).

Other adjacent Authorisation areas are A174 (Mount Sugarloaf), A171 (Bayswater) and A173 (Drayton) all on the east side and A102 on the north west boundary which is held by the Department of Mineral Resources. These Authorisation areas are also shown in **Exhibit 3.3.**

During 1980 the Electricity Commission has acquired properties within the Authorisation area and as of August 1980 owned about 40 percent of the area. That position regarding land ownership by the Commission is also shown on **Exhibit 5.6, Land Ownership,** along with a definition of the total area of land the Commission intends to purchase.

Excluding lands already acquired by the Commission, there are some 54 individual holdings of substantial size wholly or partly within the Authorisation area. Absentee ownership within this area is minor with only four properties held in this manner, three in the extreme south in the vicinity of Mount Arthur and the fourth in the south west sector.

5.10 AGRICULTURE

5.10.1 Existing Use and Capability

The present agricultural uses and capabilities within the Mount Arthur North Authorisation area have been assessed through farmer interviews and property inspections supported by aerial photograph interpretation. Both use and capability are diverse, but within the Authorisation area seven main classes have been delineated on the basis of topography and soils as summarised in **Table 5.7** and as shown on **Exhibit 5.7, Agricultural Land Classes.** The full text of the Agricultural Assessment Survey is given in Supporting Document 7 of VOLUME 2.

TABLE 5.7 - AGRICULTURAL LAND CLASSES
MOUNT ARTHUR NORTH AUTHORISATION AREA

Land Classes	Area (ha)	Percentage of Total Area
1. Alluvial River Flats	850	13
2. Lower Slopes	220	3
3. Whites Creek Area	400	6
4. Undulating Areas of Duplex Soils	3 540	53
5. Undulating to Hilly Areas	710	10
6. Steeper Slopes	840	13
7. Very Steep Areas	130	2
	6 690	100

Class 1 - Alluvial River Flats
These areas are liable to infrequent flooding although the floods have not restricted the land use pattern to any great extent. The soils are generally loams of good structure and texture, free draining, and of high natural fertility.

Within the Authorisation area virtually all the river flats are irrigated. Crops include lucerne, winter cereals, permanent improved pasture for milk production or beef cattle fattening, lucerne for commercial hay production, winter grain crops and summer crops. About 10 hectares are planted to wine grapes and at least two properties undertake horse breeding and spelling on irrigated improved pasture.

Class 2 - Lower Slopes
These are generally sloping to undulating terrain comprising mainly red podzolic and kraznozem soils, well drained and suited to irrigation. Natural fertility is moderate but response is shown to superphosphate application.

As these areas adjoin the river flats, many farmers have extended their irrigation schemes to include a proportion of their lower slope areas. Land use is similar to that on the flats although no areas of continuous cash cropping were identified and a higher proportion is sown to permanent pasture.

Class 3 - Whites Creek Area
Principal soils are red, yellow or yellow brown podzols and kraznozems. Top-soil depth is 70 to 120 mm with a pronounced clay (B) horizon. The soils are acid (pH about 5.5) and respond well to superphosphate application. The area is level to gently sloping and is all cultivatable apart from the creek banks and other eroded or erosion prone areas. It is currently used for beef cattle grazing although some areas have been cropped with winter cereals in the past.

Class 4 - Undulating Areas
The soils are variable but are mainly podzols and kraznozems with small areas of black prairie soils and lithosols (sandy soils). All of the soils apart from the lithosols (140 hectares) are suited to rotational cropping and improved pasture establishment. Class 4 encompasses over 50 percent of the Authorisation area.

The area is mainly under native pasture although some 420 hectares were sown to winter crop in 1979. Carrying capacity at present is estimated at one livestock unit to 1.4 hectares. This could be almost doubled with the regular application of superphosphate and the establishment of improved pasture species.

Class 5 - Undulating to Hilly Areas
Portions of this area, at the base of Mount Arthur, show signs of overgrazing in the past and gully and sheet erosion are widespread. Carrying capacity is about one livestock unit to two hectares at present. The area is well suited to pasture improvement by aerial or sod seeding techniques and would respond well to superphosphate. It is generally too steep for cropping or prepared seed bed pasture establishment.

Class 6 - Steeper Slopes
Sopils are principally red, yellow, brown and grey-brown podzols, interspersed with kraznozems. The area is under native pasture and although aerial pasture improvement is technically feasible, it is less suitable and economic than on the Class 4 and 5 areas. The areas can be safely grazed by beef cattle providing stocking rates and grazing management are carefully controlled.

Class 7 - Very Steep Areas
The area surrounds the peak of Mount Arthur is moderately heavily timbered and is not considered suitable for grazing, except on a limited seasonal basis.

5.10.2 Production and Productivity

The Authorisation area's agricultural enterprise mix has been estimated from a survey of about 50 percent of the properties wholly or partly within the area. This survey examined five classes of properties grouped on the basis of location, size and enterprise range. The number of farms in each group, their enterprise mix and workforce figures have been collected. The detailed breakdown is given in Document 7.

The Authorisation area of 6 700 hectares supports a livestock population of about 450 milking cows, 1300 beef cows, 140 horses and 360 breeding ewes. Total carrying capacity is approximately 4 700 livestock units. About 140 hectares are used for irrigated crops and a considerably greater area is cut for hay for on-farm use. Cash crops in addition to lucerne include winter cereals and summer grain and oilseed crops. On at least three properties a double cropping system is practiced. The total labour force is estimated at 50.

Using standard indices the annual productivity of the area has been estimated as shown in **Table 5.8, Agricultural Productivity.**

The value added by properties in the area would probably lie in the range of \$0.7 to \$0.8 million per annum (value added = gross value of output less purchased inputs). The area is obviously significant in terms of agricultural employment and production.

TABLE 5.8 - AGRICULTURAL PRODUCTIVITY
MOUNT ARTHUR NORTH AUTHORISATION AREA

	Units	Gross Output per Unit($)	Annual Gross Output($)
Dairy Cows	450 head	880	440 000
Beef Cows	1340 head	200	270 000
Dry Stock	880 head	100	90 000
Horses	140 head	300	40 000
Irrigated Crop	140 hectare	750	100 000
Vineyards	10 hectare	5 000	50 000
Dryland Crop	640 hectare	200	130 000
		TOTAL	$1 080 000

Of the total annual gross value output of $1.08 million it is estimated that the river flats produce about $0.65 million ($750 per hectare) and the dryland areas $0.43 million ($72 per hectare). The river flats are therefore about ten times as productive as the hills. Consequently as large a proportion of the river flats as possible should remain in their present use. Two further conclusions may also be drawn:

- most of the riparian farms south of the river can afford to lose their hill country (south of the Denman Road) without significantly affecting productivity. However if the Denman Road is shifted to excise a proportion of the lower slopes and flats the viability of the residual areas would be reduced.
- on the northern bank, the viability of the farms would be seriously impaired if the area within the Authorisation ceases to be available for farming

5.10.3 Regional Significance

In order to place the agricultural sector of the Authorisation area into a regional context, **Table 5.9, Agricultural Significance**, lists a number of parameters for the Authorisation area in relation to Muswellbrook Shire and the Upper Hunter region, which for this purpose comprises the Shires of Muswellbrook, Scone and Singleton.

TABLE 5.9 - AGRICULTURAL SIGNIFICANCE OF MOUNT ARTHUR NORTH AUTHORISATION AREA - 1978/79

	Site Area Units	Denman Shire Units	Site/Denman Shire(%)	Upper Hunter Units	Site/ Upper Hunter(%)
Dairy Cows	450	11 600	3.9	31 600	1.4
Beef Cows	1 340	23 650	5.7	110 400	1.2
Total Cattle	4 400	62 200	6.7	279 700	1.6
Total Sheep	700	10 100	6.9	183 400	0.4
Capacity (LU)	4 700**	67 000	7.0	306 000	1.5
Irrigation (ha)	790	5 900***	13.4	13 300	5.9

Source: Australian Bureau of Statistics and Water Resources Commission
* data refers to Denman Shire prior to amalgamation with Muswellbrook Municipality on 1 July 1979.
** including horses.
*** from Hunter River plus groundwater for areas between Glenbawn Dam and Goulburn River.

The irrigated area within the Authorisation area is thus significant in both local and regional context. It is therefore considered to be desirable to maintain the present intensity of use.

The livestock carrying capacity of the area is less significant due to the high proportion of beef cattle and sheep in the region which are run on areas distant from the river. In relation to the livestock numbers on the valley floor and adjoining lower slopes, the carrying capacity of the Authorisation area represents in excess of 5 percent of Muswellbrook Shire's carrying capacity.

5.11 LANDSCAPE

5.11.1 Regional Landscape

The Hunter region has been described as a rich and varied rural and natural landscape comprising the broad river valley of the Hunter surrounded by an ampitheatre of mountain ranges of elevations in excess of 1 500 metres above sea level and opening onto the low lying coastal lands to the east. In the inland areas of the Upper Hunter the landscape is characterised by the natural environment of mountains and valleys, rivers and streams and associated flood plains, and the superimposed urban townscapes of the rural settlements scattered throughout the valley. The prevailing rural image dominating within the Upper Hunter is of an idealised pastoral valley containing small rural settlements and surrounded by natural wooded mountains. Exceptions to this overall image are the range of varied townscapes with their own unique character and rich heritage of historic buildings as previously described (refer **Section 5.8.3**).

5.11.2 Local Landscape Elements

The Authorisation area has been analysed using contour plans and extensive field observations. The area has been classified into nine distinctive landscape units based on landforms, slope drainage patterns, soils, vegetation and relative location. A full description of the landscape units is contained in Document 8 of VOLUME 2. The most significant landscape units are the peak of Mount Arthur and the Hunter floodplain. An outline of the principal characteristics of landform, soils and vegetation are given below:

Landform: The dominant landform feature is Mount Arthur which, at an elevation of 483 metres above sea level, forms the core of an isolated system of hills and ridges. A series of major spurs radiate from Mount Arthur with a further series of spurs and slopes at a lower elevation. The slopes immediately below Mount Arthur are strongly disected by narrow, steep drainage lines which lead into broader, flatter valleys forming tributaries of the Hunter River to the north and Saddlers Creek to the south of the site. Mount Arthur not only dominates the site, but also constitutes a landscape feature of regional significance visible from a distance of at least 15 kilometres. The alluvial flats of the Hunter Valley are also considered a landscape feature of regional significance with the lush texture being a feature by itself and providing scenic contrast to the backdrop of drier hills. The character of the site land form is shown on **Exhibit 5.8, Natural Land Forms.**

Soils and Vegetation: Soil characteristics with regard to physical structure and fertility have been described in the preceeding **Sections 5.2 and 5.10.**

Natural soil/vegetation associations have been almost entirely removed from the site by clearing, except for a small area around the summit of Mount Arthur and a few other isolated patches. As a result existing native vegetation decreases in density with lower elevation, as shown in **Exhibit 5.4, Site Vegetation.** The remnant stands of trees provide a guide to species that would regenerate naturally, or are suitable for planting for visual screening.

5.11.3 Visual Access

The landscape study considered the following two main categories of views into the site:

Views from adjoining roads: The proposed mining lease is bounded on three sides by public roads which afford views of various parts of the site. The extent of these views was determined by field observations and recorded as view catchments on **Exhibit 5.9, View Catchments.** It should be noted that some parts of the site are visible from more than one of the adjoining roads, while other parts of the site are only visible from one road. There are only a few areas which are not visible from any of the adjoining roads. **Exhibit 5.9** can be used to identify areas where tree planting or earth mounding would be effective in screening mining operations.

Views from surrounding areas: As the site is generally located on the northern slopes of a major system of hills separating two catchments, views from areas south of the site are blocked. The primary viewing points are therefore from the Hunter River valley and Muswellbrook township. In the case of Muswellbrook, views of the site are possible only from a high ridge running east west through the township. Views from lower elevations are blocked by an intermediate ridgeline between the town and Mount Arthur North site. Views into the mining area can be obtained from large areas of the river valley which are impractical to block by tree sccreening or mounding. Although these are distant views they are nevertheless significant, partly because of residences in the valley and travellers on various roads north west of the river, and partly because such views will affect the important scenic quality of the valley. Long distance views will be particularly affected by any operations on prominent ridges, areas of generally higher elevation and near the peak of Mount Arthur in particular. The design for visual control is set out in **Chapter 6, Environmental Safeguards.**

5.12 TOWN PLANNING

5.12.1 Existing Planning Controls

The Authorisation area is covered by an existing town planning scheme of the Muswellbrook Shire Council, being Interim Development Order Nos 1 and 2, gazetted in June 1968 and April 1974 respectively. Under Interim Development Order No 2, the area is included largely within the land use zone 1(A), 'Non Urban A'. The other main zone is 1(B), 'Non Urban B' which extends for 400 metres on either side of the Denman Road. Both of these zonings are primarily for primary industry land uses. In the extreme north east of the Authorisation area a small area, zoned as 5(A), 'Special Uses A' for the Council sewage treatment works intrudes into the area. The existing generalised land use zonings for the town of Muswellbrook and the Authorisation area are illustrated on **Exhibit 5.10, Town Planning Zones.**

5.12.2 Current Planning Proposals

At the regional level the Hunter region has been the subject of a number of studies over the last two decades. The most recent and comprehensive regional planning study has been 'The Hunter Regional Plan' undertaken by the Hunter Regional Planning Committee (HRPC) in its advisory role to the former NSW Planning and Environment Commission. The ultimate intention of this work is to adopt a Hunter Regional Plan as the guideline for future government and private initiative within the region. Whilst this work is still continuing, the Committee has completed a Discussion Paper as a result of earlier studies which outlines planning proposals (including policies) which are intended for inclusion in the Hunter Regional Plan (**Reference 21**).

In another move to coordinate future planning and development undertakings within the Hunter Region, a Coordinator has been recently appointed and a special advisory unit has been established within the Premier's Department.

At a local level there are two current planning undertakings which have some influence upon this impact statement. They are:

Muswellbrook Shire Community Impacts Study which commenced in September 1980 on behalf of the Muswellbrook Shire Council. The intention is to provide Council with an overall strategy for their Shire taking into account all known and foreseeable development proposals within the Shire, namely those projects or associated projects related to mining and power development. The study will be mainly concerned with the physical implications to the Shire and its urban centres as a result of future pressures and demands created by these developments. An interim report for the study is contained in Document 12 of VOLUME 2. The Singleton Shire Council has likewise recently undertaken to complete a similar study.

Buffer Zone Determination Study which commenced also in September 1980. The Muswellbrook Shire Council has commissioned consultants to examine the implications of mining and other development proposals within the vicinity of the towns of Muswellbrook and Denman and to recommend an environmental protection zone for these settlements to safeguard the residents from such effects as noise, dust, vibration and loss of visual quality that might result from these developments. It has recently been reported that this work would form the basis of a larger study which would result in the preparation of the Local Environmental Plan for the Shire.

5.13 REGIONAL TRANSPORTATION AND SERVICES

5.13.1 Road Network

The principal road access through the Upper Hunter is the New England Highway, State Highway No 9. The road is generally of a high standard, two lane construction with short sections developed to four lanes. Department of Main Roads long term plans are to improve it to dual carriageway standard from Maitland through to Scone. Plans for diversions around Singleton and Muswellbrook are not known. Other principal public roads in the vicinity of the Mount Arthur site are:

- Muswellbrook to Denman Road, Main Road No 209
- Edderton Road connnecting the Denman Road to the Jerry's Plains Road
- Mitchell Line of Road from the Denman Road to Bayswater No 2 Colliery

Existing traffic volumes are low to moderate in relation to the standards of these roads with noticeable increases around the outskirts of Muswellbrook. Past growth of annual average daily traffic volumes (AADT) is shown in **Table 5.10, Daily Traffic Volumes.** The most noticeable feature is the increase in volumes on the town end of Denman Road (Sydney Street) caused by recent development along this route.

TABLE 5.10 - DAILY TRAFFIC VOLUMES (AADT)

Location	Count Station	1972	1976
New England Highway:			
. rural section	5.039	3 810	5 600
. urban fringe	5.244	4 720	7 680
. at junction with Denman Road	5.245	6 030	8 420
Denman Road:			
. west of Edderton Road	5.073	1 040	1 270
. at junction with New England Highway	5.477	5 400	9 690
Edderton Road:			
. at junction of Denman to Jerrys Plains Road	5.696	250	440

Source: Department of Main Roads.

5.13.2 Rail Facilities

The Main Northern Railway passes through Muswellbrook and provides the Sydney to Brisbane rail link. Over a 24 hour period it provides the services, shown in **Table 5.11, Rail Traffic on Main Northern Line,** between Muswellbrook and Newcastle. A total of 62 train movements occur on average in each 24 hour period from Monday to Saturday while on Sunday the traffic flow is considerably lower.

TABLE 5.11 - RAIL TRAFFIC ON MAIN NORTHERN LINE

Origin to Destination	Daily Rail Traffic		
	Passenger	Freight	Coal
Newcastle to Muswellbrook	3	7	19
Muswellbrook to Newcastle	3	14	16
TOTAL	6	21	35

Source: State Rail Authority

At present the line is single track between Muswellbrook and Antiene, double track from Antiene to Maitland and with four tracks from Maitland to Newcastle. The State Rail Authority expects that traffic flow on this line will double by 1985. Track duplication is being considered for a short section north of Antiene to Grasstree. Electrification is being considered for the line south of Muswellbrook. A rail spur will shortly be constructed from Antiene Junction to the proposed Drayton coal mine site.

The Muswellbrook to Merriwa branch rail line closely parallels the northern boundary of the Authorisation. The line runs from Muswellbrook to Denman and through to Merriwa. Present movements on this line are relatively low. However, with the completion of the Ulan to Sandy Hollow rail link a considerable increase in traffic will occur initially principally because of the Ulan Coal Mine development. However, it is expected that other produce from the northern district of NSW will be moved by this route in lieu of the Main Western Line through Lithgow. The Environmental Impact Statement for the Ulan to Sandy Hollow rail line was released in September 1980.

5.13.3 Air Services

The principal airfields in the Upper Hunter are located at Scone, Singleton and Maitland. The Singleton airfield is associated with the Army Base. They are classified by the Department of Transport as Class C aerodromes indicating that their runway length is 1 500 metres or less. Scheduled services from Sydney operate to each of the three establishments. In addition private landing strips are located on many of the local properties. A private strip is used by the Electricity Commission at Ravensworth. Muswellbrook has no air service.

5.13.4 Power Supplies

Power reticulation in the region is controlled by the Shortland County Council. Reticulation to the township of Muswellbrook is serviced by two 15 MVA transformers which have the capacity to supply up to 15 000 persons. Rural properties are all connected to main electricity.

5.13.5 Water Supply and Sanitation

Muswellbrook's existing water supply, sewerage and waste disposal systems are summarised below:

Water Supply: water is drawn directly from the Hunter River with the present system having a capacity equivalent to approximately 14 000 persons.

Sewerage: the vast majority of houses in Muswellbrook are connected to the sewerage system; the existing treatment works has a capacity equivalent to 14 000 persons.

Solid Waste: a garbage collection system operates in Muswellbrook. Garbage is disposed in the local Council tip on the north east corner of the town.

The Council is currently extending a water supply service to the new Council industrial estate located on the Mitchell Line of Road. It is proposed to also make connections available to the proposed Drayton, Black Hill and Mount Arthur North mine offices and amenity areas.

The situation in Singleton is not as good with both water supply and sewerage facilities operating at their maximum capacity. The smaller urban centres of Denman and Scone are reasonally serviced with water and sewerage facilities. Water supplies are extracted again from the Hunter River and are not treated capacity for chlorination. The sewage treatment facilities in both towns are in need of upgrading.

5.14 POPULATION AND EMPLOYMENT

5.14.1 Regional Population

The Local Government Areas (LGA) of significance to this project are Muswellbrook Shire, (formerly Muswellbrook Municipality and Denman Shire prior to amalgamation in 1979), Singleton Shire and Scone Shire. This local region currently contains approximately 0.7 percent of the State's total population and some 7.6 percent of the Hunter Statistical Division's (SD) population. In terms of population growth, this Upper Hunter region has fallen well below that of the State and Hunter SD. From 1971 to 1976, its average annual population growth was 0.07 percent compared with 0.75 percent for the State as a whole and 0.67 percent for the Hunter Division. In more recent times (1976 to 1979) the trend has been improved (0.82 percent) but the region's annual growth rate has in no way equalled that of the State (1.12 percent) nor that of the Hunter (0.95 percent) for the same period.

In the past this region has not absorbed its share of the State's population growth. The main demographic factors associated with this region which have contributed to this situation include:

. lower proportions of woman in the child bearing ages
. declining fertility ratios
. net out-migration especially in the younger age groups
. increasing average age of population

Table 13(a) of Document 13, VOLUME 2, provides a demographic comparison between the LGA's, the Hunter region and State as a whole, in terms of average age of the population and fertility ratios.

Populations and demographic trends for the LGA's are tabulated in **Table 5.12, Upper Hunter Population.** Whilst the more recent growth rates (1976 to 1979) for all LGA's have all increased in comparison to those for the 1971 to 1976 period, the overall population growth in this Upper Hunter region has been slow and with the exception of Singleton Shire, have been below the average annual growth ratios for the Hunter SD and the State as previously discussed.

Other demographic characteristics such as the age/sex structure, masculinity, marital status, and birthplace of the LGA's have been tabulated in **Table 13(b)** of Document 13 along with corresponding statistics for the Hunter SD and the State for comparative purposes. The figures demonstrate very little variation between the LGA's but moderate to significant differences to the characteristics of the Hunter SD and the State. The proportion of the LGA's population is higher in the lower age groups (0 to 5, 6 to 14 and 15 to 17 age groups) whilst lower in the remaining upper age groups as compared to the Hunter SD and the State. Likewise, all LGA's display higher masculinity ratios. Of note is the significantly higher proportion of the LGA's populations that are Australian born.

Of the current population of the LGA's, some 67.5 percent are located in urban centres. These include the settlements of Singleton, Muswellbrook, Denman, Scone and Aberdeen. The sizes of these settlements in population terms are given in **Table 5.13, Urban Centre Population.**

TABLE 5.12 - UPPER HUNTER POPULATION

Local Government Area		1971	1976	1979 (Est.)	Average Annual Growth Rate (Percent) 1971-1976	1976-1979
Muswellbrook	(1)	8 125	7 805		-0.79	
Municipality	(2)		8 150	8 300		0.61
Denman	(1)	3 646	3 713		-0.37	
Shire	(2)		3 900	4 000		0.85
Muswellbrook	(1)	11 771	11 518		-0.43	
Shire*	(2)		12 050	12 300		0.69
Singleton	(1)	11 863	12 359		0.84	
Shire(3)	(2)		12 900	13 350		1.16
Scone	(1)	7 519	7 379		-0.37	
Shire	(2)		7 700	7 800		0.43

Source: Australian Bureau of Statistics

Notes: (1) 1971 and 1976 census as recorded

(2) 1976 census adjusted (ABS) for the effects of under enumeration.

(3) Muswellbrook Municipality amalgamated with Denman Shire on 1 January 1979 to form present Muswellbrook Shire

TABLE 5.13 - URBAN CENTRE POPULATION

	1966	1971	1976	1980*
Singleton	6 188	7 187	8 250	8 630
Muswellbrook	6 486	8 125	8 150	8 350
Scone	2 915	3 262	3 550	3 610
Aberdeen	1 127	1 118	1 200	1 220
Denman	775	784	808	830

Source: Australian Bureau of Statistics

* Estimated using 1971 to 1976 LGA annual average growth rates.

5.14.2 Local Population

The resident population within the Authorisation area is approximately 154 persons. This has been estimated by multiplying the number of known occupied dwellings by 3.59, the average occupancy rate for CD5 (this description of the existing population is based on the 1976 census results for Collection District No 5(CD 5), Subdivision 6, Census Division of Paterson, which contains the Authorisation area.)

The population is unevenly distributed throughout the Authorisation area with some 84 percent concentrated in the northern section in the vicinity of Denman Road. Thirty seven percent of the residents are between the Denman Road and the Hunter River. A further 14 percent of the population is located in the western sector in the vicinity of Edderton Road. Only two percent reside in the north east corner along the Mitchell Line of Road. About 30 percent of the dwellings have been constructed in the last 10 years and almost all of the residents have resided in the same dwellings since 1976.

The general demographic characteristics of the local population are as follows:

- practically all are of European racial origin
- about half of the population is married
- almost 40 percent are below the age of 15 years with approximately 30 percent attending school
- just less than one half of the population are in the permanent labour force
- about 25 percent are engaged in rural occupations
- 20 percent are employed in the coal mining industry
- the balance of the workforce are engaged in activities and industries located in or closely associated with Muswellbrook

5.14.3 Employment Structure

In 1976 less than one half of the population of the respective LGA's was in the labour force (as shown in **Table 13(c)** of Document 13). Whilst the proportion of labour force to population in each LGA was marginally or slightly below that for the State, all were well above that for the Hunter SD. The ratios for the main urban centres were similar with the exceptions of Singleton and Aberdeen whose ratios were lower than those for both the Hunter SD and the State.

Table 13(d) of Document 13 gives the distribution of the labour force in the main industry categories for the four LGA's that existed in 1971 to 1976. The urban areas of Muswellbrook and Singleton have comparable proportions of their populations employed in primary (including mining) and secondary industry. Muswellbrook has about twice the proportion of employment in Tertiary I category (utilities, construction and transport) compared to Singleton, whereas Singleton dominates in the Tertiary II category due largely to the presence of the Army Base.

In the rural areas, primary industry accounts for over 50 percent of employment, as would be expected. However, while agricultural employment tended to drop slightly between 1971 and 1976, mining employment increased by an overall average of 60 percent over the same period and increased by over 70 percent in Singleton Shire. In 1976 mining represented 30 percent of primary industry employment for the four LGA's. The majority of miners resided in the main urban centres.

Table 13(e) of Document 13 gives the distribution of the labour force by occupation for 1971 and 1976 for all LGA's as well as for the Hunter SD and the State for comparative purposes. The LGA areas are characterised by lower proportions of their labour force in the professional, technical, administrative, managerial and clerical occupations in comparison to the Hunter SD and the State. The lack of employment in the 'white collar' occupations in these LGA's reflects the low level of employment in industry and commerce. This is probably a significant factor associated with out-migration especially in the younger age groups from this region.

Recent developments in the Muswellbrook-Singleton district are changing the employment characteristics of the area. Detailed statistics are available only up to 1976 and consequently trends and characteristics identified from these statistics may be subject to appreciable amendment when more recent data becomes available. Employment related to mining has undoubtably continued to increase substantially in the four years since 1976 and a related but smaller increase in the Tertiary II category can also be expected. The population of the workforce engaged in the mining occupation for Muswellbrook and Singleton Shires is significantly higher than those for the Hunter SD and the State as a whole.

5.14.4 Unemployment

The registered unemployed for the periods April 1980 (latest statistics available), July 1979 and July 1978 are tabulated in **Table 13(f)** of Document 13.

The sections of the labour force of these areas that are most affected by unemployment are clearly adult males and junior females. With the exception of Singleton, the rate of unemployment has not differed significantly from those of the Hunter SD and the State. This LGA has also recorded a significant increase in unemployment from 1976 to 1979 whilst Scone has had a significant decrease. Rates of unemployment are tabulated for both years in **Table 13(g)** of Document 13.

Table 13(h) gives the distribution of unemployed by occupational class as of 30 May 1980 (latest statistics available) for the Maitland CES Office. The clerical and administrative group has the highest unemployment in absolute terms, followed by the semi-skilled and unskilled groups. The latter two groups are the most significant in terms of unemployed males, whilst the former has by far the largest number of unemployed females. There are no unemployed skilled miners.

5.15 HOUSING AND ACCOMMODATION

5.15.1 Regional Status

The region as a whole is currently experiencing a serious shortage of permanent housing and temporary and rental accommodation. Plans are underway to increase the supply of housing by all of the local authorities within the region concerned with many new residential areas being subdivided for housing by the Council, government and private organisations.

Building applciations for new dwellings within the LGA's have increased over the previous three years and this trend is continuing as is evidenced by the number of approvals granted in the first six months of 1980. Details are given in **Table 13(i)** of Document 13.

The acute shortage of rental accommodation in this area has resulted in the high use of caravans as temporary dwellings. The capacity of caravan parks in most cases has been reached or exceeded. A number of new caravan park sites are presently under construction and more are being planned for the near future. **Table 13(j)** of Document 13 provides a summary of temporary accommodation available in the main urban centres.

The current housing and accommodation situation in the five main urban centres is summarised in the following sub-sections:

5.15.2 Muswellbrook

At present there is a housing shortage within the town due to the increased demand by the employees of various companies involved in coal mining in this region. The Council had planned to release 78 allotments for sale in October 1980 and all but 15 were purchased three months before their release. These allotments form part of 900 proposed allotments north of the town which the Council hopes to be able to release in groups every six months. Further allotments south of the town adjacent to the showground are also being developed by private developers, 40 of which are planned to be released for sale in August 1980.

Temporary accommodation is provided by 12 hotels, motels, and guest houses, plus two caravan parks all of which are presently operating at their maximum capacity. It is planned to construct a new caravan park consisting of 150 sites by June 1981.

5.15.3 Singleton

There is currently a housing shortage in the township with permanent and rental accommodation being difficult to obtain. The Council planned to release 48 allotments in August 1980 and a further 100 towards the end of 1980. These would form Stage II of the Council's planned programme with Stage III being released in mid 1981.

Temporary accommodation is provided by 11 hotels and motels plus two caravan parks.

5.15.4 Denman

Demand for housing is high within the town and a shortage exists at present. Current zoning covers some 600 building lots, half of which are built on. Forty seven new allotments, located on the northern edge of the town, are planned for release in the first six months of 1981.

There are two hotels which provide temporary accommodation and a new caravan park is presently under construction.

5.15.5 Scone and Aberdeen

As with the other townships Scone and Aberdeen have a general shortage of housing and accommodation. To help reduce this problem the Council plans to release for sale 80 residential blocks in Scone early in 1981 in addition to an 84 block subdivision at Aberdeen to be released in November 1980. A private company has planned 600 residential blocks on the eastern side of Scone which it hopes to subdivide and release in the near future.

Temporary accommodation in the town of Scone is currently provided by 8 hotel/motels and three caravan parks.

5.16 COMMERCIAL AND INDUSTRIAL STRUCTURE

5.16.1 Economic Hierarchy

The urban centres of Singleton and Muswellbrook are the dominant centres of economic activity in the Upper Hunter sub-region although they themselves are relatively small compared to centres in the Lower Hunter and at Newcastle. Other towns in the sub-region have very little economic significance, being confined as a rule to a purely rural service centre function. A listing of all categories of commercial and industrial concerns is given in **Table 13(k).**

5.16.2 Retailing

A study of retailing activity in the Hunter region was carried out in 1977 **(Reference 23)** and this is the basis for the following discussion.

The Upper Hunter region has a large net outflow of retail spending amounting to about $23 million in 1973/74 and indications are that this situation has continued since then, if not accelerated. The main beneficiaries of this spending appears to be the Lower Hunter (particularly Maitland) and Newcastle for major comparison shopping. A proportion of spending goes to Sydney and a small proportion is known to be attracted to Tamworth, which is expanding.

In 1973 the commercial net selling floor space in Singleton was 4 500 square metres and modest increases have occurred since. Muswellbrook has a similar area of commercial space. For comparison, these towns have less than one third the commercial space of Maitland. Both Muswellbrook and Singleton provide a good standard of convenience shopping. Aberdeen and Scone also provide convenience shopping, partly supported by trade from highway traffic, but both are smaller than Muswellbrook.

5.16.3 Building Activity

An indication of current growth trends is shown in the Building Applications approved for each LGA. The number and value of approvals is given in **Table 13(l)** of Document 13.

Known proposed commercial developments of significance to this region include a two-storey shopping complex to be built within the town of Muswellbrook. It is proposed that this complex will include provision for one major department store plus 16 speciality shops.

5.16.4 Industry and Service Enterprises

There are no large scale secondary manaufacturing enterprises in the Upper Hunter. However there are a number of industries processing primary produce. The Hunter Valley Co-Operative Dairy Company operates a factory in Muswellbrook. F J Walker Pty Ltd operates the abattoir in Aberdeen and Walfertan Pty Ltd operates the associated tannery. There is another dairy factory in Singleton.

The main towns have one or more dealers or repair workshops for agricultural machinery and motor vehicles. Agencies and service enterprises associated with the mining industry have become established in Singleton and some are being set up in Muswellbrook.

Recent industrial developments in proximity to the Authorisation area include the new industrial estate of the Muswellbrook Shire Council on the Mitchell Line of Road. Stage I of the development is nearing completion and to date a number of development applications have been approved.

5.17 COMMUNITY FACILITIES

5.17.1 Primary and Secondary Schools

The main urban centres of Muswellbrook and Singleton are serviced with a full range of educational facilities ranging from Pre-Schools through to Technical Colleges and including specialised facilities such as Sub-Normal Schools. Both towns act as the educational centres for their respective sub-regions. **Table 13(m)** in Document 13 lists all schools in the region with enrolments as of May 1980.

Pre-School/Kindergarten facilities are available in the larger centres of Muswellbrook, Singleton and Scone. Government and Non-Governnment sponsored primary schools are located in all the larger towns and in most of the smaller rural towns such as Aberdeen (one school) and Denman (two schools). The schools in the larger towns tend to a large average size which permits a degree of specialisation and access to a wider range of resources.

Secondary schools are confined to the towns of Muswellbrook, Singleton and Scone. Small extensions are being made to Muswellbrook High. The primary schools at Muswellbrook, Scone, and Singelton are presently at their capacities and additions are planned.

Table 13(n) provides a comparison of average school size between the main urban centres (including government and non-government schools). Of all centres, Muswellbrook has by far the highest average school size for both primary and secondary schools. Consideration of only government schools does not change the position as indicated in **Table 13(n)** to any extent. **Table 13(o)** provides another comparison of the educational facilities in terms of the average number of school age children served by primary schools within each LGA. The situation with respect to the town and Shire of Muswellbrook, in comparison with surrounding areas, does not change.

5.17.2 Technical and Tertiary Education

A large technical college at Muswellbrook offers a range of trades, business, fashion and adult education courses. Total enrollment in the college is about 1 200 full time and part time students (74 full time and 1126 part time) of which 300 are engaged in trade courses. The Government is expected to spend approximately $1.7 million on the college within the next few years and this would increase its capacity to approximatey 2 500 students.

A small technical college with 461 students both part and full time (28 full time, 433 part time) is located in Singleton and offers business and fashion courses. Extensions are currently underway with the construction of a welding shop and lecture room and further extensions are planned for 1981.

Tertiary education facilities for the Hunter Valley region are located in Newcastle, these being the Newcastle University and Newcastle College of Advanced Education.

5.17.3 Health and Welfare Services

The region is generally well provided with health services which are listed in **Table 13(p)** of Document 13 **(Reference 24).** Most general services are available locally, although higher order specialist services can only be obtained in Newcastle or Sydney.

An extension is nearing completion at Muswellbrook Hospital and development plans are being prepared for Singleton, both related to ancilliary facilities.

The rate of provision of general purpose hospital beds in the Upper Hunter is comfortably above the State average on a per capita basis. The provision of certain special purpose beds such as obstetric and paediatric are also satisfactory at present. Provision of geriatric care, in both hospitals and nusing homes, tends to be below the desired standard of 50 beds per 1 000 population aged 65 or more. This is significant because the over 65 age group is increasing faster than overall population growth.

The number of doctors in the Upper Hunter region is near the average for non metropolitan areas of Australia, but significantly below metropolitan area standards. Doctors attend the district hospitals as required on an honorary basis.

5.17.4 Other Community Facilities

A comparative listing of institutional and other community facilities for each of the main urban centres is provided in **Table 13(q)** of Document 13. Of all centres Muswellbrook is served with a good range of these facilities and it in turn serves the sub-region by the location and range of institutional facilities that have been established there.

5.18 RECREATION AND TOURISM

5.18.1 Town Facilities

A reasonable range of recreational facilities are available in the larger towns, most oriented to sporting activities. Muswellbrook and Singleton have licensed social and sports clubs with associated facilities for golf, bowls and tennis. Other sporting facilities include Olympic swimming pool complexes, sports grounds and racecourses.

Non sporting recreation needs are served by Municipal libraries, museums, and a variety of special interest clubs and associations. Smaller centres such as Aberdeen and Denman have correspondingly fewer facilities. A detailed list of facilities in each town is given in **Table 13(r)** of Document 13.

Associated with the facilities tabulated are many sporting, social and service clubs. Sporting clubs are relatively strong within the community and include such clubs as golf, bowls, league, cricket and swimming. Service clubs include such groups as CWA, Apex, Parents & Citizens Associations etc. In all, the towns are well served by social facilities and organisations considering the population base within the area.

5.18.2 District Facilities

A variety of recreational attractions are available within a reasonable range from Muswellbrook. These are shown in **Exhibit 5.11, District Recreation,** and are described below.

National Parks and Aboriginal Sites
The Barrington Tops National Park with an area of 16 000 hectares is 50 kilometres east north east of Muswellbrook and forms part of a southern extension of the New England Plateau along the Mount Royal Ranges. This park is considered a wilderness area with limited access and contains a great diversity of plant communities from sub-alpine woodlands, grasslands and swamps to hardwoods, beech forests and warm temperate rain forests set in rugged terrain. The area is dissected by fast running creeks.

Wollemi National Park covers an area of 450 000 hectares extending from the Hunter River between Denman and Singleton south into the Blue Mountains and west to Rylestone. The park is largely a wilderness area with many species of native fauna and flora. It contains many aboriginal relics and traces of their culture such as hand stencils, cave drawings and grinding grooves. These can be seen in the Appletree Aboriginal Area situated on the northern boundary of the Wollemi National Park, 20 kilometres west of Singleton.

State Forests
A small State Forest, No 975, lies south east of Muswellbrook between the New England Highway and the Main Northern Railway and a State Nursery is located near Muswellbrook.

Nature Reserves
There are four nature reserves within the general area. Burning Mountain, Wingen Maid and Cedar Brush Nature Reserve are situated close to each other and are about 20 kilometres north of Scone. The Manobali Nature Reserve is situated about 30 kilometres west of Muswellbrook. The nature reserves provide a protected area for flora and fauna and are important as an education tool as well as providing a pleasant recreation area.

Water Sports
Glenbawn Dam and Lake Liddell provide outlets for power boats, sailing and fishing. Lostock Dam and proposed Water Resources dams at the Wybong Creek, Brushby, Rouchel Brook and Fal sites will add to the recreation resource, although permitted uses of the water bodies are not known at present.

Wineries
Although the Upper Hunter is much less significant than the Pokolbin area for wine making, there are a few established vineyards and a number of recently planted areas in the Denman area. The newer wineries are known for quality wine. There are currently some 14 vineyards in this Upper Hunter region.

Historical
The historical heritage of the Hunter Valey has been described in **Section 5.8, Early History and Settlement.** As yet few of the historic buildings are open to the public but it is anticipated that efforts of local historical societies to restore old buildings such as Merton, will improve the situation in time.

5.18.3 Tourist Industry

The tourist industry in the Upper Hunter generates modest but steady revenues. As the area lacks tourist attractions of mass appeal, business is largely dependent on short term accommodation for travellers and visitors. The present outlook is for continuing slow growth. The extent to which mining and industrial development can be developed for tourist appeal is concluded in a later section.

Throughout the year there are a number of annual events which attract large numbers of inter-regional visitors to the Upper Hunter. The main events include:

- Muswellbrook Rodeo (March)
- Muswellbrook Agricultural Show (April)
- Muswellbrook Art Exhibition (April)
- Muswellbrook Picnic Races (May)
- Muswellbrook Art Prize and Purchase Exhibition (July)
- Upper Hunter Wine Festival - Denman (October).

5.19 SUMMARY OF EXISTING ENVIRONMENT

This chapter has described the component characteristics of the environment of both the immediate Authorisation area and the adjacent and regional area which may be affected by the proposed mine development. The potential constraints are reviewed below as an input to the development in **Chapter 6, Environmental Safeguards,** of necessary design and operational safeguards for the project.

Soil Types
Limited areas have been identified of soils which are suitable for stockpiling and later reuse; soils are characterised by low nutrient levels which will require application of complete fertilisers to improve their fertility level; soil types susceptible to erosion have been identified.

Overburden Rocks
Massive sandstones with some fine grained sandstone and mudstones make up the interburden and overburden material; the mudstones and fine grained sandstones will disintegrate rapidly when exposed to the atmosphere; the chemical composition of the rocks indicate that leachate flows will be moderately saline, high in iron and slightly acidic; oxidised coal will result in higher groundwater salinity levels; soluble toxic compounds were not detected in either the oxidised coal or overburden rocks.

Topography
Ground slopes in the areas proposed for mining are generally less than 5 degrees and will pose no special construction problems.

Flooding
Catchment areas of the principal watercourses which drain the site are relatively small and will not pose any significant problems due to flooding; the one in 100 year flood levels of the Hunter River which range between 137 and 142 metres at the boundaries of the Authorisation will cause backwater flooding in the lower reaches of Whites and Ramrod Creeks; these areas are not affected by mining under the current proposals although under future proposals mining is likely in the lower reaches of Whites Creek.

Groundwater
The coal seams form groundwater aquifers with the thicker seams being the principal sources; from site pumping tests individual bores will yield of the order of 5 000 litres per hour.

Water Quality
Groundwater is relatively saline with TDS levels of between 3 000 and 5 000 mg/L; surface water is highly saline during low flow times due to inflow from the groundwater aquifers; Hunter River salinities are between 250 and 500 mg/L.

Climate
The area is characterised by occasional severe frosts, extended dry periods of up to 6 months or more, and relatively high evaporation leading to a water deficit in all months of the year; wind directions are predominantly from the south east and the north west; monitoring of air qualities has resulted in the adoption of a median dust deposition rate of 1.0 gm/m^2/month; the predominant direction of dust movement from the site during mining operations will be to the north west; temperature inversions will occur in the area approximately 30 to 40 times per year.

Flora and Fauna
Extensive overclearing has removed most of the original native trees from the Authoristion; the site area is generally unimproved pasture with the exception of the southern area around Mount Arthur, which is virtually unchanged, and the northern area where intensive irrigated pasture development has occurred along the Hunter River flood plain; apart from the 60 hectares of natural bushland in the Mount Arthur area, the loss of natural habitat has reduced the native fauna populations generally throughout the site; no indangered species were identified on the site although the presence has been recorded of platypii on the lower reaches of Whites Creek.

Acoustic Environment
Background noise levels on the site are typical of rural areas; three off-site locations were monitored to the north and north west of the site in the area likely to be most affected by mining operations - the three areas selected are described as suburban, rural and distant rural; the ambient levels recorded were 28 to 45 dBA during the day, 34 to 40 dBA in the evening period, and 27 to 39 dBA at night; the adopted ambient levels for later comparative purposes were 30 to 35 dBA at night, and 40 to 45 dBA during the day.

Early History and Settlement
A survey for the site for aboriginal relics did identify a number of former camp sites at which various artefacts were collected; apart from recording the locations of these sites, there is no site which warrants preservation within the Authorisation; within the bounds of the Authorisation there are a number of homesteads which because of their association with the region's history, their architecture and location have been recorded by the National Trust as being worthy of preservation.

Land Fabric
The site is generally zoned Non-Urban A; there are no planning proposals within the Authorisation which will conflict wtih the proposed mining use; the lands within the Authorisation are progressively being acquired by the Commission for the proposed operational areas and to provide buffer zones around proposed mining areas and provision for future mining proposals.

Agricultural Assessment
The site area has been predominantly developed for agricultural pursuits; existing productivity of the various land classes has been assessed - apart from the river flats, the regional agricultural significance of the site area is low; however the irrigated area is significant agriculturally in both local and regional terms and should be preserved.

Landscape
The site is a good example of immediate Hunter River Valley landform which characterises the Upper Hunter Valley landscape; the two significant landscape features are the peak of Mount Arthur and the Hunter River flood plain; high visual access of the site is afforded from three roads which border the site; visual access from more distant parts is restricted to areas north of the Hunter River and from a high ridge running through the Muswellbrook township.

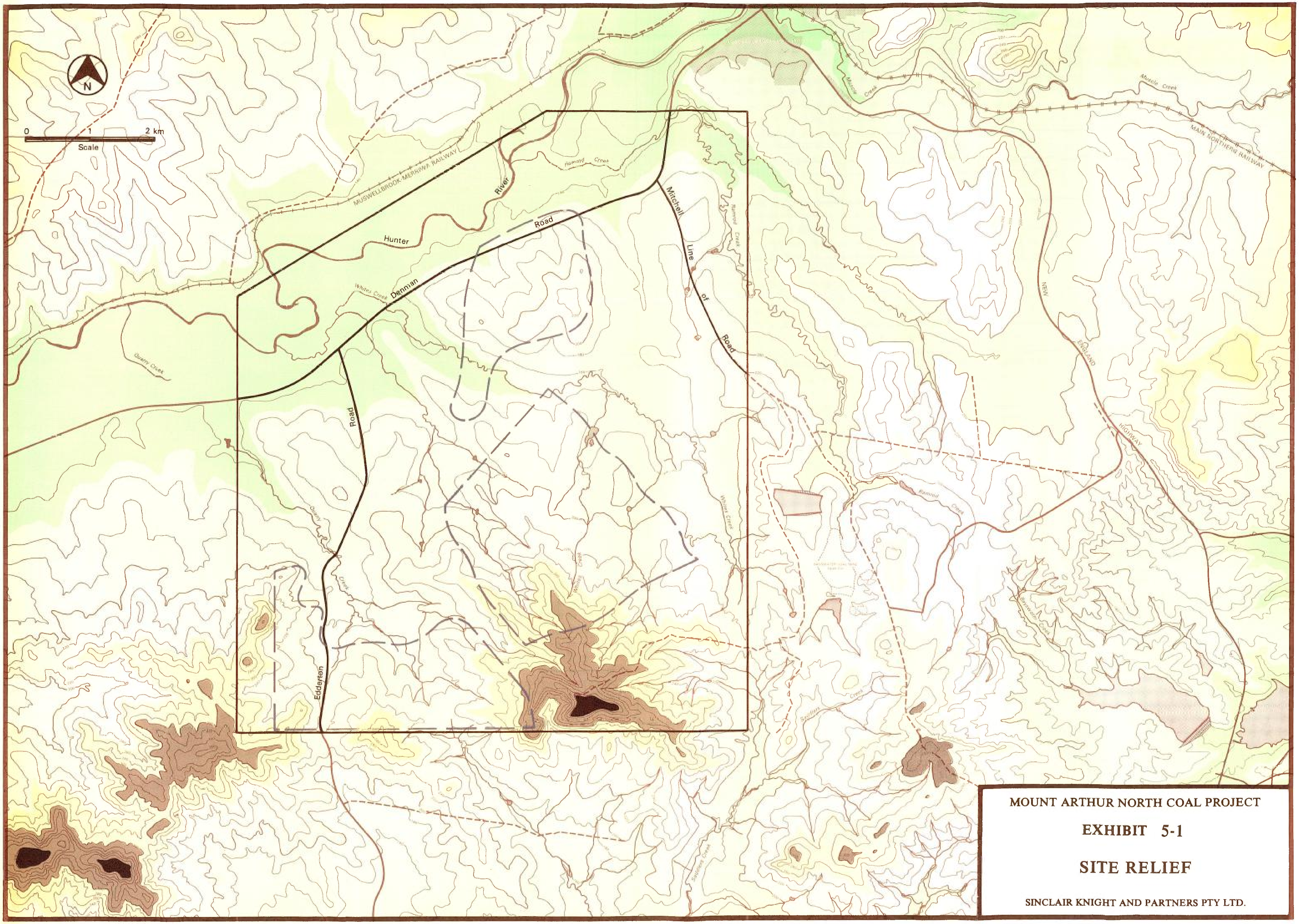
Transportation
Main roads and minor public roads pass to the north, east and west of the site; the region is serviced by the New England Highway and the Main Northern Railway.

Services
Power is available on the site although upgrading of transmission line capacity will be required to service the site demands; extensions of the Muswellbrook water supply system will be available for potable water uses on the site.

Population
The resident population of the site has been estimated at 154 persons, with the majority concentrated in the north of the site along the Denman Road; the regional population is centred in the town of Muswellbrook with a present population of 8 600 persons.

Housing and Accommodation
The region as a whole is currently experiencing a severe shortage of permanent housing and temporary and rental accommodation.

Regional Facilities
The area is well serviced by local community facilities located in Muswellbrook; recreational facilities are well established; the area has a moderate tourist industry.

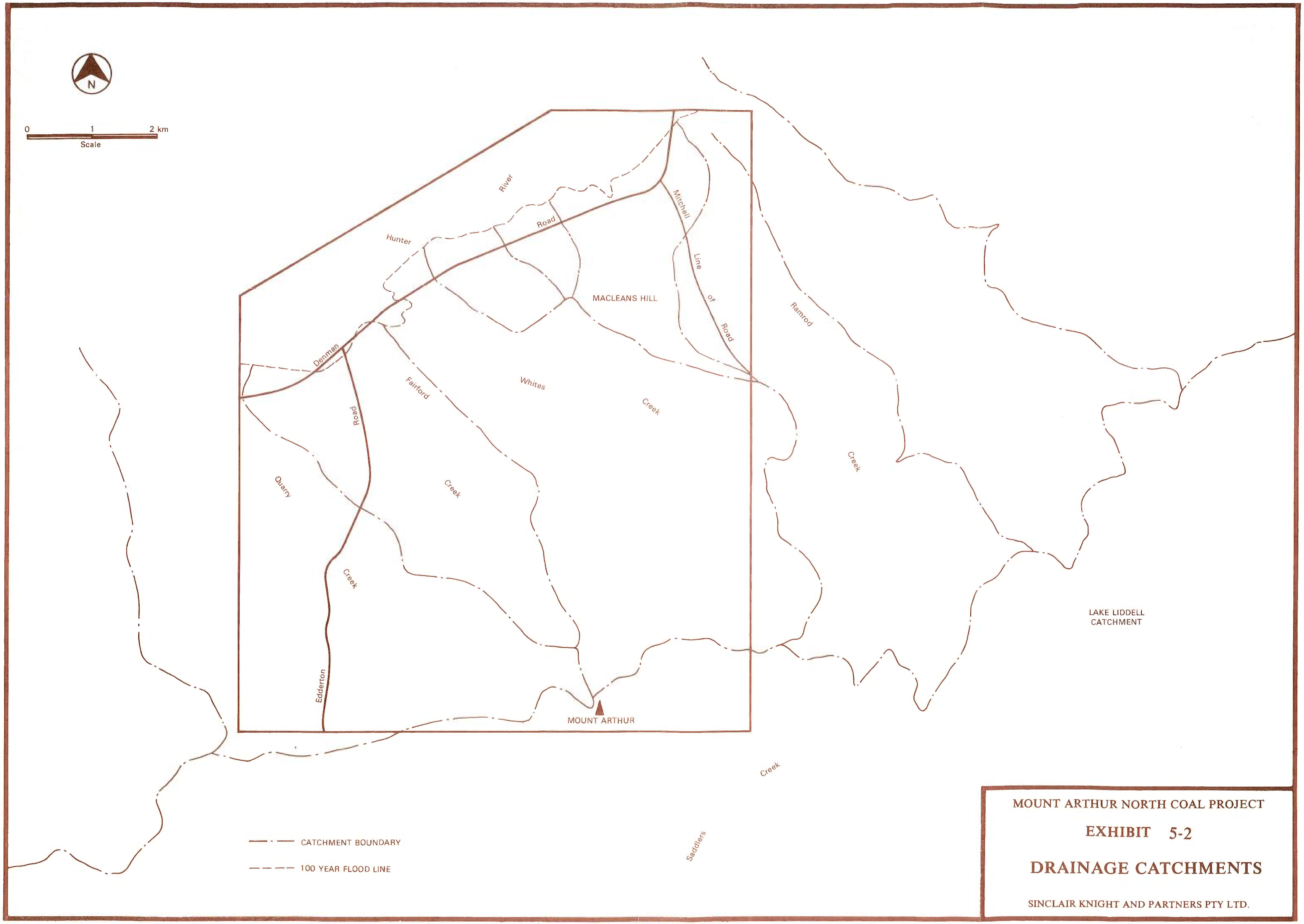


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-1

SITE RELIEF

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

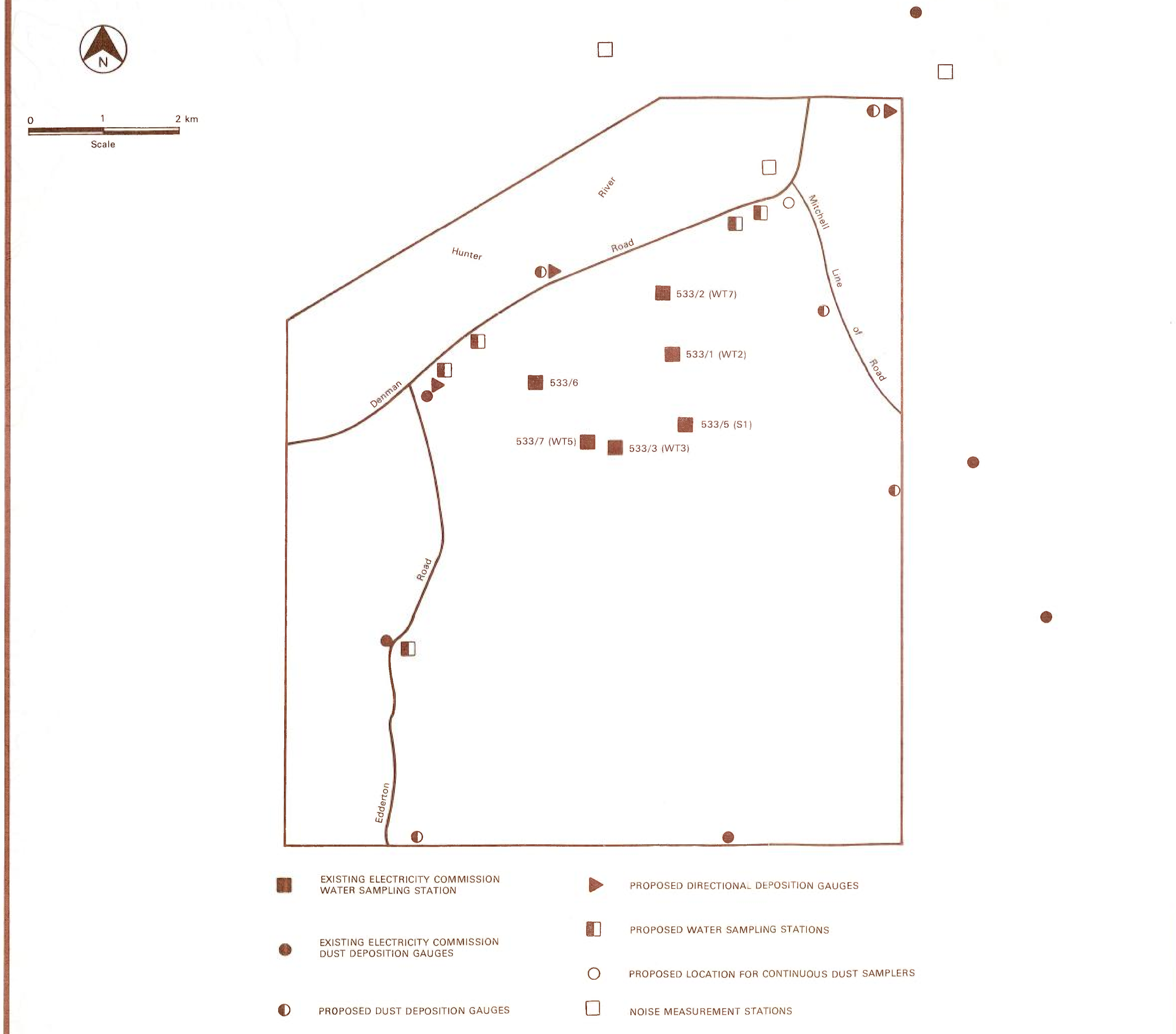


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-2

DRAINAGE CATCHMENTS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

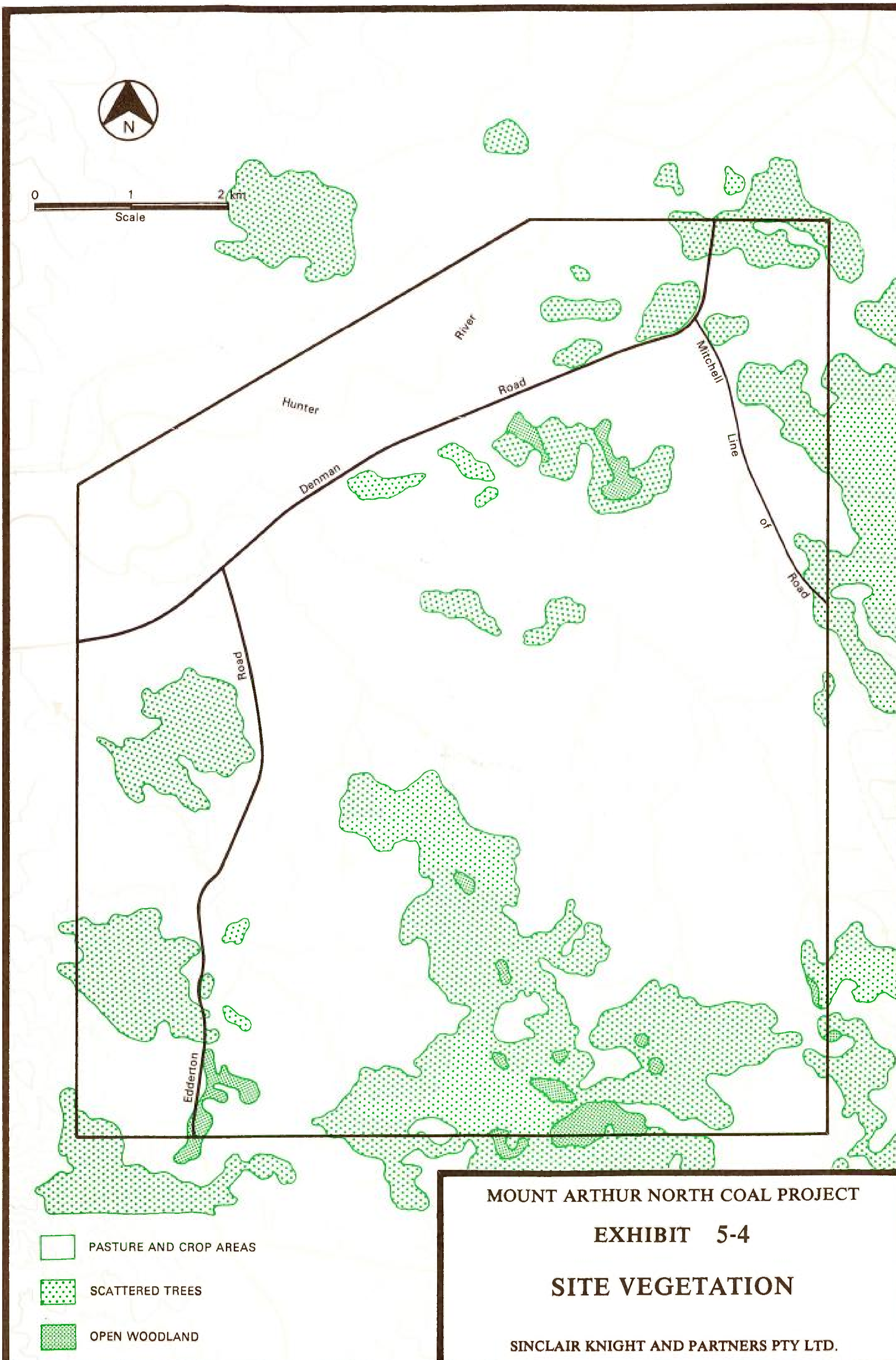


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-3

MONITORING STATIONS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

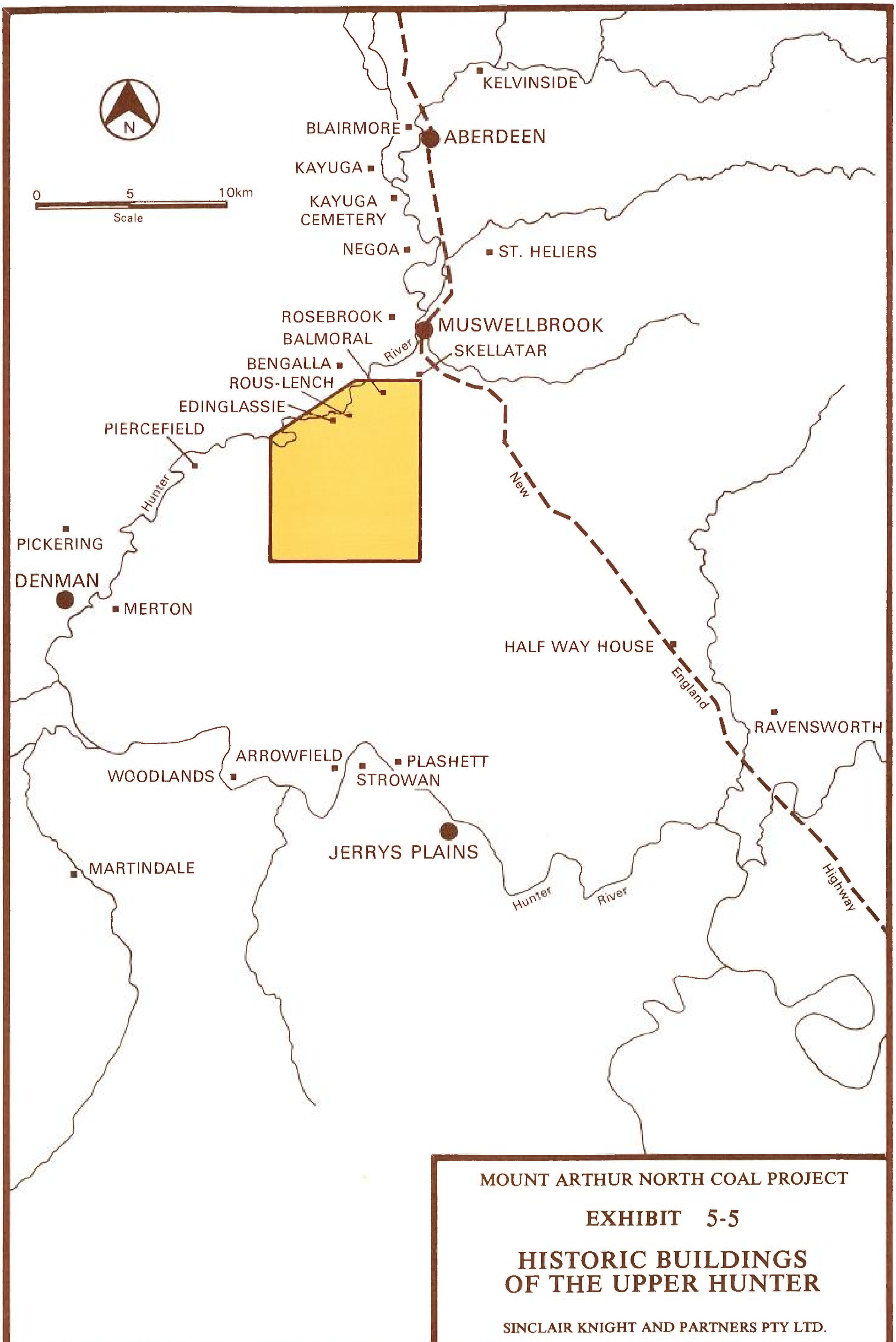


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-4

SITE VEGETATION

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



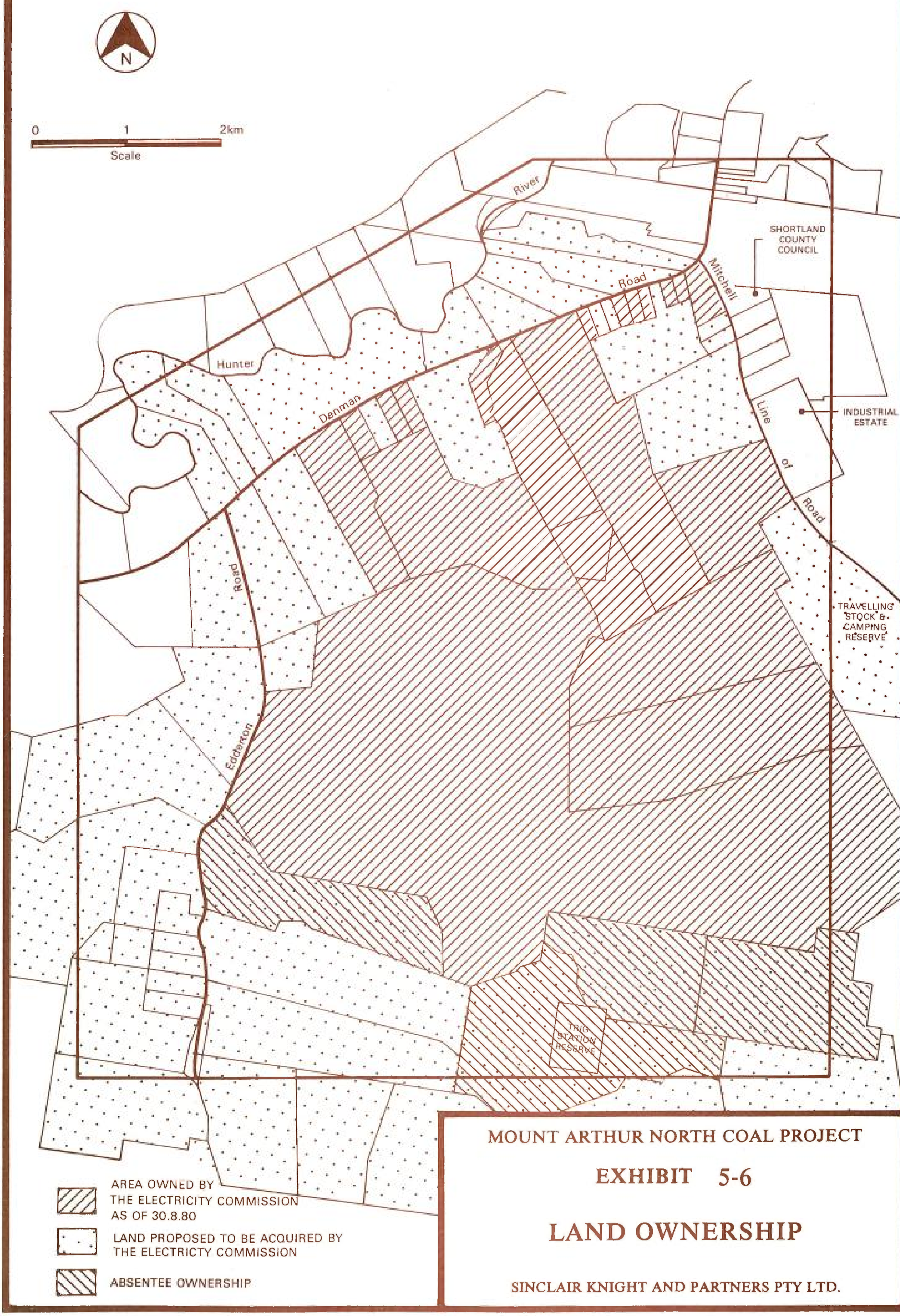
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-5

HISTORIC BUILDINGS OF THE UPPER HUNTER

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: PLANNING WORKSHOP PTY LTD

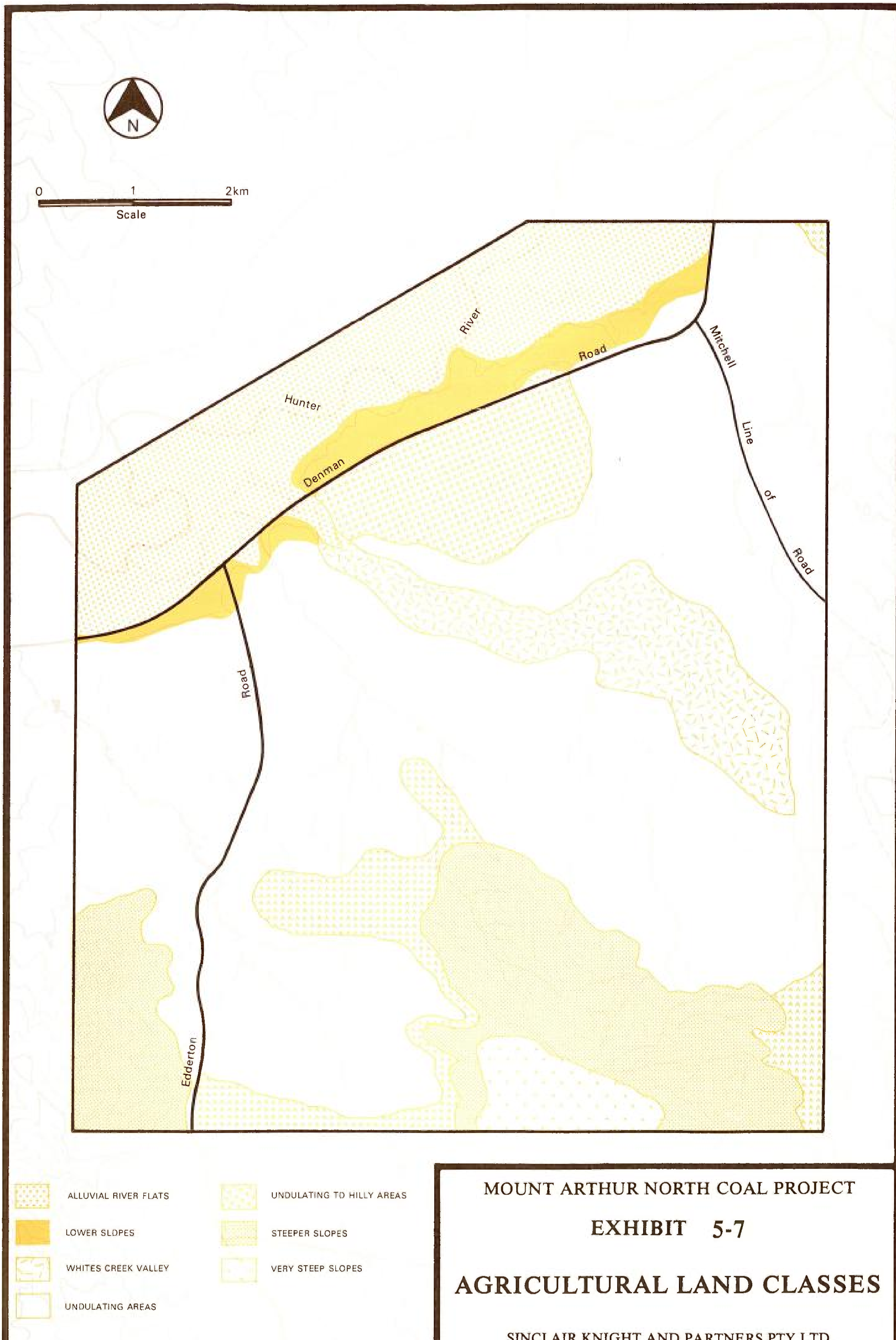


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-6

LAND OWNERSHIP

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



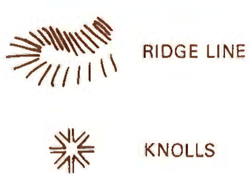
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-7

AGRICULTURAL LAND CLASSES

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: SLOANE COOK & COMPANY PTY LTD

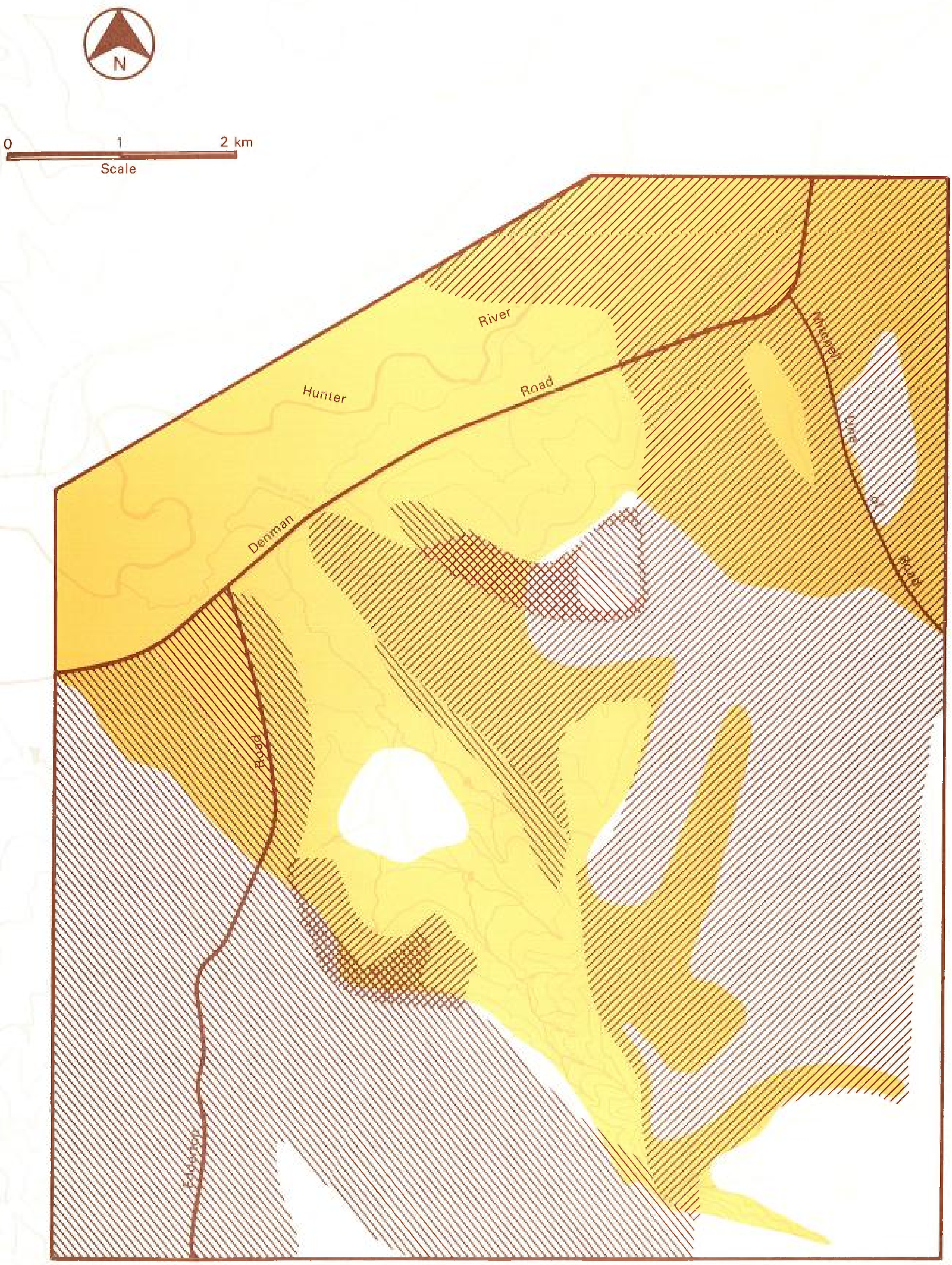


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-8

NATURAL LANDFORMS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



FROM DENMAN ROAD

FROM EDDERTON ROAD

FROM MITCHELL LINE OF ROAD

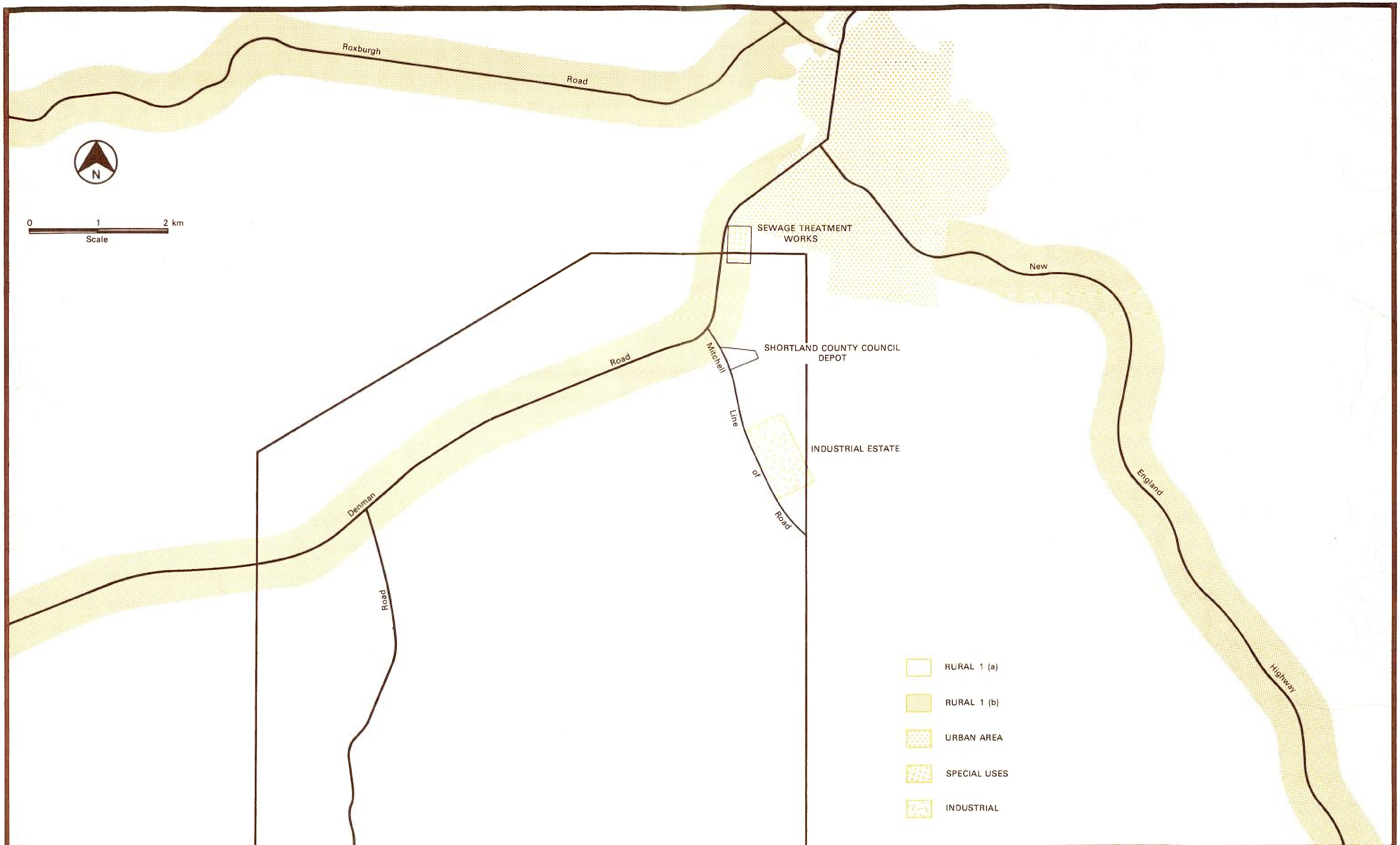
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-9

VIEW CATCHMENTS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: EDMOND BULL & CORKERY PTY LTD

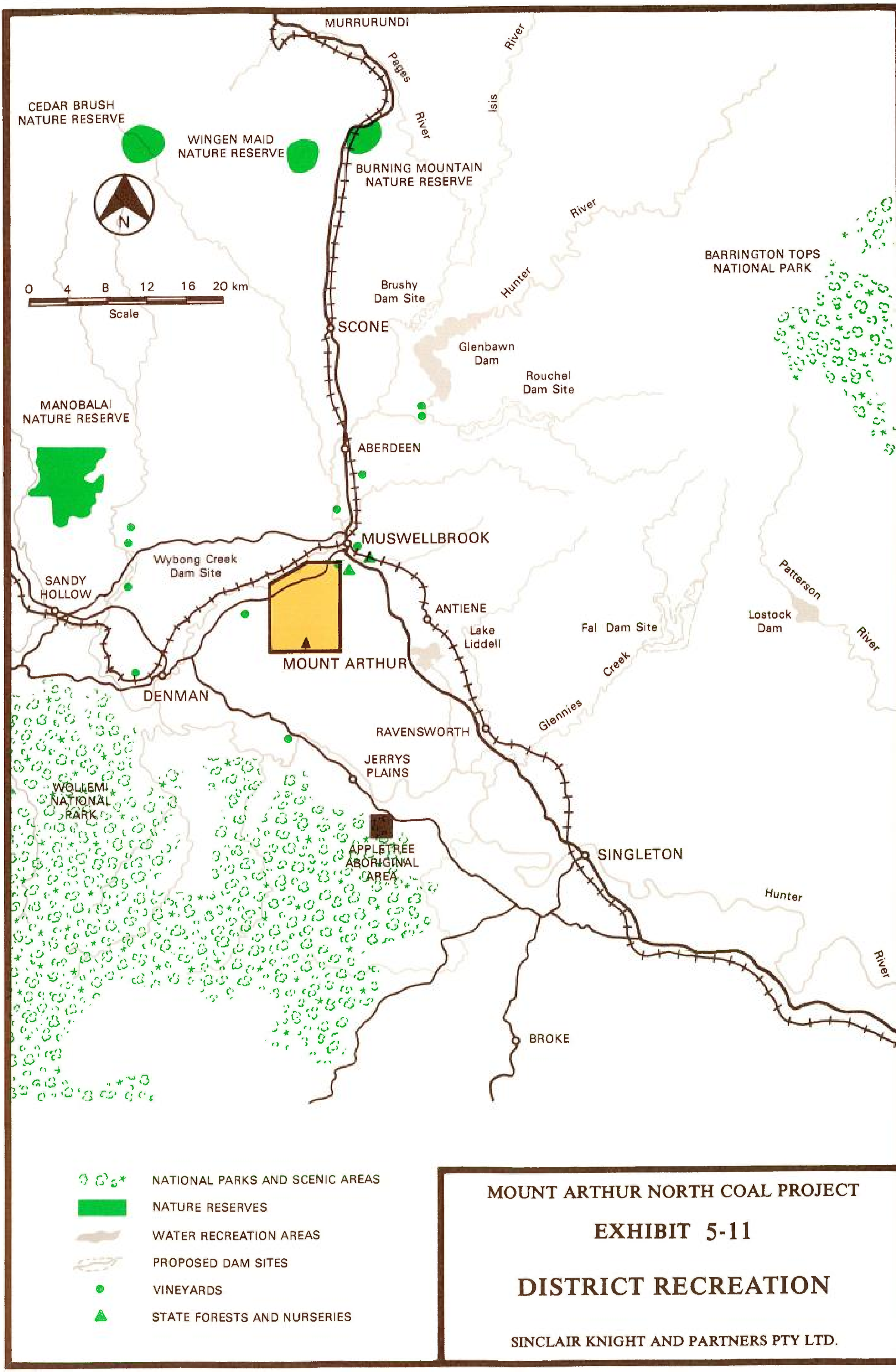


MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-10

TOWN PLANNING ZONES

SINCLAIR KNIGHT AND PARTNERS PTY LTD.



MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 5-11

DISTRICT RECREATION

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SAFEGUARDS

6. ENVIRONMENTAL SAFEGUARDS

This chapter describes the safeguards which are designed into the project and the operational controls and procedures which will be used to minimise the adverse effects of project activities.

Details are also presented of the ongoing and proposed monitoring programme which will assess and control the effectiveness of the proposed safeguards.

6.1 ENVIRONMENTAL DESIGN OF THE PROJECT

Environmental consequences have been a major consideration in the planning and design of the project. While a number of unavoidable effects must occur with the development of a large open cut mine operation of the magnitude of Mount Arthur North, particular effort has been made to minimise these effects and, particularly, to limit the extent of their influence outside the future lease area. The description of the proposal presented in **Chapter 4** reflects the awareness of environmental issues in the design of the project. The principal considerations were:

- provision for establishment and management of a buffer zone around the operational areas.
- provision for immediate landscaping measures to be effective from the beginning of the construction period.
- commissioning of a separate planning study to identify the urban infrastructural requirements and broad planning for the local urban area.
- selection of mine location, type and methods to maximise coal extraction from the lease area while limiting the extent of visual disturbance and environmental consequences.
- integrated planning of mine operational areas, spoil disposal, site haul roads and site infrastructure.
- design of final landforms to screen operational areas and to produce a final landscape consistent with surrounding topography.
- control of pollution sources within the site to minimise any resultant effects outside the site.
- consideration of post-mining use of the land and the means and form of land rehabilitation.
- establishment of a management structure which will ensure that safeguards will be implemented and monitoring procedures established to ensure compliance with the various conditions and requirements of the development consent, the mining lease and the operating licences.

The potential environmental constraints which were identified in **Chapter 5, Existing Environment,** and summarised in **Section 5.19, Summary of Existing Environment,** are incorporated into the proposed safeguards for each aspect of the mine development and operation.

6.2 SITE PREPARATION AND CONSTRUCTION

During the construction phase of the development of the Mount Arthur North project, major earthworks will be carried out. These operations will mean high sediment loadings during periods of excess rainfall runoff. To ensure there is no deterioration in downstream water quality, the initial stages of site preparation will involve the formation of perimeter drains, primary and secondary settling ponds, and stream diversions. All earthworks will be carried out inside these systems to ensure that discharges to Whites Creek and the Hunter River are not contaminated.

The area disturbed, at any one time, by the construction operations will be kept to a minimum in order to minimise dust problems. Topsoil, where suitable, will be stripped from working areas and either stockpiled for later rehabilitation works or used immediately in the revegetation of areas in which earthworks have been completed. Topsoil which requires stockpiling for any extended period will be grassed to control dust generation.

Noise levels from earthworks operations during the construction period will at times be higher than during the mine operating phase because the plant will be operating at or near existing ground surface levels and no shielding will be available to reduce noise emissions. As set out in the Noise Assessment Report included as Document 11 in VOLUME 2, noise levels from the main earthworks activities will result in noise levels approximately 10 dBA higher than maximum mine operation levels at the most affected residences. The principal activities are works associated with the coal processing area, the Tailings dam and the Denman Road relocation. The residences principally affected will be Linhay, on the Mitchell Line of Road, and Yammanie to a lesser extent. Construction activities will be restricted to daytime hours. The temporary nature of construction noise and the type of such works make any noise containment bunding impractical. However, plant source levels will be controlled so that noise level at the most affected residence does not exceed 55 dBA (L10).

To enable the early establishment of site screening and the partial control of noise levels associated with construction activities, initial site works will include the construction of earth bunds and the planting of tree screens. The earth bunding that is presently being carried out along the Mitchell Line of Road will be further extended, and, associated with the relocation of the Denman Road, extensive bunding will be created along the southern boundary of the new easement. Other site tree plantings would commence to strengthen existing site vegetation outside the extremities of the mine areas.

6.3 SELECTION OF THE MINING METHOD

The alternative methods of mining which were considered, before selecting the proposed method, were outlined in **Section 4.3.1, Mine Planning.** The mining method outlined in this Statement was selected as being the best solution for a combination of economic, technical and environmental reasons. The merits of the proposed mine plan and operations are:

- mining commences at the subcrop line and advances down dip. The spoil will be placed back into the pit after the initial box cut. The quantities of spoil have been calculated following detailed mining investigations and the final landform designed by a specialist landscape architect. Spoil will be placed to conform to the final landform initially and rehandling will be minimised. This will enable rehabilitation to take place as mining proceeds rather than at a later date.

- by advancing down dip and placing overburden behind the working area, the mine working area will quickly become shielded by the reshaped overburden pile. The overburden landform for each mine has been planned so that at an early stage the mine workings are effectively screened, minimising the visual impact of the operations. The selected overburden profile will also significantly reduce noise and dust emissions from the mine area.

- the dragline mines will use a shovel truck operation to prestrip overburden. With a dragline, spoil has to be placed within the reach of the machine in a relatively uniform manner. The prestrip overburden will be placed over the dragline spoil piles enabling the shape of the land surface to be created as part of the backfilling operation. Double handling of spoil and excessive reworking at the contouring and grading stages of the rehabilitation process are minimised. The trucks loaded with overburden move over previously backfilled dragline spoil heaps and, in doing so, compact the fill. This will reduce the amount of surface runoff infiltrating into the spoil pile and also reduce long term settlement.

- the Whites Creek mine has operational benches at approximately 60 metre intervals in height from the pit floor for both the working face and the backfill disposal face. This enables overburden to be transported from the mine face to the overburden face at the corresponding level within the pit. Large quantities of overburden do not have to be transported to the top of the disposal area. Any noise, therefore, is largely confined to within the pit. This feature also means that overburden mined at the bottom of the highwall is dumped at the bottom of the overburden pile and the geological sequence is not altered except for the removal of coal.

The natural bulking of excavated material and the need to provide sufficient working room, resulting in a large void between the operating face and the backfill benches, requires an appreciable raising of the original land surface. In the case of the dragline mines, levels will be raised an average of between 20 to 30 metres. The Whites Creek mine results in an increase of an average of 70 metres. However, careful attendance to the design of the landscape profile and mine design, to allow for early rehabilitation, will result in a landform which is quickly revegetated, conforms to surrounding landscape profiles, and which provides a natural shielding to the mine face as it progresses.

With Mount Arthur North, it has been possible to prove up a coal resource with sufficient reserves to supply a large thermal power station complex totally from within the one mine site. By the development of the large open cut Whites Creek mine, the power stations can be supplied from virtually a single concentrated operation in which the control and protection of environmental effects is made considerably easier compared with a number of smaller and geographically separate mining operations.

6.4 MINING OPERATIONS

The mining operations have a potential impact on the surrounding environment due to increases in soil erosion, increases in noise and dust levels, pollution of water, vibrations associated with blasting, and the disruption of the visual landscape. The safeguards designed to minimise the impact on the environment from these effects of mining are outlined in this section.

Soil Erosion Controls
Soil erosion can occur as a result of either water or wind effects on disturbed areas of the site. Any area which has lost its vegetation cover is potentially liable to erode. Sediment loadings to the watercourses will also increase as a result of increased surface erosion. While it is not possible to completely prevent erosion occurring, the following controls will be placed on the operations to limit the impacts:

- the preparation of any working area will involve the removal of vegetation and topsoil. Since the site has been extensively cleared and grazed, the existing vegetation is principally grasses with some low shrubs and a few isolated trees. The shrubs and grass will be removed with the topsoil. This portion of the soil is valuable as a seed and nutrient source and is to be preserved. Wherever possible, the soil will be immediately placed on the final recontoured land surface. If this is not immediately possible, because of the sequencing of operations, then the soil will be stockpiled for later use and, if necessary, temporarily sealed to control erosion. Only the duplex soils are suitable for reuse as topsoil. Other soils will be handled with the overburden.

- clearing and stripping of topsoil for the mining operations will be limited to specific areas immediately ahead of overburden removal.

- the movement of vehicles and plant will be restricted to prepared areas. Movement on areas to be left undisturbed will be prohibited.

- drainage channels will be designed to limit flow velocities, even during high flows. Where high velocities cannot be prevented, for instance at discharge points, scour protection methods will be installed. Banks of channels will be battered and grass establishment encouraged.

- rehabilitation of spoil disposal areas will proceed as soon as practicable after the completion of final contouring.

- existing watercourses, receiving additional flows from surface diversions, will be subject to improvement where required. This will generally comprise the consolidation of embankments through revegetation, tree planting or, in steeper areas, placement of rock linings.

Drainage Controls
Drainage control measures have been instituted to contain and control surface water runoff throughout the site as well as to control groundwater inflows into mining areas.

To control groundwater inflows through the coal seam aquifers into the mining pits, borefield extraction systems are proposed in advance of each mining operation. Such a system will have a twofold advantage in both providing a dry working area within each pit as well as extracting a groundwater which would otherwise have become contaminated within the pit areas with fine suspended solids.

Surface water drainage control has been considered under three broad categories:

- runoff from undisturbed, up-catchment areas of any mine site or infra-structure area
- runoff from within pit areas
- runoff from infrastructure areas and spoil disposal areas

Surface drainage from undisturbed areas will be channelled around all mining operations by diversion drains. Drainage from the upper Whites Creek catchment will be diverted to the Clean Water dam for site use. Excess water will be conveyed by open channel through the east diversion channel to discharge downstream of the Tailings dam into the lower reaches of Ramrod Creek. Drainage from areas in advance of the Whites Creek mine will be diverted to the lower reaches of Whites Creek. Similar smaller scale and local diversion drains will be provided in conjunction with the two dragline mines.

Runoff from rain falling within the actual pit areas will be collected in sumps in the floor of each mine and pumped to either of two detention ponds. As this water will contain suspended solids a period of retention will be required.

Runoff from disturbed areas will be limited to direct rainfall. The diversion channels for the mining operations will restrict any flow from adjacent areas. Again, runoff will be contaminated with fine suspended material and will be channelled through a series of detention basins or treatment units to improve water quality.

Flood control measures within the site have been provided to ensure that no flooding is possible of mine areas. In the initial years of the Whites Creek mine flood levees along Whites Creek will protect the workings. Following development of the Clean Water dam, the eastern diversion channel has been designed to be able to discharge the maximum probable precipitation flood. Similarly, the Tailings dam is able to store its maximum flood volume without discharging. Protection of the mine workings from the effects of flooding of the Hunter River is provided by increasing surface level contours away from the river, to the south of the Denman Road realignment. The Denman Road deviation alignment is a minimum of 2 metres higher than the one in 100 year Hunter River flood. Further bunding between the road and the Ramrod Creek mine will afford additional protection. Backwater flooding of the lower reaches of Whites Creek will be prevented by flood flaps on the culverts under the Denman Road.

Noise Control

The report on noise assessment and the resultant noise control measures are contained in Document 11 of VOLUME 2, Part A, Noise Assessment. The principal noise source from the Mount Arthur North operations will be associated with the mining operations. Such operations, for the purpose of noise assessment, include the actual mining operation, the haulage of overburden and coal, and the overburden disposal operation. The latter two operations are discussed in the following two sections, **Section 6.5, On-Site Haulage,** and **Section 6.6, Overburden Disposal.** However, for the purposes of noise assessment and control this section will assess noise levels from all three operations.

Although much of the equipment associated with these operations will emit continuously varying noise levels, the large number of items of plant is expected to result in an almost steady broad band noise at nearby residential locations, punctuated by occasional, intermittent, impulsive noises associated with impacts. The steady noise level may be taken as the L10 level and the peak intermittent level as the L1 level. (L10 and L1 values are those noise levels exceeded for 10 and 1 percent of the time respectively).

It is generally considered that a tolerable noise from substantially continuous sources may be 5 dBA above existing background (L90) levels. The L90 background levels, for the three sites which were monitored, were 30 to 35 dBA at night and 40 to 45 dBA by day. Hence the maximum levels to be aimed for are 35 to 40 dBA at night and 45 to 50 dBA during the day. These details are contained in Document 11 and are set out below as regards the noise levels generated by mining operations.

In the prediction of generated noise levels at affected residences, estimates of noise reduction with distance are required. From on-site monitoring the attenuation rates adopted are a base attenuation of 6 dBA per doubling of distance plus an excess, because of surface effects, of 1 dBA per kilometre during the night and 2 dBA per kilometre during the day. The lower night time attenuation takes account of possible temperature inversion effects.

To limit off-site noise levels at affected residences, various control measures are necessary. The controls for the mining operations which will be implemented, where required, are discussed below:

- haul trucks represent the greatest source of intensive noise due to their large numbers and high source levels; accordingly noise reduction kits are proposed to be fitted at the outset of operations and a reduction of 8 dBA at the source (at 7 metres) has been allowed; discussions have taken place with equipment suppliers to confirm this assumption.

- overburden and coal haul truck loaders will be internally lined with rubber or similarly resilient material to reduce impact noise during loading.

- haul roads will generally be placed in cuts or bunds will be constructed at strategic positions to ensure haul truck noise is shielded by at least 14 dBA; bund positions will require attention as mining progresses with changes in their siting required progressively; it is proposed that bunds be a height of 5 metres above road level and the tops of such bunds be maintained at a distance not more than 10 metres from haul trucks.

- at night time, overburden haul trucks operating in the Ramrod Creek mine will dump at the southern end of spoil dumps furthest from nearby residences.

- spoil disposal areas for night shift disposal will also include bunds, as for the haul roads, so that at all times truck dumping will be shielded to provide at least a 14 dBA noise level reduction; similar shielding will also be provided for dozers working on the overburden dump areas at night time.

The principal source of noise generation affecting nearby residences is the Ramrod Creek mine with the principal noise generating operations being the operation of the draglines, the overburden drills, trucks operating on overburden hauling and dumping, and dozers working on the spoil piles.

The steady noise levels which emanate from the mines have been calculated for day time and night time for key years. The calculation involved assigning a noise level to each piece of equipment at an assigned location and duty and then adjusting for any noise control modifications. **Exhibit 6.1, Predicted Daytime Steady Noise Contours,** and **Exhibit 6.2, Predicted Night Time Steady Noise Contours,** give the noise contours for the critical year of 1986. Although the amount of equipment increases between 1983 and 1992, natural shielding also increases as does distance to the affected residences. The net result is that steady (L10) noise levels change by less than 1 dBA during the period 1983 to 1992. The contours are dominated by the Ramrod Creek mine operations and will reduce significantly after 1992 when operations cease in the Ramrod Creek mine and equipment is relocated to the Glen Munro mine.

From **Exhibits 6.1 and 6.2**, it can be seen that the tolerable levels are not exceeded by steady (L10) levels from site operations. The only exception is at Wontana where the night time tolerable level of 35 dBA is exceeded by 3 dBA. However, the level here will be almost identical to the L10 level expected at the same location when coal trains commence transporting coal from the Ulan mine, which will occur before Mount Arthur North operations commence.

After commencement of mining operations, extensive noise monitoring will be carried out to ensure that the noise levels estimated in this study will not be exceeded. Where control measures may be relaxed or where additional control measures are proved necessary, appropriate changes will be made to the equipment and/or the operating procedures.

Vibration and Overpressure Control

The environmental effects related to mine blasting are ground vibration and overpressure or air pressure waves carried by the blast. These effects have again been separately studied and the resultant report is also included in Document 11 of VOLUME 2, Part B - Blast Control Investigation.

Air vibrations are produced from that part of the explosive energy vented directly into the atmosphere and by the impulsive forward movement of the burden. The disturbance travels outwards from the blast as an overpressure or sound wave front at a velocity of 345 metres per second. Noise is that portion of the air vibration spectrum which lies in the audible frequency range. Air blast is that portion of the spectrum below human hearing frequency. Ground vibration takes the form of a wave train travelling at a velocity of generally between 1 500 and 2 500 metres per second and with a duration up to several times the actual blast duration. When the wave passes a point in the ground, a particle of that point will be subject to motion which is defined in terms of the amplitude of particle displacement and frequency. For estimating vibration at various distances from a blast, the scaling of field measurements is used almost exclusively. Both these effects have the potential for creating disturbance to nearby residents and, at higher levels, may cause superficial or even structural damage to buildings unless particular care is taken while blasting in any of the mine areas. It is possible to exercise control over blasting design and practice in order to minimise these effects.

The Whites Creek mine and Glen Munro mine are a minimum of 3 000 metres and 1 900 metres respectively from the nearest occupied residences. The Ramrod Creek mine will be a minimum of 1 200 metres from the nearest occupied residence, Balmoral. Residences closer to the Ramrod Creek mine are Edinglassie (700 metres) and Rous-Lench (200 metres). Both of these residences are proposed to be purchased by the Commission. However, the residences have been classified by the National Trust, and as such, restrictions are imposed as to the levels of the effects at these buildings.

The investigation 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 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.

The test blast methods and analyses of results are contained in the report in Document 11 (**Sections 2, 3 and 4**). The recommended limits for <u>ground vibration</u> have been adopted as follows:

- Balmoral (historical building) - 2 mm/s
- Residences in general - 10 mm/s
- Industrial area - 20 mm/s
- Edinglassie and Rous-Lench - 30 mm/s

Edinglassie is situated a minimum of 700 metres from the Ramrod Creek mine with the associated building, Rous-Lench, located a minimum distance of 200 metres from the Ramrod Creek mine. Since the Commission proposes to purchase these properties and is prepared to tolerate minor architectural damage, which they will immediately rectify, it is proposed that a design level of 30 mm/s be adopted. This limit is consistent with the upper level for minor architectural damage indicated in the draft ISO document. However, seismic work will be carried out prior to commencement of mining to determine the seismic properties of the ground underlying the buildings to confirm that this level of 30 mm/s does not result in structural damage. The buildings will also be closely and regularly inspected during mining operations to monitor effects.

The recommended levels for overpressure, for the purpose of establishing guidelines relating to blast design and blasting techniques, are given below. For assessment purposes, the State Pollution Control Commission has recently adopted an overpressure limit at residences of 115 dBL based on annoyance to residents.

- Residences in general - 115 dBL
- Edinglassie and Rous-Lench - 128 dBL
- Industrial areas - 128 dBL

The recommended limits on vibration and overpressure have been used to calculate maximum instantaneous charges (MIC) per delay and other details of the blast design. For the reasons set out in Document 11, it is proposed that 40 millisecond delays be used between holes. However, final blast design and practice will not be established until the mining operations have commenced and trials have been carried out to establish optimal blasting procedures for the overburden rock and coal seams.

The blast parameters which have been developed for overburden bench blasting for the Ramrod Creek mine are:

- Maximum bench height - 20 metres
- Hole diameter - 229 mm
- Burden - not less than 7.5 metres
- Maximum instantaneous charge - 360 kg ANFO
- One hole per delay

This design will meet the adopted acceptability criteria for blasting within the mine for distances of at least 350 metres from Rous-Lench and 2 100 metres from Balmoral. The maximum levels with this restriction are estimated to be:

Location	Vibration	Overpressure
Edinglassie	10 mm/s	118 dBL
Rous-Lench	30 mm/s	125 dBL
Balmoral	2 mm/s	113 dBL
Wontana	3 mm/s	110 dBL

To blast as close as 200 metres to Rous-Lench and 1 200 metres to Balmoral as is proposed, the MIC should not exceed 120 kg. Such blasting would result in 30 mm/s and 127 dBL (based on a burden of 4 metres) at Rous-Lench. For these reduced instantaneous charges, lower vibration levels would be anticipated at Edinglassie and all other residences. To achieve the reduced MIC, two practical alternatives will be considered:

- reduction of the hole diameter to 100 mm associated with a reduction of burden and spacing
- deck loading of the 229 mm diameter holes with one deck charge being fired per delay.

To maintain vibration levels below 2 mm/s at Balmoral requires extensive and expensive controls on blasting, as discussed above. However it is considered that seismic studies of the ground underlying Balmoral may permit a reassessment of the vibration limit of 2 mm/s with the possibility of higher vibration levels of up to 5 mm/s, being acceptable.

For the Whites Creek mine the following overburden blast parameters are proposed:

- Maximum bench height - 18 metres
- Hole diameter - 229 mm
- Burden - not less than 7.5 metres
- Maximum instantaneous charge - 1 200 kg ANFO
- Three holes per delay - 400 kg per hole

Such a design will result in the following maximum vibration and overpressure levels. For all other residences, anticipated levels are lower than the maximum levels for Balmoral given below:

Location	Vibration	Overpressure
Edinglassie and Rous-Lench	3 mm/s	115 dBL
Balmoral	2 mm/s	113 dBL
Industrial area	4 mm/s	118 dBL
Belmont	2.5 mm/s	106 dBL
Linhay	2.5 mm/s	115 dBL

Slight relaxations to this design will be possible when blasting in areas away from the northern part of the mine. The blasting parameters for the Glen Munro mine are presented in Document 11. The principal determinant for blasting at this mine will be overpressure effects at the residence of Belmont to the south of the mine. **Exhibit 6.3, Overburden Blasting Charge Levels,** summarises the maximum instantaneous charge levels adopted for blasting within each of the three mines in order to meet the adopted acceptability criteria. **Section 8** of the Blast Control Investigation Report provides a summary of the guidelines proposed for each mine for both overburden and coal blasting.

The prediction of vibration and overpressure levels, made in order to establish the necessary control measures discussed above, rely upon the implementation of a number of practical control measures, particularly aimed at avoiding blowouts and production of excessive overpressure:

- for overburden blasting, stemming will be maintained at a length equal to or greater than the burden in critical areas. Stemming material will consist of drillings firmly located in the holes, using a tamping pole, or alternatively coarse gravel poured into the hole, with consideration given to damage it may cause to detonating cord. However, a small collar charge may sometimes be used within the stemming to improve fragmentation near the top of the hole and reduce back-break, provided the scaled depth of this collar charge and stemming above is consistent with the scaled depth of the main charge and burden.

- where a batter or sloped bench face has been constructed to give sufficient bench stability and blasting utilises vertical holes, care will be taken to ensure that the first row of holes is appropriately lightly loaded near the top where effective burden is quite small.

- blasting will only occur during the day and will be avoided during times of known temperature inversions and high winds.

- in order to reduce the likelihood of annoyance caused to nearby residents by blast vibration and overpressure, all attempts will be made to blast at similar times every day, commonly at change of shift. With approximately 4 blasts per day occurring during the peak period of mining, it is expected that these will be carried out at 2 or 3 standard times each day. The frequency of blasting in each of the mines is described in detail in the Document 11 report.

- because of the historical significance and proximity of Edinglassie and Rous-Lench, vibration and overpressure effects will be monitored continuously during all blasting near these buildings so that blast design may be modified, as required, to meet acceptable levels.

In conclusion, although it is anticipated that levels close to the recommended limits may apply for a particular residence nearest the blasting area, the vibration and overpressure levels for the remaining residences in the immediate area are in general well below the recommended limits. As the mining faces are continually moving in one direction, residences close to the mine sites will experience vibration and overpressure levels close to the recommended limits only for part of the period of operation of the mines.

Dust Emission Controls
Actual mining operations have the potential for generating large volumes of dust, particularly from scraper operations, overburden drilling, blasting and dragline operations. Coal drilling and blasting can also be a source of dust generation however, this is generally deep in the pit and has limited impact outside the excavation. Overburden haulage and placement can be major source of dust if appropriate controls are not implemented. Safeguards for these operations are discussed in the following **Sections 6.5 and 6.6.** Safeguard controls discussed in this section relate to in-pit operations.

An assessment study of dust generation and control was carried out as part of the water management study **(Reference 24).** An estimate of dust generation rates was made for all the various dust sources using both Australian and overseas data material. To predict dust deposition rates in the area, a mathematical model was developed. This model enabled dust deposition contours to be plotted and **Exhibit 6.4, Incremental Dust Deposition Contours,** presents a conservative envelope of average dust deposition contours based on average wind speed and distribution. The wind rose for Liddell Power Station, included in Document 3, Climatic Data, was used as the base data for wind speed, direction and duration for the study.

Both the State Pollution Control Commission (SPCC) and the Electricity Commission monitor existing dust deposition rates in the Muswellbrook area. As set out in **Section 5.5.7, Air Quality,** the following figures have been adopted as being representative of existing conditions.

- central Muswellbrook - 3.5 gm/m^2/month
- Authorisation area - 0.7 gm/m^2/month

By way of comparison, average deposition rates for central Sydney, as measured by the SPCC, are 2 gm/m^2/month. Average rates for the residential areas of Muswellbrook are somewhat lower at 1.4 gm/m^2/month.

Exhibit 6.4 depicts fallout contours over and above the existing backgound level of 0.7 gm/m^2/month. Negligible incremental effects result outside the Authorisation area with most of the dust generated having been deposited within 2 kilometres of the source. Due to the prevailing wind patterns and the distance to South Muswellbrook, air quality in the Muswellbrook urban area is shown to be unaffected by any operations at Mount Arthur North. Areas outside the future lease which will be most affected by increased dust deposition will be an area to the north of the Ramrod Creek mine. This section of flood plain north of the Hunter River and south of the Denman to Muswellbrook rail line, will have an increase in deposition levels of up to twice existing levels. The potential impacts created are discussed in **Chapter 7, Interaction and Impacts.**

A prediction of off-site dust deposition levels generated by an operation of the magnitude of Mount Arthur North can never be precise. Very little research has been carried out either within Australia or overseas which is applicable to open cut coal mining. Nevertheless, as discussed in full in the dust study, the extent of available knowledge has been applied and it is considered that the results represent the likely average maximum fallout figures. As discussed later in this section, and as developed in conjunction with the State Pollution Control Commission, dust control will be based on good mining practices supported by a sophisticated and extensive monitoring setup which will enable a correlation to be established between site operations and practices, and the resultant atmospheric dust concentrations and fallout. This will enable continuous regulatory control of site practices.

The following comments relate to the method of prediction of dust generation and dispersion as carried out in this study:

- the generation rates assume reasonable dust suppression techniques.

- all mine site operations have been modelled as a focus of point sources within each mine with the dominant sources being mining operations, overburden haulage, and blasting operations.

- all three mines have been included, (however it is noted that the Glen Munro mine has a negligible effect on deposition rates around the Ramrod Creek mine and conversely, operations in the Ramrod Creek mine will not affect the levels of fallout in the Glen Munro mine area.

- the model uses point source emissions which are only an approximation for operations such as overburden haulage.

- the use of the model for sources which are spread over a large area is not well developed.

- dust sources for the actual in-pit mine operations have been taken as being located at ground level and generating a dust plume which rises 30 metres above ground level. In fact, it is likely that much of the dust generated in the deeper levels of each pit will not rise above ground level and will therefore be redeposited in the pit. This assumption is therefore likely to result in an overestimation of deposition levels away from the pit.

- methods of predicting suspended dust concentrations are imprecise, however it is to be expected that deposition rates would have some direct correlation to air quality levels.

The control measures that will be instituted to limit dust emissions and which were assumed in the analysis are as follows:

- the use of dust collection equipment attached to drilling rigs to collect dust generated at the drill collar following air blasting to clear holes
- overburden and coal crushers in the Whites Creek pit will be fitted with water sprays
- dust from dragline operations is difficult to control in practical terms although operating practices such as limiting the drop distance will be enforced
- dust emisssion from truck and shovel operations at the face will be low and no special control measures are proposed, it being noted that most of these operations occur below ground level
- dust emissions from shot firing will be limited by the use of good blasting practice; however it is accepted that control measures that are generally nominated do not have a great effectiveness in limiting emissions; (measures such as wetting the surface prior to blasting and the use of material of large particle sizes for stemming instead of drill cuttings will be evaluated during site blasting)
- major blasts will, if necessary, not be fired during periods of high winds; similarly, when draglines are in adverse locations, operations may need to be curtailed in high winds. Such restrictions on mining operations can only be determined by continuous monitoring when operations are underway
- dust emissions during prestripping operations and from previously stripped areas will be controlled by both limiting the area of prestrips and surface watering.

As stated previously, it is proposed to control dust generation principally by establishing a monitoring system which will allow a direct cause and effect relationship to be established. Although it is proposed to establish additional deposition gauges as shown on **Exhibit 5.3, Monitoring Stations,** deposition gauges do not allow a direct correlation to be established between the dust generating activity and the resultant dust levels. It is proposed that at two locations on the north east and north west corners of the site both a continuous monitor, known as a nephelometer, and a high volume sampler, be installed. The continuous monitor enables a direct readout of suspended dust concentrations, and the high volume sampler collects a sample of that suspended dust in order to identify the actual particle types in the dust. Such a system, when integrated with anenometer data and site operations occurring at the particular time, will enable an actual modelling of site dispersion characteristics.

6.5 ON-SITE HAULAGE

As part of the mining operations large volumes of overburden will be moved from the face of each mine to the overburden disposal area. A smaller, but still significant, quantity of coal has to be transported from the mine to the coal processing area. This section outlines the steps proposed to minimise the impacts.

Equipment Selection
It is proposed that coal from the mines be generally transported by conveyor to the coal processing area. The decision was primarily based on economics, however, the environmental advantages of a conveyor system when compared to truck haulage, were also a factor.

Coal from the Ramrod Creek mine, because of the mines relatively close location to the coal processing area, will predominantly be hauled by truck. However, coal from the Glen Munro mine will be overland conveyed and coal from the Whites Creek mine will be transported by two conveyors. A base conveyor will be located on the floor of the Ramrod Creek seam at the northern end wall and progressively extended as the mine advances. The conveyor will be progressively buried under the overburden disposal. A second overland conveyor along the side ramp will transport coal won from the higher seams in the succession.

The use of conveyors in lieu of haul trucks for overburden haulage in the Whites Creek mine is being investigated and the intention is that a crusher conveyor system will be installed after the first two to three years of mine operation. Trucks, however, will still be required to haul overburden to the crusher and the oversize material direct to the disposal area.

Noise Controls
Haul trucks potentially represent the greatest source of intrusive noise due to their large numbers and high source levels although the overall effect will be reduced considerably by utilising conveyor transport systems.

The control measures proposed for on-site truck haulage have been described in **Section 6.4, Mining Operations.** The control measures apply to both the trucks and to the layout and design of the haul roads. They particularly apply to the operation in the Ramrod Creek mine.

Conveyor source noise is relatively low compared to the haul trucks. Source levels at 7 metres are 61 dBA compared to levels for haul trucks of 94 to 98 dBA.

Dust Emission Controls
Dust emission from on-site haulage operations is principally from the action of haul trucks on unsealed roads. Extensive road watering will be employed, assisted if necessary by chemical suppressants, to keep road surfaces continually moist.

The crushers in the Whites Creek pit will be fitted with water sprays to reduce dust generation. Their location and the location of the overburden conveyors, being well below natural surface, will mean considerable shielding from surface winds.

Coal conveyors will be semi-enclosed to provide wind protection and fine mist sprays at the coal handling plant will damp down the coal and apply a dilute solution of an agglomerating agent to bind the fines. Transfer stations will be fully enclosed buildings.

Water Pollution Controls
Runoff from haul roads and along conveyor routes is likely to be high in fines, particularly coal dust from crushed spillage. All runoff will be intercepted in catch drains and channelled into settling ponds where it will be disposed of through evaporation or draw-off for use in road watering.

6.6 OVERBURDEN DISPOSAL

In the context of this Statement, overburden disposal is the placement of all overburden and interburden material removed from the mines in areas either outside the mine area, in the previously excavated pit void, or in-pit above original ground surface level.

The total volume of overburden and prestrip to be moved in all three mining operations over the 20 year Stage I mine life, totals almost 1 300 million cubic metres of in-bank material. The Whites Creek mine has a total volume of 770 million bank cubic metres. The peak annual volume is approximately 78 million bank cubic metres.

The bulking or swell factor for the overburden has been taken as a net overall 30 percent from in-bank to placement volume in spoil areas in all mines and for all material. The bulking will result in a total disposal volume of 1 650 million cubic metres. Of this volume, approximately 1 000 million cubic metres will require to be placed above existing ground surface levels. The balance will be placed back in the excavated pits. A large proportion of the volume to be placed above existing ground levels will be placed over the area of the mines. Movement of this quantity of material necessitated that an overall site landscape plan be developed to marry together disposal operations at each of the mines and to use the disposal volumes to create natural shielding of continuing mine operations and a final landform that blended with the existing character of the area.

The principals of the overburden disposal system, as it relates to the mine plan for each of the three mines, has been described previously. The placement as it relates to the rehabilitation, landscaping plan and visual screening, has also been described.

Noise Control
A description of noise control measures for overburden placement has been given in **Section 6.4, Mining Operations.**

Drainage and Water Pollution Control
The water management system to control drainage and to prevent releases of waters of inferior quality outside the site has been described in this chapter under **Section 6.4.**

Particular attention has been given to the possibility of an interconnection between the Ramrod Creek mine and the Hunter River alluvium through the coal seams. Once mining ceases, the spoil backfill will become saturated over a period of years and the possible formation of a ground water mound may provide the hydraulic head difference necessary to induce flow from the pit into the alluvium. The Ramrod Creek pit will be kept dry by pumping following the completion of mining, and because of the higher permeability of the spoil, it is more likely that groundwater flow will be towards the pit floor and not towards the Hunter River. However, to guard against saline water flowing towards the Hunter River, it is proposed that the coal seams be sealed by a clay cutoff zone during the pit backfilling operation.

Dust Emission Control
Spoil disposal areas will be potential sources of wind blown dust and particular emphasis will be placed on early rehabilitation and revegetation. Irrigation may be used to promote successful vegetation growth for the more sensitive areas and, in particular, in dry years. Additional limited measures which could be used include mulch or bitumen emulsion spraying and the spreading of wood chips.

Soil Erosion Control
Surface erosion of overburden and spoil areas will be prevented by the establishent of contour embankments and by rapid revegetation. Irrigation will be used to provide and ensure successful revegetation. During landscaping of the overburden areas, future watercourses will be developed in a controlled and aesthetically attractive manner to prevent random and undesirable development of creeks. Steeper slopes to watercourses will be protected by placement of rock rip-rap. Emphasis will be placed on the establishment of suitable vegetation cover to these watercourses to ensure continued erosion protection.

6.7 RAW COAL HANDLING

The raw coal handling system includes the dump and breaker stations, the raw coal stockyard and the screen house. The environmental safeguards for these facilities are described hereafter.

Water Pollution Control
Rainwater runoff from the raw coal handling site will be collected in drains which will discharge to settling basins in order to remove all the finely divided coal particles. The settling basins will be preceded by a treatment unit to accept dry weather flow and first flush storm flows. The unit will have the facility to remove any free oils.

Water used for dust control spraying operations will not be of such a magnitude that runoff from the site will occur. The settling basins will be designed to allow regular cleaning out of settled material. This material will be disposed of in an approved manner.

The treatment unit for these areas will be designed to accept first flush runoff washdown waters and any excess drainage water from dust control spraying. Excess storm runoff will bypass the units and be diverted into the settling basins. These basins will overflow into the Tailings dam.

Dust Control
The dump hoppers at the dump stations will be fitted with special containment sprays to prevent egress of dust carried by updraft air from the hoppers. A proportioning plant will add a measured dose of a wetting agent to water sprays. This, together with the use of fine atomised spraying, will ensure the complete washing of all up draught air and hence prevent dust escaping from the hoppers.

The surfaces of all stockpiles in the raw coal stockyard will be sprayed with a binding solution from a reticulated pipework system and distributor nozzles around the perimeter of each stockpile. On drying, this will form a durable crust which will resist wind erosion and dust lift-off from the stockpiles. New surfaces formed during stacking or reclaiming operations will be promptly sprayed to maintain continuous control of stockpile dust.

Surfactant spraying at conveyor feeders and transfers will ensure the effective suppression of dust during the conveying and stacking-out of coal throughout the plant. Spray stations will be equipped with multiple spray headers and nozzles designed to effectively penetrate the open coal stream to agglomerate all fines. The level of treatment will be sufficient to maintain control of dust until the coal has been stacked-out in stockpiles or loaded into rail wagons.

Noise Control
The main noise sources in the raw coal handling system are the dump stations and breaker stations with noise levels at 7 metres of 101 dBA and 96 dBA respectively. These sources are at least 2 kilometres from the nearest affected residence, Linhay, and more than 1 kilometre from the Muswellbrook industrial estate.

From the Noise Assessment Study, day and night levels at Linhay are determined by mining operations at the Ramrod Creek mine and are not affected by operations of the coal processing system. Noise levels at the industrial estate will be higher because of its closer proximity to the coal handling and processing plant area. Daytime noise levels at the industrial estate are estimated to be 49 dBA. This level is likely to be below actual levels generated by activities within the industrial area when it is fully developed.

Noise safeguards included in the raw coal handling system include cladding of the screen house to both minimise noise and reduce dust and the selection of stacker reclaim equipment in the raw coal stockyard rather than a tunnel reclaim system with its necessary bulldozers and front end loaders.

6.8 COAL PREPARATION PLANT

The coal preparation system consists of the wash plant and associated facilities for coal product and coarse and fine reject handling.

Water Quality Control
All washdown water and spillages within the plant will drain to collection sumps and then to a treatment unit for separation of the coal particles and oils and greases. For plant shutdowns, wash water will be directed to the Tailings dam after preliminary separation in the treatment unit. The drainage and treatment system is a common system for the complete coal processing area and was outlined in the previous section, **Section 6.7, Raw Coal Handling.**

Dust Control
Coal preparation is basically a wet process and no dust will be generated inside the preparation plant.

Noise Control
The preparation plant buildings will be a steel framed structure with multi floor levels for plant and equipment. Concrete floors will provide noise and vibration damping. Source noise levels will be lower than for other operations within the coal processing complex. It is proposed not to fully clad the building. The control room annexe building will be acoustically insulated in order to ensure a low noise level for operator and amenity comfort.

6.9 WASHERY REJECTS DISPOSAL

The washery rejects consist of coarse rejects, of material greater than 0.5 mm, and fine rejects, of material less than 0.5 mm, which is disposed of in a slurry form. The coarse rejects will be placed in the Whites Creek mine disposal area and the fine rejects will be discharged to the Tailings dam after thickening to 40 percent solids. On a dry weight basis the quantity of coarse rejects produced will be up to a maximum of 950 000 tonnes per year. At a compacted density of 2 tonnes per cubic metre, the volume will be 475 000 cubic metres. This volume represents approximately 0.5 percent of the volume of overburden disposal to spoil areas in any one year.

Water Pollution Control
From analyses of the coal it is to be expected that the reject material will be higher in soluble salts than the overburden. However, what effect the washing process will have is unknown and analyses will need to be taken of the rejects when the plant is operating. Low levels of pyritic sulphur in the coal mean that leachates from rejects disposal areas will not be significantly acidic. Segregation of the rejects into layers in the spoil areas appears to be unnecessary. Irrespective of the final placement method, reject material will not be disposed of close to the final recontoured land surface.

Fine rejects of tailings will be discharged to the Tailings dam. Disposal of tailings water and local runoff entering the Tailings dam will be by evaporation. Provision will be made for recycling water decanted from the storage although it would only be used for watering of haul roads. The Tailings dam will be provided with sufficient freeboard to ensure that the probable maximum precipitation storm can be totally stored within the dam. No scour outlet will be provided from the dam and a downstream seepage collection weir will be provided to prevent highly saline water entering Ramrod Creek. Seepage waters will be pumped back to the Tailings dam.

Dust Controls
The only potential source of dust from the operations of rejects disposal would be provided if the surface of the Tailings dam were to dry out. However, tailings will be discharged at the upstream end of the storage at the shallowest point and deposition of particles will proceed out towards the dam wall. As discussed in **Section 4.4.6, Rejects Disposal,** the dam will be progressively raised as required to provide the storage volumes necessary. The storage surface will be finally sealed and grassed.

6.10 FINAL PRODUCTS HANDLING

The final product coal handling system includes the final products stockyard, the conveyors to the rail loading bin, the rail loading facility, and the two 250 tonne surge bins at the start of the overland conveyor to the Bayswater Power Station.

Water Pollution Control
The water quality control provisions for this area are part of a common system for all the coal processing area.

Dust Control
Clean coal on conveyors to the stockpiles will be saturated and will not require covering or addition of water to prevent dust emission.

The surfaces of all stockpiles in the final product coal stockyard will be sprayed with a binding solution from a reticulated pipe network surrounding each of the stockpiles. On drying, a durable crust will be formed which will resist wind erosion and dust lift-off from the surface of the stockpiles.

Rail wagon loading chutes will be shielded from wind and fitted with washing sprays to effectively prevent dust egress during loading operations. A proportioning plant will add a wetting agent to the water sprays.

Noise Control
No special noise control measures are proposed for the final product handling system. Source levels are low in comparison with other coal processing operations.

6.11 OFF-SITE COAL HAULAGE

All coal transported from the site will be moved by either conveyor or rail. There will be no use of public roads for the haulage of coal. The conveyor to the power station will transport approximately 7.7 million tonnes per year. The proposal for the conveyor was included in the Environmental Impact Statement for Bayswater Power Station and the safeguards to be provided are outlined in that document.

Two million tonnes of coal would be transported from the site by rail each year. Half of this would be coking coal destined for export from the port of Newcastle with the other one million tonnes to be railed, as required, to other Commission power stations.

The rail spur from the Drayton balloon loop is approximately 4.9 kilometres in length through the northern part of the Bayswater and Drayton lease areas. Environmentally the only significant effect of rail operations is noise and the results of the noise assessment study are discussed below:

Noise Control
Trains travelling at normal speeds between the Mount Arthur loop and the rail junction near the Drayton loop are expected to produce up to approximately 100 dBA at a distance of 7 metres. On this part of the rail spur, the nearest residence is approximately 400 metres away, resulting in a peak level from rail movements of approximately 65 dBA. This level will occur for an average of only 4 movements per day associated with the Mount Arthur North operation, but the number of train movements will increase to 18 per day if the proposed Mount Arthur South and Black Hill operations are approved. Such levels should be viewed in the light of rail loading and train movement noise levels associated with the Drayton rail loop and also continuous mining noise levels associated with the proposed Drayton mine.

Locomotives at and near the Mount Arthur rail loop are expected to produce noise levels of approximately 90 dBA at 7 metres. Attenuation to Linhay, the nearest residence at a distance of approximately 1.5 kilometres is expected to be 50 dBA resulting in an intrusive level of 40 dBA. Noise from brakes as the empty trains stop within the loop is estimated to be 95 dBA at 7 metres, resulting in an intrusive level of approximately 43 dBA at Linhay, allowing for the additional distance attenuation because of the high frequency noise. When these operations take place, the level of intrusive noise at Linhay will rise by 8 to 10 dBA.

Train whistles are variable in sound pressure level, but are unlikely to produce levels greater than 40 to 42 dBA at Linhay. Their low frequency of occurrence is considered to render them insignificant. Mount Arthur trains will also travel along the Drayton rail spur east of the Mount Arthur/Drayton rail junction and it is on this section of the rail spur that trains will pass closest to residences. Rail operations east of the Drayton rail loop junction are covered by the Antiene/Drayton Rail Spur Joint Venture Agreement and the impact has been assessed and reported on in the Drayton Environmental Impact Statement **(Reference 25).**

6.12 VISUAL SAFEGUARDS

A series of landscape design and management guidelines were established following analysis of the existing landscape with the overall intent of controlling visual imact and enhancing the rehabilitation process. It was appreciated from the outset that disposal of the large volumes of overburden material generated would create difficulties with respect to physical extent and appearance, and consequently a landscape design study was undertaken (Document 8 of VOLUME 2).

The basic aims of the study were:

. the development of a mining operation which is visually compatible with its surroundings
. recognition of the difference in visual consequences and means of control obtained from near views along the perimeter roads compared with distant views from Muswellbrook or from across the Hunter River
. the control of unsightly views by effective planting and use of earth mounds, developed in a sequence which gives maximum protection at the earliest time
. siting of mine buildings, stockpiles and operational areas to reduce the need for visual protection works
. provision for progressive development of the post-mining landscape
. rehabilitation of the mined areas to a viable and manageable ecosystem.

Within the rehabilitation plan described in **Section 4.8**, and discussed further in the following **Section 6.13**, the measures incorporated to minimise visual intrusion by the project include:

. early development of planting and mounding along Mitchell Line of Road, part of which has already commenced, and along the Denman Road mainly in the vicinity of the Ramrod Creek mine area

. protection of existing stands of trees by fencing to control stock intrusion and encourage natural regeneration

. design of a finished landform to eliminate or minimise long distance views of the mining face of Whites Creek mine on the higher slopes of Mount Arthur, the mining face of Ramrod Creek mine on Macleans Hill, and haul roads, site conveyors and other site works

. provision for progressive revegetation; a high priority will be given to the northern part of the area most visible from Muswellbrook and local public roads and it is proposed that this general area of the site be also given priority for irrigation of finished land surfaces and landscaping features

6.13 REHABILITATION

Post-Mining Land Use
Various long term land use options are available to the project which will require further investigation before firm decisions are reached. The options considered at this preliminary stage were:

. complete revegetation with a mixture of grass, shrub and tree species to obtain an eventual natural forest cover
. reestablishment of grazing land under native or improved pasture
. establishment of commmercial forestry operations using softwood species
. preparation of as much area as possible for arable uses with marginal areas restricted to grazing or retained as shelter belts of trees in the more exposed or erosion prone areas
. non agricultural uses, for example, recreation, residential or industrial uses

From consideration of the size of the area of rehabilitation to be undertaken, it was deemed desirable to obtain maximum flexibility and economic potential for the long term. The forestry option was discarded based on the relatively poor experience of past softwood plantations in the Hunter while the non agricultural uses were considered inappropriate as long as there was active mining within the Authorisation.

Within the overall physical and visual objectives of the finished landform, the end use adopted for design purposes comprises a mixture of grazing, some arable areas and extensive shelter belts of native understorey and canopy associations.

Slopes
The limits on slope suggested by the Soil Conservation Service are that slopes of 10 degrees (1 in 6) are the maximum desirable with local steepening to 14 degrees (1 in 4) permitted on occasions. The slope cirteria adopted in the proposal were:

- new slopes on the peripheral aspects and skyline of new landforms to be a maximum of 1 in 10 in order to be consistent with adjacent existing land-forms. Spurs and saddles are designed with slopes of 1 in 15 to 1 in 20 for the same reason except where they join existing landforms of greater slope and they are increased to blend.

- internal temporary faces outside the mines proper have been increased in slope to a maximum of 1 in 4. It is proposed that within the overall 1 in 10 slopes there may be localised increases in slope on ridgetops and along drainage channels, (both of which would be stablised by revegetation with trees and understorey associations), in order to leave areas of broad slopes for eventual agrcultural use as arable land.

Restoration Trials
Due to the extensive area involved, significant variations occur in growing conditions and natural systems throughout the site. The most satisfactory restoration technique for various parts of the site are therefore also likely to vary. While experimental restoration areas have been established on other mining areas in the district, it will be necessary to establish a series of restoration trials on the Mount Arthur North site to confirm local site conditions. These trials will be commenced at an early date and will include participation by officers from the NSW Department of Agriculture and the Forestry Commission.

Rehabilitation Management
The Environmental officer responsible for all site environmental control will coordinate rehabilitation planning for each mine. For the site as a whole, and for each mine in detail, the following items will be prepared:

- programme of topsoil stripping and stockpiling in conjunction with the NSW Soil Conservation Service

- detailed landscape form plans

- plans and programme of overburden placement, levelling, topsoil, replacement and final surface treatment

- maintenance and management proposals of areas not yet disturbed by operations, and complementary management of rehabilitated areas. Maint-enance will include erosion control, weed and insect infestation control and pasture conservation.

6.14 OFFICE, AMENITY AND WORKSHOP AREAS

The facilities areas have been located away from the mining operations. The facilities areas accommodate a variety of support functions for the mine operations including:

- administrative offices
- bathhouses
- personnel car parking
- maintenance workshops
- storage of fuel, lubricants, spares, and bulk materials
- mine equipment and plant storage, excluding explosives and inflammable material which will be stored separately.

The administration buildings will generally be near public roads and will be designed to commercial standards of layout, materials and colour so as to present an attractive but unobtrusive appearance. Bathhouse construction will be of similar standard and with finishes in accordance with accepted mining industry standards. Bathhouses have been located to serve mine, workshop and maintenance personnel. Workshop and stores buildings will be of steel frame, metal clad construction.

Car parking will be provided near buildings in proportion to the relevant numbers of employees and visitors. Parking areas will be constructed to normal standards of layout, and will be paved. Facilities areas will be built with due consideration for visual screening and shading. For facilities near public roads, the landscape planning would include roadside treatment.

Water Pollution Control
Surface runoff and drainage of workshop areas and service roads will be collected and treated by local treatment units for the removal of oils, greases and suspended solids. The Whites Creek mine and coal processing plant workshop areas drainage will be combined and treated with that from the coal processing plant for discharge to the Tailings dam. Separate treatment facilities will be provided at the Ramrod Creek and Glen Munro mine facilities areas and treated water will be discharged to settling ponds for reuse for road spraying. Oils and greases will be collected and sold for reclamation.

Wastewater from ablution areas will be treated in package treatment plants. The effluent will be used for land irrigation of rehabilitation areas. Runoff from landscaped gardens and private vehicle car parks will be discharged directly to the local natural drainage systems.

Dust Control
Dust generation from the facilites areas will be low as most trafficked areas will be paved.

Noise Control
Significant levels of noise emission may occur in or near workshops. The main noise sources will be engine testing and noise asssociated with movement of materials. One or two bays of the workshop will be allocated for engine testing. This area shall be screened from the rest of the workshop by the use of noise absorption screens.

Flammable and Explosive Materials
The location, method of storage, and precautions for transport of these materials will comply with relevant legislation and conform to Australian Standard

1940-1976, Flammable and Combustible Liquids Code, the Dangerous Goods Act, 1975, and the Coal Mines Regulation Act, 1912, as amended. Inflammable liquids will be stored away from other buldings, surrounded by bunds, and with appropriate fire fighting equipment, as required, while explosives, detonators and similar stores will be stored in small magazines remote from the facilities areas.

The provision for mixing ammonium nitrate and fuel oil explosive on site will practically eliminate the need for explosives storage, as described in **Section 4.5.5, Explosives Transport and Storage.** Dry ammonium nitrate pellets will be delivered by road. Moderate quantities of slurry type explosives will be delivered directly to drill holes by truck as required.

6.15 OFF-SITE ROAD NETWORK

Development of the Mount Arthur North mining operations will require the relocation of two sections of public road around the mining areas. Another section of road will be partly upgraded and partly relocated. Public roads in the vicinity of the site will also be affected by increased traffic movements associated with employee trips at shift changes and deliveries of goods and materials to the site. The environmental considerations and effects on the local public road network is outlined in this section.

Road Deviation Works

The Denman Road deviation was required to limit visual access for road traffic into the mining operations of the Ramrod Creek mine. The deviation also provided additional reserves of extractable coal along the present alignment of the Denman Road. The vertical alignment has been designed to ensure that the road is flood free with a minimum of 2 metres clearance from the 1 in 100 year flood line. The horizontal alignment is clear of the irrigated agricultural land along the river flats. An earth bund will be constructed and trees planted between the deviation alignment and the mine workings.

The deviation has placed the road closer to both Edinglassie and Rous-Lench. The sections of road, adjacent to each of these buildings, are in cut. Tree screens will be provided to visually reinforce the effect of the road being in cut.

The relocation of the Edderton Road is required prior to commencement of operations at the Glen Munro mine in 1992. The road will be relocated along the western boundary of the Authorisation to link up with the proposed relocation necessitated by the proposed Mount Arthur South operation. The road will not pass close to any residences and no special safeguards will be provided. The road will be constructed to Department of Main Roads standards consistent with the existing topographical constraints.

A section of the Mitchell Line of Road west of the Drayton rail loop will be deviated to an alignment adjacent to the proposed rail aligment. This deviation was located to minimise land acquisition and possible coal sterilisation, and to provide a better geometric standard than currently exists. The road will connect with the Greta Road currently being constructed through to the New England Highway.

Road Traffic

Whilst some small increase in traffic noise will occur on the Denman Road as a result of additional light and heavy vehicle movements, the existing traffic density is such that increases will be marginal. However, further increases in density will occur as a result of other mining developments proposed for the area.

Additional traffic associated with Mount Arthur North operations on the Greta Road will be noticeable because of the very low existing traffic densities in the area. Noise levels from heavy vehicles is expected to be up to 89 dBA at 7 metres and from light vehicles up to 82 dBA at 7 metres, with the occasional noisy light vehicle possibly up to 85 dBA. At the nearest existing residence, Mulawa, which is at a distance of approximately 100 metres, these peak intrusive levels would be reduced to approximately 66 dBA and 59 dBA, with occasional light vehicles to 62 dBA, respectively. Whilst these peak levels will occur from each vehicle movement, the greatest impact will probably occur during the morning shift change period, 5.30 am to 6.30 am, when just over 200 light vehicle movements are expected. During this period, the L10 has been estimated to be approximately 44 dBA.

The two residences potentially affected by increased traffic levels on the Mitchell Line of Road, Yammanie (300 metres) and Linhay (250 metres) will experience relatively low peak noise levels from traffic because of their distance from the road:

. Yammanie
  Light vehicles - 49 dBA, occasionally up to 52 dBA
  Heavy vehicles - 56 dBA

. Linhay
  Light vehicles - 51 dBA, occasionally up to 54 dBA
  Heavy vehicles - 58 dBA

Again, the greatest potential for impact will be during the morning shift change period, 5.30 am to 6.30 am, when approximately 340 light vehicle movements are to be expected. An L10 of approximately 33 dBA is expected at Linhay during this period.

6.16 MONITORING PROCEDURES

The monitoring programme will be controlled by the site environmental officer as described in **Section 4.6.2, Environmental Management.** The monitoring programme that has been operating during the investigation and conceptual design stage, will be continued to supplement the information pertaining to ambient conditions.

Prior to operations commencing, further stations are to be set up to record the impacts and to establish the details for the mining practice. This programme will be continued into the operating phase and is to form the basis for the design of safeguards to minimise pollution. Monitoring in this stage will be an on-going procedure and will be used to provide background information as a basis for safeguards for new methods and plant, and to test the effectiveness of those procedures currently in use.

The monitoring procedures will utilise a variety of techniques and employ a combination of automatic and manually operated equipment.

Water Quality
Salinity, turbidity and pH are to be monitored on a regular basis. Other determinations will be conducted as required. Measuring and recording devices

will be located and samples taken from water channels, ponds, dams, groundwater bores and from the sites nominated on **Exhibit 5.3, Monitoring Stations.** These latter sites are located on the downstream reaches of the natural drainage channels and will monitor the quality of any water prior to it entering the Hunter River.

The results of water analyses will be correlated with analyses of the overburden to identify any sources of excessive salinity or levels of pH outside of the range 6.5 to 8.5.

Noise
Analyses based upon 'Noise Control Guide, Data Sheet N1014', issued by the State Pollution Control Commission, will be conducted to monitor the noise levels associated with the early operations to establish mining practice.

Sound level surveys during mining operations will be conducted regularly to monitor changes as the mines advance to the west and to provide the necessary data for control measures on plant, acoustic bunding, and site operations generally.

Air Quality
A dust monitoring programme has been discussed with the SPCC and monitoring will commence in the near future to enable a repesentative selection of background data to be obtained before major construction or mining commences.

A number of dust deposition gauges both standard and directional will be installed in the locations indicated in **Exhibit 5.3** to reinforce the existing network of gauges. Gauges will be monitored at monthly intervals and analysed for soluble solids, insoluble solids and ash content together with a microscopic examination.

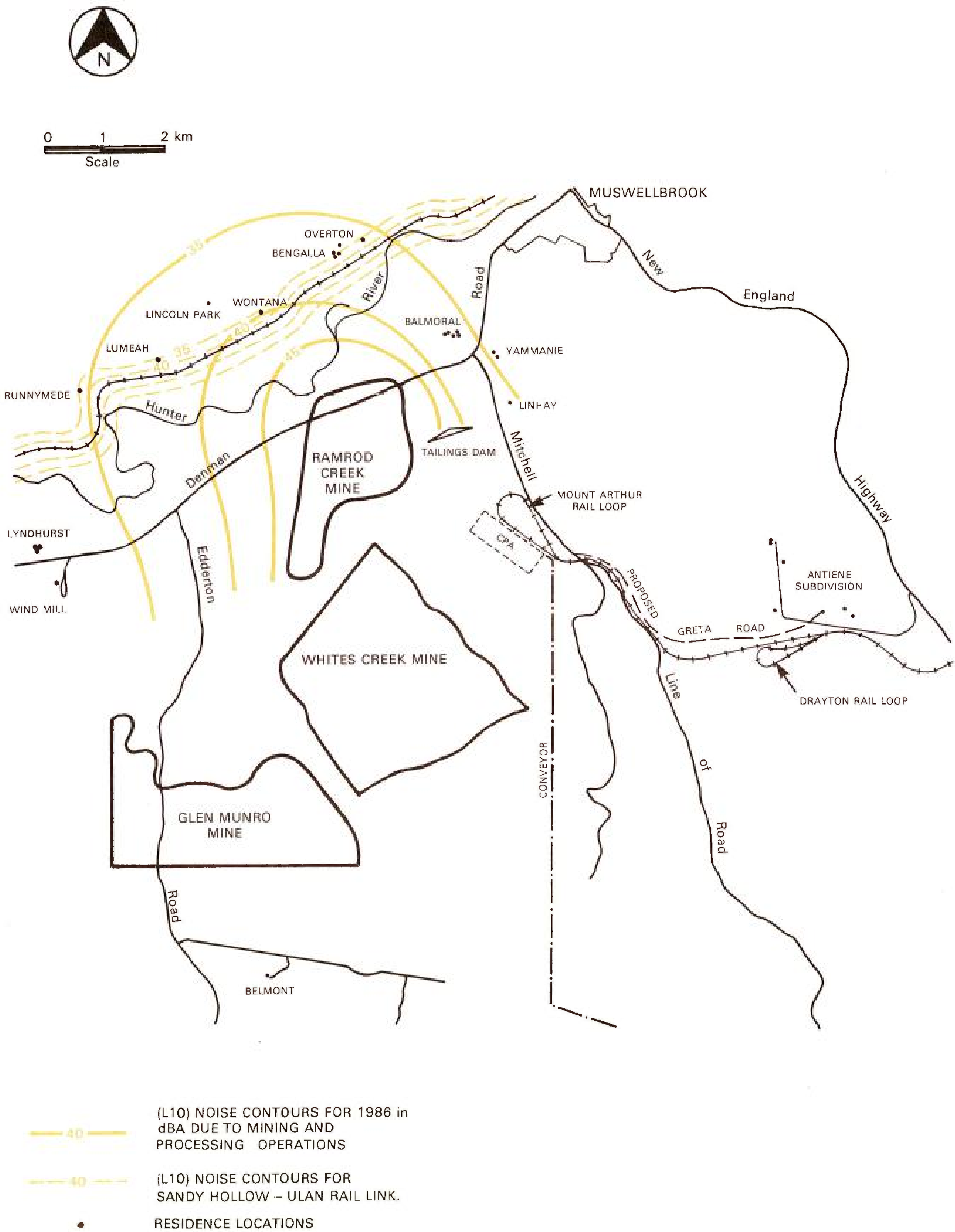
In addition a high volume sampler and a continuous monitoring instrument will be installed in both the north east and north west corners of the Authorisation for measuring and recording suspended dust concentrations in the atmosphere. The continuous monitor will be operated in conjuction with an anemometer and will enable a correlation between suspended dust concentrations and wind speed and direction to be developed.

Vibration and Overpressure
In conjunction with the monitoring programme for noise levels, regular surveys will be carried out for the purpose of monitoring vibration and ovepressure effects resulting from site blasts. Particular attention will be given to the area north of the Ramrod Creek mine in order to develop site blasting techniques to control resultant effects at Edinglassie, Rous-Lench and Balmoral.

Local Climatic Data
A meteorological station will be established on the site to record basic data specific to the site. An evaporimeter will be included in the station. Wind directions and speeds will be monitored at various localities on the lease and on adjoining areas.

Other Factors
Various other structures and activities within the site will be monitored on a regular basis. Such monitoring will include:

- settlement and pore pressure levels of the Tailings dam embankment
- groundwater yields and aquifer drawdowns as a result of borefield pumping
- daily records of site water usage
- periodic analysis of interburden material and coal preparation plant rejects.



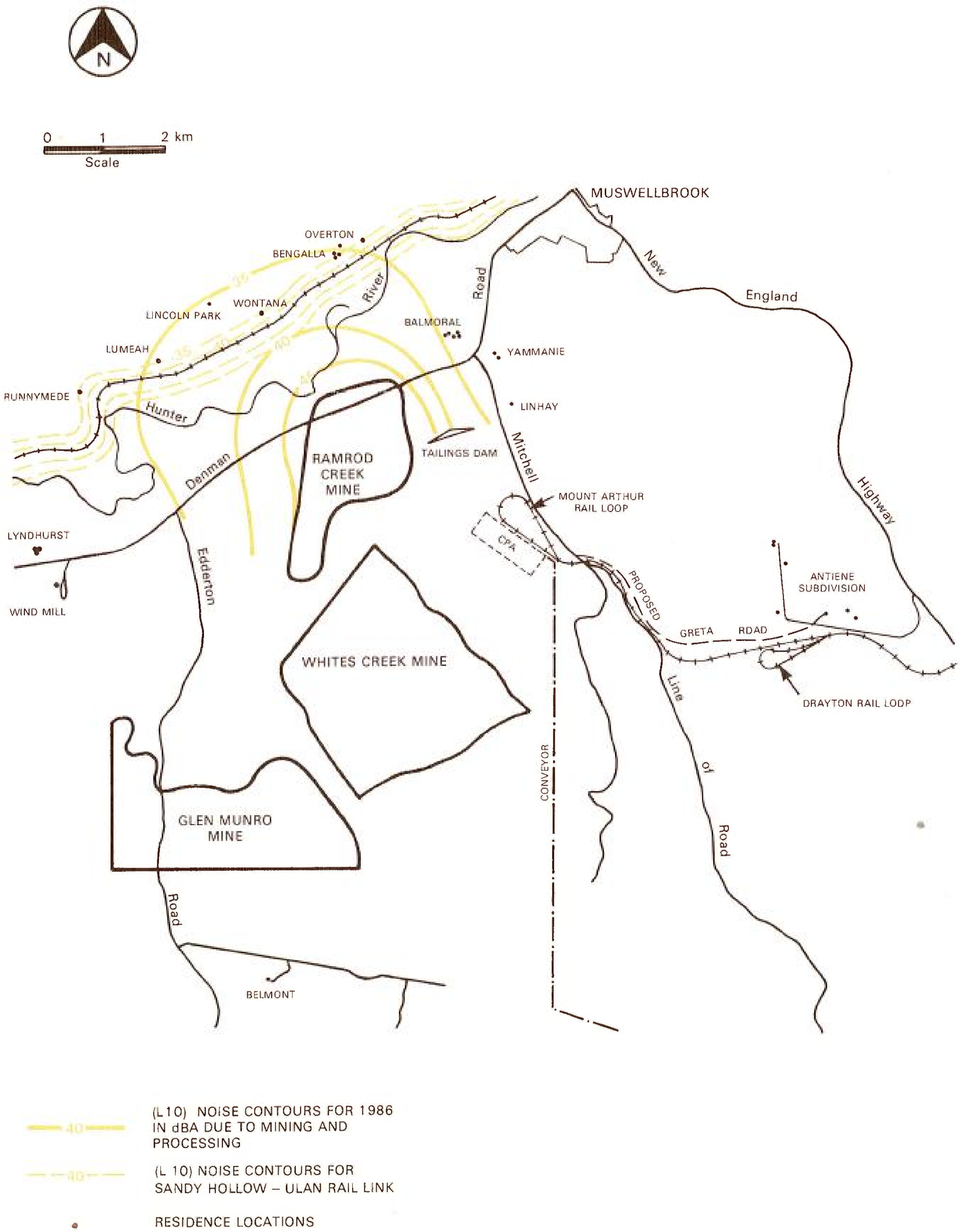
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 6-1

PREDICTED DAY-TIME STEADY NOISE CONTOURS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: WILKINSON-MURRAY CONSULTING PTY LTD



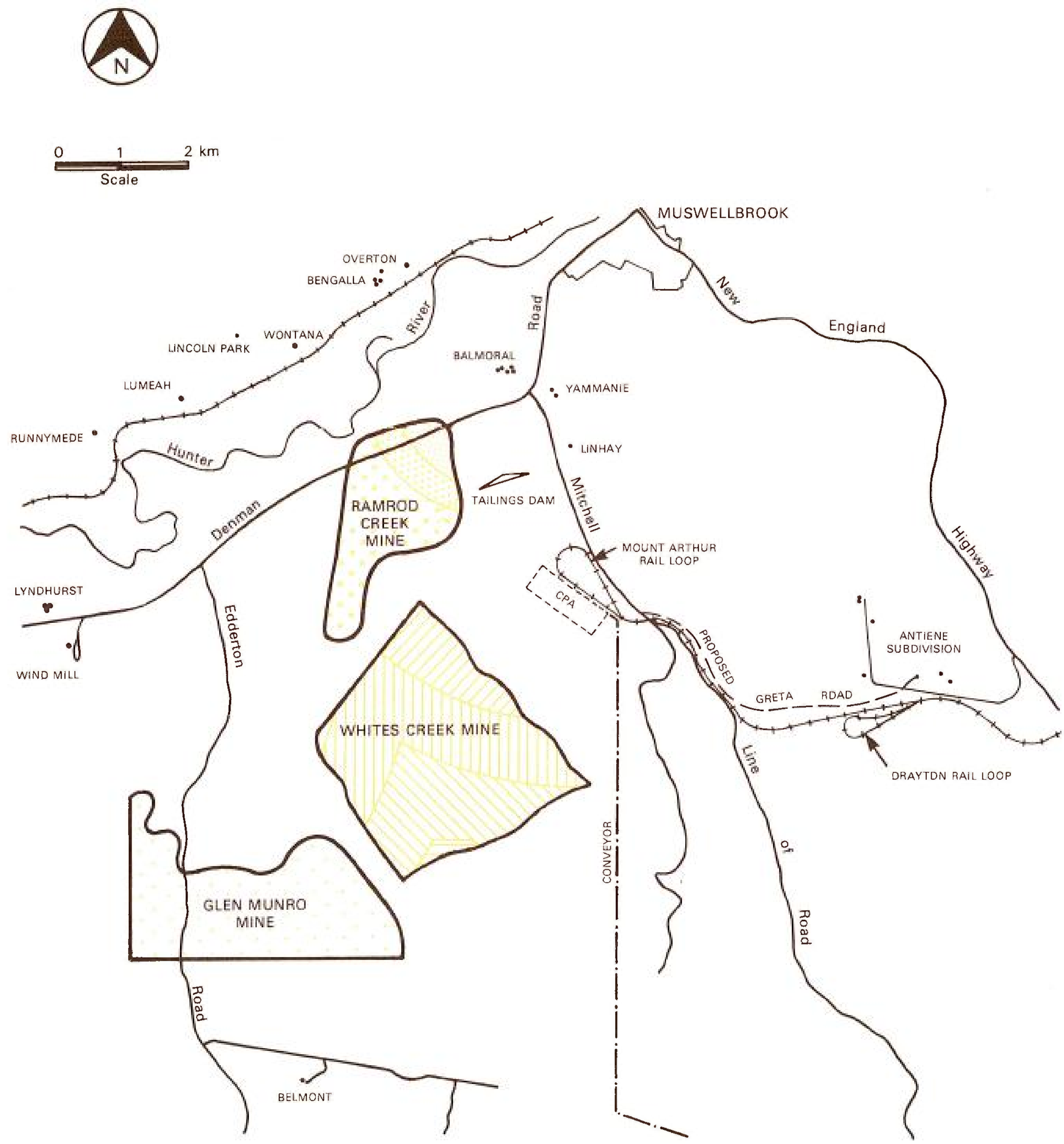
MOUNT ARTHUR NORTH COAL PROJECT

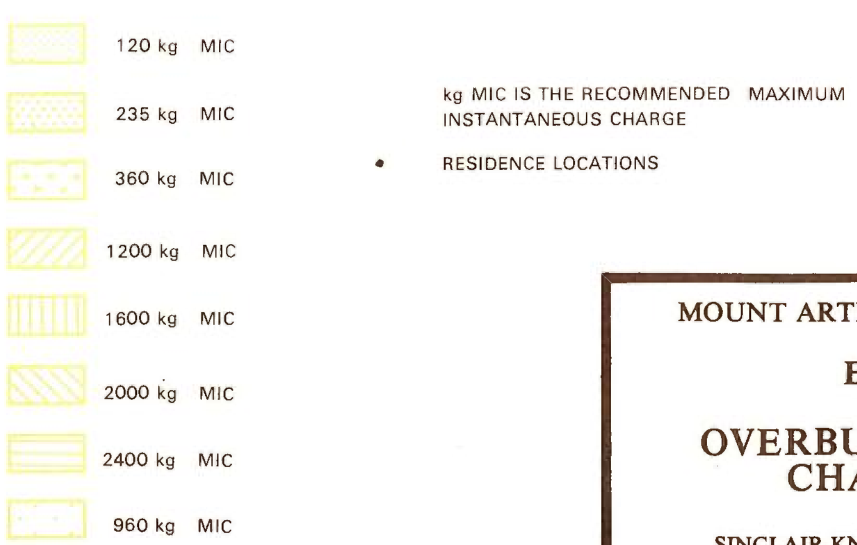
EXHIBIT 6-2

PREDICTED NIGHT-TIME STEADY NOISE CONTOURS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: WILKINSON-MURRAY CONSULTING PTY LTD





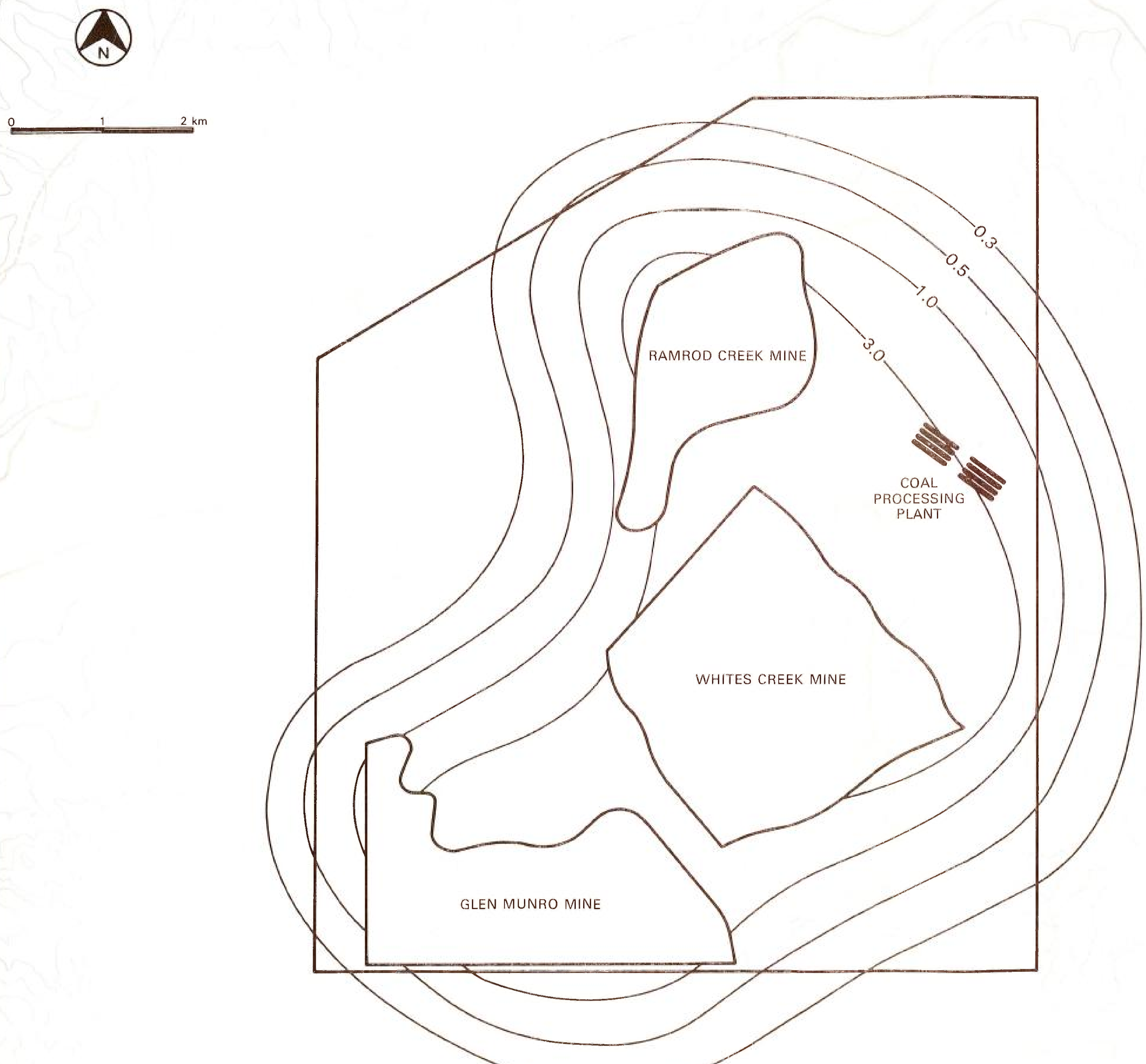
MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 6-3

OVERBURDEN BLASTING CHARGE LEVELS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

SOURCE: WILKINSON-MURRAY CONSULTING PTY LTD



NOTES

- CONTOURS INDICATE INCREASED DUST DEPOSITION LEVELS OVER BACKGROUND DUST LEVEL AND ARE ANTICIPATED MAXIMUMS
- EXISTING BACKGROUND DEPOSITION RATE = 0.7 gm/m^2/MONTH
- UNITS gm/m^2/MONTH
- RAMROD CREEK MINE HAS A NEGLIGIBLE EFFECT ON DUST DEPOSITION RATES AROUND GLEN MUNRO MINE AND CONVERSELY

ASSUMPTIONS

- AVERAGE WIND VELOCITY OF 5 m/s
- GLEN MUNRO, RAMROD CREEK AND WHITES CREEK MINES ARE OPERATIONAL SIMUTANEOUSLY
- REASONABLE DUST SUPPRESSION TECHNIQUES ARE USED.

MOUNT ARTHUR NORTH COAL PROJECT

EXHIBIT 6-4

INCREMENTAL DUST DEPOSITION CONTOURS

SINCLAIR KNIGHT AND PARTNERS PTY LTD.

IMPACTS

7. INTERACTIONS AND IMPACTS

The short term and long term interactions of the Mount Arthur North project with the existing environment are considered. The potential impacts on the environment of the proposed lease area and surrounding areas, taking into account the proposed operational safeguards, are assessed.

7.1 IMPACTS DURING MINING

7.1.1 Existing Landforms

There will be an unavoidable impact on the topography of the site. The natural bulking of the excavated material and the need to provide sufficient working room in the open cut for the mining operations results in a considerable excess of excavated material which must be placed outside the cut itself.

Approximately 1 000 million cubic metres of overburden material will be placed outside the mines and this will result in a considerable modification to the original land surfaces. Careful attention to the landscape profiles developed during placing operations and early planting of the new landforms with grasses and native vegetation will result in a landform which is aesthetically attractive, conforms with surrounding landscape profiles, and provides a natural shielding to the mine workings as they progress.

The existing landscape will be permanently changed but the production of new compatible landforms will have an acceptable environmental impact.

7.1.2 Soils and Erosion

Suitable topsoil on the site will be stripped from the mining, construction and overburden disposal areas. The soil will be removed and stockpiled for use in rehabilitation of the overburden disposal areas, landscaping and repair of construction damage. Soil quality will be improved by the application of appropriate fertilisers.

Erosion will be increased in the short term in those areas where mining is being carried out and where topsoil is being stripped and replaced. The erosion safeguards detailed in **Chapter 6, Environmental Safeguards**, will ensure that a high level of erosion protection is provided. Disturbed areas outside of the mine site areas will be kept to a minimum. Runoff from earthworks which have not been revegetated and which enters channels that subsequently flow off the site will be intercepted by settling ponds. Existing vegetation along stream channels in areas not affected by mining operations will be reinforced as part of the overall site rehabilitation plan. It is concluded that impacts due to the loss of soil, siltation of watercourses or spread of sheet erosion on the site are unlikely. Indeed, it is more likely that with the higher standard of land management that will exist under the Mount Arthur North operations, the overall site soil environment will improve.

7.1.3 Water Quality and Drainage

The water management plan for the project provides for no water discharges from the site during dry weather conditions and that any discharges during excessive wet weather periods shall not cause deleterious effects on the Hunter River. This plan is summarised in **Section 4.7, Water Management.** During times of extreme rainfall, the salinity of water discharged from the site will not exceed levels set by the relevant authorities. The project will not be a source of water pollution off the site nor will it add to the regional salinity problem.

Water will be stored in dams on the project site to provide all water demands for coal washing, dust suppression and road watering. Water imported to the site will be limited to a small supply of potable water drawn from the Muswellbrook Shire Council town system and a supply of irrigation water either from the town sewage treatment works or from the Hunter River.

The existing water courses draining the Authorisation area will be significantly diverted or modified as the project develops. The water management plan details the safeguards which will be provided to ensure no deterioration in the quality of water in these watercourses. The main impact will be a considerable reduction in average and flood flows in these watercourses, notably in Whites Creek, and to a lesser extent, in Fairford Creek and Quarry Creek. The placement of overburden spoil in Whites Creek between the Whites Creek mine and the coal processsing area will substantially change the topography in that area. Whites Creek flows will be diverted into Ramrod Creek below Balmoral corner. The reduction in catchment area for these three creeks will have a negligible impact on flows into the Hunter River and it is not expected to create any significant changes in regard to the hydrology of the Hunter River near the site or to the supply available to the existing or potential users.

Increased flows in the lower reaches of Ramrod Creek will be caused by the diversion of upper Whites Creek flows parallel to the Mitchell Line of Road before discharging below the Tailings dam. To safeguard against any potential increase in flooding in this area, lower Ramrod Creek will be realigned and improved to its confluence with the Hunter River.

7.1.4 Noise Levels

Noise levels and proposed noise controls during both the construction and operation phase of the project are discussed in **Chapter 6, Environmental Safeguards.** It must be borne in mind that at the time of commencement of operations at Mount Arthur North, activities at the Muswellbrook Shire Council's industrial estate and increased coal rail traffic through Muswellbrook because of the Sandy Hollow to Ulan rail connection, will cause a noticeable change in the noise environment in the northern surrounds of the site.

Construction Phase
Constructon activities will generally result in a noise level of 55 dBA (L10) at the nearest residences of Linhay and Yammanie. This level is 10 dBA in excess of the daytime maximum tolerable level under mining operations and 15 dBA in excess of existing levels. No night time working is proposed. For a short period, the level of 55 dBA will be exceeded, at Linhay, but only during those times when earthworks are carried out on the eastern side of the Tailings dam wall, in total less than 3 weeks. Construction noise will cause some annoyance to residents. However, given the short period of exposure and taking account of increased noise levels in this area likely because of Council's industrial area, the increases are not considered to be excessive.

Mining and Processing Operations
From **Exhibits 6.1** and **6.2** of **Chapter 6,** (drawn for 1986 but applying within 1 dBA for the period 1983 to 1992) it can be seen that the tolerable levels at nearby residences are generally not exceeded by steady (L10) noise levels from Mount Arthur North mine operations during the period 1983 to 1992. The only exception is Wontana, where the night time tolerable level of 35 dBA is exceeded by 3 dBA. However, the level will be almost identical to the L10 level expected at the same location when coal trains commence transporting coal from Ulan, which will occur prior to 1983. After 1992, when the Ramrod Creek operation moves to Glen Munro Mine, noise levels at all affected residences around the proposed lease will be well below tolerable levels. Since peak (L1) levels resulting from the punctuation of the steady noise level by intermittent noises from the mining operation are only 1 to 2 dBA higher than the steady levels, they are not considered significant in the total noise environment.

After commencement of mining operations, extensive noise monitoring will be carried out to ensure that the recommended limits for mining and processing operations will not be exceeded. Where control measures may be relaxed or where additional control measures are proved necessary, appropriate changes will be made to equipment and/or operations.

Road Traffic
The impact of noise resulting from road traffic on the Greta Road will be the greatest during the morning shift change period, 0530 to 0630, with an L10 level at the nearest residence estimated to be approximately 44 dBA and peak levels up to 66 dBA. Other traffic flows on this road will be associated with other mines in the area, including road transportation of coal from one of the mines. The net effect will be a noticeable increase on ambient levels.

Road traffic on the Mitchell Line of Road has its greatest potential for causing annoyance during the shift change period, 0530 to 0630, during which the L10 level has been estimated to be approximately 39 dBA at Linhay, with peak levels in the range 51 to 58 dBA. It is unlikely that these levels would cause annoyance to the occupants of Linhay.

Yammanie is already subjected to noise from a greater volume of traffic along the Denman Road and the effect of increased traffic on the Mitchell Line of Road at this residence is expected to be negligible.

Rail Operations
The peak level of 65 dBA expected at the nearest residence in the Antiene subdivision from traffic on the rail spur extension is not considered to be significant in relation to other noise levels expected within the Antiene subdivision.

The increase of 8 to 10 dBA on the intrusive noise level expected at Linhay, as a result of rail operations on the Mount Arthur rail loop, is not expected to cause annoyance to the occupants of this residence, taking into account the fact that on average only two trains per day will be loaded in association with Mount Arthur North operations. However, should it be decided to load Mount Arthur South coal on this loop, the number of trains will increase to an average of 8 per day and this noise will begin to become significant at Linhay. However, other residences, including Yammanie, are not expected to be affected.

Conveyor
Since the proposed conveyor route to Bayswater Power Station is at least 2 kilometres from the nearest residence, its noise level is not expected to be detectable.

7.1.5 Blasting Effects

The impacts of the effects of blasting can be quite severe. Hence for a mining operation, blasting is viewed as a particularly crucial issue and accordingly an extensive evaluation of the effects of blasting has been carried out with field data collected from actual site blasts. From this data it has been possible to establish detailed guidelines for blast design in each area of each mine in order that limiting criteria for both the effects of overpressure in the atmosphere and the effects of shock waves in the ground will not be exceeded. It should, however, be appreciated that such a study can simply supply blasting guidelines. The final evaluation of blast strengths will be determined once mining operations have commenced by regularly monitoring actual working blasts.

For occupied residences, accepted levels for ground vibration and overpressure have been met. Maximum ground vibration levels for historical buildings, such as Balmoral, of 2 mm/s will not be exceeded. For residences in general, a level of ground vibration of 10 mm/s and overpressure of 115 dBL are the adopted maxima. For the residences of Edinglassie and Rous-Lench, the Commission has accepted the responsibility for total preservation of these buildings and although higher vibration levels will be permitted, regular monitoring of ground vibration will be carried out for blasting in crucial areas of the Ramrod Creek mine to ensure that the buildings do not suffer any minor structural damage.

Impacts from blasting will be controlled to normal and acceptable limits set by both local and international authorities. However, while levels of both ground vibration and overpressure close to the recommended limits may apply for one or two residences nearest a blasting area, the levels for the remaining residences will in general be well below the recommended limits. Also those residences that experience levels close to the limits will only do so for a short period of the total period of operation of the mines. As far as Muswellbrook is concerned, blasting will generally be inaudible. It is considered therefore that if blasts are limited to a set time period during each day-time shift, the overall impacts from blasting will be minimal.

7.1.6 Air Quality

Safeguards to minimise dust generation are discussed in detail in **Chapter 6, Environmental Safeguards.** Existing average dust fallout levels in the area are as follows:

- Central Muswellbrook - 3.5 gm/m^2/month
- Suburban Muswellbrook - 1.4 gm/m^2/month
- Authorisation Area - 0.7 gm/m^2/month

The results of the dust analyses are shown on **Exhibit 6.4, Incremental Dust Deposition Contours.** This exhibit shows that the greatest incremental deposition occurs to the south and east of the proposed lease area with incremental rates up to 2 gm/m^2/month. Elsewhere, the incremental rate outside the lease is less than 1 gm/m^2/month.

However, the principal area for impact from dust deposition will be to the north and north west. Affected residences will be Linhay and to a lesser extent Balmoral and Yammanie where deposition rates may be up to double ambient rates although the resultant level will still be less than the existing fallout in Muswellbrook. An area of the irrigated river flats to the north of the Hunter River will be affected by similar increases over the ambient. However, it is unlikely such a change will be noticeable. Effects further away from the site will be negligible. It is stressed that these results have been maximised and generally much lower levels will result. The Liddell wind charts which are presented in Document 3 of VOLUME 2 show that the winds which would carry dust from Mount Arthur North towards Muswellbrook have a very low frequency of occurrence.

The proposed environmental safeguards will mean that the impact of dust on the adjacent area to the Mount Arthur North project will be low. The low frequency of south westerly winds also minimises the likelihood of dust pollution from the project in Muswellbrook itself. Nevertheless, the Commission will carry out an extensive dust monitoring programme, as outlined in **Section 6.4, Mining Operations,** and additional measures will be taken if the dust impact is more severe than predicted. Dust impacts to the north of the site will reduce after 1992 when operations in the Ramrod Creek mine have ceased and operations within the Whites Creek mine will generally be located at depths and overburden haul truck operations will have reduced.

7.1.7 Flora and Fauna

Flora

Most of the original timber has been cleared from the Authorisation area and the principal vegetation comprises pasture grasses, crops and scattered timber. In those areas where mining or overburden dispoal will take place, total removal of existing flora will be carried out. Existing flora will be preserved where possible. Extensive replanting of trees and grasses will take place on the rehabilitated overburden disposal embankments and natural re-generation will be encouraged and reinforced by additional plantings in areas of the site unaffected by direct mine operations. The activities proposed by the Commission in this Statement will have no impact on the flora. The landscaping and rehabilitation programme will add to the vegetation cover of the site in the long term. The quality of the future pasture areas will be of equivalent or better standard than presently existing.

Fauna

The fauna surveys carried out as part of this study revealed a large number of common mammals, birds and reptiles. The wooded area in the vicinity of Mount Arthur provides a range of habitats not found elsewhere on the site. This area will be largely undisturbed by the mining operations.

All of the fauna found is relatively widespread and common in New South Wales. The Mount Arthur North project will probably attract additional wild fowl due to the large bodies of water which will be developed. The mining operation will drive what remnants of the original fauna that presently exists to other areas. As the project areas are rehabilitated, native fauna will probably return to the area. No endangered species or specially protected species were identified in the surveys. Reports of platypus in the lower reaches of Whites Creek will be investigated. However, no mining operations will be carried out in this area.

7.1.8 Land Fabric Changes

Changes in Land Tenure and Ownership

The purchase of land within the Authorisation area by the Commission constitutes a change of land tenure from land owned individually or by family groups to land owned by the Electricity Commission. As shown in **Exhibit 5.6, Land Ownership,** most of the Authorisation area is already held by or is proposed to be purchased by the Commission. A travelling stock route reservation along Mitchell Line of Road will also be purchased or exchanged for another more suitable area. Outside the Authorisation area, land will be used for construction of the railway and Greta Road, and a new road reservation will be required for the relocation of the Edderton Road.

At the Shire level, other additional areas will need to be set aside for local government purposes and the like, as a consequence of this project and other developments within the region. Whilst it is not possible to identify the specific location of these areas at this stage, they would largely be associated with the expansion of urban areas at Muswellbrook and other nearby towns where the workforce for the development will be resident.

The relocation of the Denman Road will be through land to be acquired by the Commission and will require gazetting of the new road reservation. Although the land between the Denman Road and the Hunter River is not required for mining operations the new road alignment will reduce the amount of land in this area. The purchase of properties for the project will displace some existing landowners. Others, whose properties or part thereof have been purchased for the project will be able to lease some land for stock grazing purposes in the buffer zone or use land on an agistment basis in the areas to be mined. Others will decide to relocate permanently.

Changes in Land Use
As the project proceeds, various areas throughout the Authorisation area currently under pastoral production will be progressively converted to an extractive industry land use. This change is a medium term impact because existing areas of pastoral production nominated for mining will remain in use until such time as they are actually required for mining.

As mining proceeds the rehabilitation programme will allow progressive return of some of the land to agricultural uses and other purposes as discussed before.

The only areas to be utilized continually for the life of the project will be the mining support areas such as the coal processing area, rail loop, conveyor/transmission line corridor roads and dams. Estimates of the areas required for mining and support operations and areas to be rehabilitated on a cumulative basis are given in **Table 7.1, Summary of Working and Rehabilitated Areas.** The total area of the Authorisation is 6 690 hectares.

7.1.9 Agriculture

The agricultural significance of the Authorisation area in terms of the Shire and the region has been quantified in **Table 5.9, Agricultural Significance of Mount Arthur North.** However, the amount of land that will remain in agricultural use is a significant proportion of the total Authorisation area, as shown in **Table 7.1.** The land removed from agricultural use is confined to the area south of the Denman Road and west of Mitchell Line of Road which is the less productive area. There will be no loss in area of the important river flats. Although the amount of land in mining use at any one time is appreciable, the reduction of production will be minimal in regional terms.

TABLE 7.1 - SUMMARY OF WORKING AND REHABILITATED AREAS

	(hectares) 1986	1990	1994	2004
Active use for mining operations, amenites and infrastructure	790	1 001	1 358	1 100
Area used for screen planting around perimeter	32	45	50	50
Area undisturbed within operation zone	452	148	126	98
Area Rehabilitated (cumulative)	330	728	1 348	2 145
TOTAL	1 604	1 922	2 882	3 400

Indirect effects from noise and dust were considered in the Agricultural Assessment Survey (Document 7 of VOLUME 2). It was concluded that the predicted noise levels from the project would not cause long terms stress to livestock in the area. Significant increases in dust deposition concentrations are not expected to extend outside the Authorisation except possibly to the south and south east of the site in areas either currently occupied by mines or proposed to be. Dust deposition rates will increase, however, along the river flats to the north of the Ramrod Creek mine. This area north of the Hunter River and south of the rail line will be affected by increased levels of between 0.3 and 1.0 gm/m^2/month. It should be noted, however, that increased average levels will be less than levels existing throughout all urban areas of Muswellbrook. The chemistry of the dust may have selective effects on different activities or types of crop. Dust from overburden blasting will be only marginally more saline than the present topsoils. The proportion of coal in the dust cloud will be small and unlikely to cause any effects. It is concluded that the effects of dust from the project will be highly localised and of minimal impact with respect to agricultural productivity.

Long term agricultural productivity of the site is likely to be improved. The restoration of extensive areas of vegetation and the improvement in surface soil layers associated with the rehabilitation practices should in the long term provide an area with an enhanced agricultural potential to that which currently exists.

7.1.10 Visual Impacts

Development on the scale of the Mount Arthur North project will cause changes in the visual environment, which will not necessarily be detrimental. Separate effects have been identified for views from the roads around the mining area, for views into the mine area from Muswellbrook and across the Hunter Valley, and in changes in visual character elsewhere in the locality.

The extensive programme of earth profiling and tree planting along the Denman Road and Mitchell Line of Road will significantly restrict the view of the operations for travellers on adjacent public roads. While views of the operation will be restricted, the screening will also restrict the present broad vistas into the site and give a more enclosed character. On the Denman Road deviation, the lower level of the road will slightly reduce the views now available across the Hunter River Valley, but will substantially reduce views into the Ramrod Creek mine. Despite the screening measures, the present rural character of Mitchell Line of Road will become increasingly industrial with major developments on either side. The most obvious visual impacts from the perimeter roads will occur during the initial construction phase while the earth screens and planted areas are being established, and earthworks elsewhere on the site are most visible. This situation should quickly improve as the surface is stabilised with grasses, vegetation matures and mining retreats from vantage points. The impact on views from Muswellbrook and from across the Hunter Valley will be moderated by distance and by the limited extent of obvious mine activities in comparison with the broad vista available.

The landform to be developed during mining will limit views of the mines to the surface and upper levels of operation, except along a few narrow lines of sight from the north west. The rehabilitated surfaces will become more visible as operations proceed, but the visual effect will not be unattractive. The designed shapes of the rehabilitated areas will lead eventually to an area generally in harmony with that existing, although different in detail. The Ramrod Creek mine will be the most prominent due to its relatively low elevation and nearness to vantage points, while the Glen Munro mine will be the least noticeable. The interim void of the Ramrod Creek mine will remain a moderately prominent but unavoidable static feature for a period after 1992 of at least 10 years or longer depending on details of Stage 2 mine operations.

Operational night lighting of the mine pits, facility areas, and the coal processing area will result in an overall glow which will intrude into the existing rural night environment. The screening of all the operational areas will not permit direct visual access of source lights.

Elsewhere in the locality a variety of aesthetic changes will occur arising from industrial and urban expansion in general. The scale of change will be proportional to the combined effects of this and other proposed projects, while the extent and quality of urban development will depend on the location and standards used. Overall however, a more urbanised and industrialised landscape will develop over time.

7.1.11 Town Planning Implications

Changes to existing land use zonings under current town planning schemes will be necessary to cater for the expected population increases which will occur as a consequence of the implementation of this project and others within the region. It is anticipated that the Muswellbrook and Singleton Shire Community Impacts Studies (see **Section 5.12, Town Planning**) which are currently underway, will identify sufficient land within the main urban centres that should be zoned for urban purposes to provide for the expected population growth. Similar considerations may need to be given to Scone Shire as other coal projects develop in this area.

7.1.12 Population Changes

The relatively large workforce reqired by the project will give rise to increased numbers and diversity of population within Muswellbrook particularly, and in other centres. The following projections of population growth are based on the Muuswellbrook Shire Community Impact Study (Document 12 of VOLUME 2) which incorporates the results of previous demographic studies by the Planning and Environment Commission, and upon experience of similar mining developments elsewhere.

Construction Phase
During the construction period from 1981 to 1986, the peak number of construction workers expected for the project is 500 during 1983/94. The origins of this workforce, the number to be accommodated locally and the direct increase in population in the Upper Hunter resulting from construction employment, is given in **Table 7.2, Population Increase, Construction Employment.** Values given in **Table 7.2** are derived from the assumptions given in **Table 13(s)** in Document 13 of VOLUME 2. The majority of the in-migrant proportion of the construction workforce are expected to be people largely from the younger age groups including young married couples with one or no children.

Operational Phase
Projections for population increase resulting from the project during the operational phase have been developed similarly to those for the construction phase, but with allowance for differences arising from the more permanent nature of employment. **Table 7.3, Population Increase, Operation Employment,** shows the maximum increase in population directly associated with the project as some 2 082 persons in 1998. Numbers in the operational workforce will become significant during 1983 when plant commissioning and initial operations commence. At this time, initial operations will coincide with high construction activity.

The Muswellbrook Shire Community Impacts Study attributes almost 25 percent of the total expected increase of Muswellbrook from 1981 to 1986 as being associated with the project, and a corresponding increase of 45 pecent for Denman. For the period 1986 to 1991 the associated increases are 18 percent and 25 percent for the two towns respectively. These increases include allowance for indirect job creation and consequent population increase on the basis of an employment multiplier of 1.5 for total jobs to basic jobs. A significantly higher proportion of the operational workforce, in comparison to the construction workforce can be expected to be married, with larger family sizes and older children. On the whole, the age structure of the Upper Hunter region should tend toward a slightly more youthful profile.

7.1.13 Changes to the Employment Structure

The project will generate a significant number of employment opportunities at both the local and regional levels. As well as the direct employment associated with the mine, there will be additional employment generated by other activities, which will be attracted to the Shire and region in order to support the mining operations and the associated workforce and their families. **Table 7.4, Estimated Employment Opportunities Generated,** gives the estimated employment opportunities which can be attributed to the project.

TABLE 7.4 - ESTIMATED EMPLOYMENT OPPORTUNITIES GENERATED

Workforce	1981	1982	1983	1984	1986	1988	1990	1992	1994	1998	2000
Anticipated Mine Workforce (construction & operation)	150	400	799	1139	1057	1142	1172	1226	1248	1281	1267
Estimated indirect & induced work-force	150	400	998	1458	1510	1713	1758	1839	1872	1922	1901
Total employment opportunities	300	800	1797	2595	2567	2855	2930	3065	3120	3203	3168

TABLE 7.2 - POPULATION INCREASE, CONSTRUCTION EMPLOYMENT

	1981	1982	1983	1984	1985	1986
Total construction workforce	150	400	500	500	300	150
Recruited locally	30	80	100	100	60	30
Workforce from outside region	120	320	400	400	240	120
Incoming workforce requiring local accommodation	90	240	300	300	180	90
Population increase in Upper Hunter from direct construction employment.	158	420	525	525	315	158

TABLE 7.3 - POPULATION INCREASE, OPERATION EMPLOYMENT

	1983	1984	1986	1988	1990	1992	1994	1998	2000
Total operational work-force	299	639	907	1142	1172	1226	1248	1281	1267
Recruited locally	45	96	136	171	176	184	187	192	190
Workforce from outside Upper Hunter	254	543	771	971	996	1042	1061	1089	1077
Incoming workforce requiring local accommodation.	194	415	590	743	762	797	811	833	823
Population increase in Upper Hunter from direct employment.	486	1038	1474	1856	1905	1992	2028	2082	2059

Comparison of the manpower requirements of the project and the existing employment structure of the region (see **Section 5.14.3, Employment Structure**), shows that the main professional and technical skills required by the project are not generally available within the region or are committed at the present time. Hence a significant proportion of those skills will need to be imported into the region. The dramatic increase in employment opportunities created by the project should improve the unemployment situation in Muswellbrook which is presently slightly higher than the national average. The amount of employment of females on the project, especially in plant operation, will be dependent on union attitudes. Employment opportunities for women and school leavers are anticipated to be high in the incoming population support services.

The proposed project will contribute a change to the existing employment structure of the nearby urban areas and the region. The traditional agricultural activities will remain constant or will decline, whereas employment in industries such as coal mining and related activities will dramatically increase.

7.1.14 Housing and Accommodation

Construction Phase
The peak construction workforce has been estimated at 500 workers during the period 1983/84. After allowing for existing local residents and those commuting from the Lower Hunter region, accommodation will be needed for about 60 percent of construction workers, that is, about 100 married units and 200 single units. The construction camp to be provided on the site with a capacity of up to 300 persons will provide for all the single workers, but married workers will require alternative accommodation. The present shortage of rented accommodation indicates little opportunity for housing short term workers in permanent-type accommodation.

Operational Phase
The operational workforce will build up during 1983 to a total approaching 300 persons of which nearly 180 may be expected to seek local accommodation in addition to the construction workforce.

Combined demand will peak temporarily in 1984 at a total workforce of 1 139 before the construction workforce begins to fall off. The Commission will work with the Shire Council to ensure that sufficient serviced land and housing is available to meet this requirement and the effects should therefore be limited to the normal consequences of controlled urban expansion.

At the peak of the operational phase in 1998, total workforce is 1 281 and the number of accommodation units required by the direct permanent workforce of this project is 628 units for the married component and 205 units for the single workers. The break-up is based on the assumptions set out in **Table 13(s)** of Document 13 of VOLUME 2. Employment from the region is estimated at 35 percent with the imported workforce requiring local accommodation made up of a single component of 16 percent and a married component of 49 percent of the total workforce. In considering the requirements for this project and other developments in the region and including the indirect employment in urban areas, the Muswellbrook Shire Community Impact Study concluded that there was an urgent need to develop residential lots at twice the rate of expected consumption, especially for the next five years to develop spare capacity and restrain price increases. The projected land consumption for the urban centres of Muswellbrook and Denman to match residential building lot demands is given in Document 12 in VOLUME 2.

7.1.15 Changes to the Commercial and Industrial Structure

Commercial Structure
The main town to be affected by the proposed development is Muwellbrook and to a lesser extent, Singleton and Denman. As a consequence of the anticipated population growth within the region generally, the existing shopping floor space in Muswellbrook will at least double, largely through the introduction of comparison shopping, discount stores and supermarkets. It is expected that most of this new floor space will be located in the existing town centre, with only neighbourhood scale provisions being provided in the residential subdivisions.

The existing commercial structure of Muswellbrook provides a firm base for future expansion to most these projected needs. Denman on the other hand, serves a lower order function and even with the projected population increases, its commercial function is not expected to expand beyond its convenience shopping nature. It is anticipated that future expansion can be accommodated within the present village centre.

The expansion of commercial services should be beneficial in terms of increased employment opportunity especially for females and clerical groups. The Mount Arthur North project will account for part of this expansion, approximately in proportion to the new population generated by it in each centre.

Industrial Structure
As part of the substantial regional development of basic industries in coal mining and power generation, the project will increase demand for a wide range of support industries and service activities.

Although specialised to the needs of the basic industries, there is a large potential for expansion of existing enterprises and for the establishment of new enterprises in or near the urban centres.

7.1.16 Transportation

Road Traffic
The distribution of traffic generated by the project is given in **Table 7.5, Traffic Generation,** for 1985 and 1995. These trips refer only to direct generation by the project and incorporate the location of workforce residences as described in the Muswellbrook Shire Community Impact Study. The daily movements given in **Table 7.5** will tend to be concentrated around the three shift change times. These workforce peaks will normally not coincide with peaks from other traffic associated with the project.

The volumes generated by the project are low to moderate in terms of number of trips but represent relatively large increases compared to present volumes. Further traffic will be generated on the roads adjacent to the site arising from the increased size of the urban centres, and hence increased traffic between them, from other mines and the industrial estate, and possibly some regional traffic induced by the better standard roads to be built over time. The details of traffic movments on the Shire and main roads at future dates will need assessment through a district traffic modelling study which has not been undertaken. However, preliminary estimates indicate that good standard two lane roads around the Mount Arthur North site should have sufficient capacity over the foreseeable future.

TABLE 7.5 - TRAFFIC GENERATION (Estimated Daily Traffic Volumes)

Road	1985		1995	
	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Denman Road:				
. West of mine entrance	290	0	440	0
. East of mine entrance	700	20	850	20
. North of Balmoral corner	700	20	1 080	30
Mitchell Line of Road:				
. North of mine entrance	810	30	1 350	40
. South of mine entrance	570	80	880	110

Rail Traffic

As described in **Section 4.10.1, Off-Site Coal Transport,** movements of coal trains from Mount Arthur will average 2 trains per day with up to 8 per day on peak days of the year. The spur line from Antiene Junction will also carry trains serving the Drayton mine and possibly the proposed Black Hill and Mount Arthur South mines. Taking movements each way averaged over a year, train movements on the spur line at Antiene are expected as shown in **Table 7.6, Train Movements.** For each of the proposed mines, anticipated annual export qantities are also shown in the Table. It should be noted Mount Arthur North train movements have been calculated on the basis of 3 234 tonne unit trains. Figures for the other mines are based on existing unit trains of 2 380 tonnes.

TABLE 7.6 - TRAIN MOVEMENTS

Source	Unit Train Movements per Day	Annual Coal Movements (million tonnes)
Mount Arthur North	4	2
Drayton	8	3
Black Hill	2	0.75
Mount Arthur South	12	4
TOTAL	26	9.75

The Mount Arthur North traffic on the spur line thus contributes only 15 per-cent of potential traffic on average, and less than 5 percent of all movements on the Main Northern Line south of Antiene Junction expected by 1985. By 1985, it is estimated that there will be of the order of 124 train movements per day on this section of the Main Northern Line. The Mount Arthur North proportion of Main Northern Line traffic will continue to reduce over time as other mines come into operation, particularly after the Sandy Hollow to Ulan line is opened. The State Rail Authority has indicated that some improvements to the Antiene to Maitland section of track will be required by 1985 which would provide line capacity of over 25 million tonnes of coal per year. The Mount Arthur North contribution would be 2 million tonnes per year and the total peak contribution from the Antiene rail spur may be 10 million tonnes per year.

7.1.17 Infrastructure and Public Utilities

Direct consequences of the Mount Arthur North project include up-grading or local deviation of public roads and the construction of the rail spur extension and balloon loop which have been described above. The construction of 132 kV transmission lines to supply the zone substation located on the Authorisation will be the subject of a separate environmental impact statement.

Two small diameter pipelines will be required from Muswellbrook to the site, one for potable water, and the other possibly for site irrigation purposes the local treatment works on the Hunter River. Both pipes would be laid in the road reserve and will have virtually no effects other than during the short period of construction.

The main indirect effects are seen in the need to expand urban areas and facilities to provide for the incoming workforce. The extent and timescale of demand for extensions of all public utilities will place a considerable responsibility on the relevant authorities. Details of the physical and financial consequences for Muswellbrook and other centres have been described in the Muswellbrook Shire Community Impacts Study, which accounts for the needs arising from the Mount Arthur project and other major developments. Muswellbrook Shire Council in particular will face significant problems in ensuring that urban development occurs at the rate required by the major projects.

7.1.18 Community Facilities

Growth of population in the urban areas will require corresponding expansions to existing community facilities, as well as the introduction of new facilities to meet the anticipated future demands in education, health care, emergency services, social and welfare facilities, and recreational facilities.

Anticipated increase and growth of these community facilities have been described in the Muswellbrook Shire Community Impact Study. In summary it is expected that expansion of educational facilities in Muswellbrook, required to service all the known proposed development will include as new projects:

- one additional primary school by 1986
- a second additional primary school by 1991
- a second high school by 1986
- new pre-schools on the basis of one per 2 500 population increase

The Technical College will need to continue with the planned increase to twice its present capacity, and selective improvements will be needed to the hospital, ambulance station and community care centres.

In Denman, the primary school may need to be relocated and upgraded, with corresponding improvements to health and welfare services. Increased recreational facilities will be needed in all towns as detailed in the Community Impacts Study.

7.1.19 Changes in Social Structure

The influx of workers and their families, associated with the various coal mining projects, can be expected to have both beneficial and adverse effects on the social structure of the existing local communities. As discussed, it is expected that Muswellbrook will absorb the majority of the additional population. Because of its long term association with the coal mining and power generation industries, the new workers and their families can be expected to be absorbed with minimum tensions and problems, providing that the strains on the community infrastructure, services and housing are not excessive.

The area is already well served by sporting clubs, and community service clubs, and expansion of the existing facilities will greatly assist in integration of the incoming population.

Social tensions may arise within the existing community when confronted by wage differences between workers on the project and those employed elsewhere, particularly in the traditional sectors, increasing pressures upon existing urban services, and from the different attitudes and lifestyles of the incoming population. This impact will be felt most by those residents who have lived in the community for the greater proportion of their lives and who may resent the intrusion of the migratory and incoming populations and the associated changes within the community.

The rapidly increasing population will cause long term changes in the social structure of the Upper Hunter. The area will become increasingly industrialised but it is believed that the foresight of the local Councils, the awareness of the community and the involvement of the State Government, the Commission, and the mining companies in planning, will all help to control the impact of changes in the social structure of the community.

7.1.20 Tourism and Recreation

It is expected that the Whites Creek mine of the Mount Arthur North development will be a considerable tourist attraction in the area. The pit will be one of Australia's largest open cut coal mines and it will probably generate significant tourist and educational interest. The Commission will arrange for visitor facilities to include:

- observation viewing point
- visitors centre with static model display and descriptive literature
- guided tours

The potential impacts arising from the use of the tourist resources of the region by the increased population, associated with or induced by the project, should be considered by the relevant agencies responsible for the management of these areas and controls should be established to minimise the impacts to safeguard these resources.

Another potential impact to tourism could arise through a conflict between travellers seeking accommodation, mainly in Muswellbrook Shire, and workers associated with the project or induced activities using the motels and caravan parks for temporary accommodation. This impact will only arise if a shortfall occurs in the provision of such accommodation.

Muswellbrook is presently well served in terms of recreational facilities such as the swimming pool, sporting ovals, parks and the like but a substantial increase in population would impose strains on the use of the facilities and the need for expansion of the present facilites.

7.1.21 Effects on Areas of Special Interest

Aboriginal Relics
The Aboriginal Relics Survey (Document 5 of VOLUME 2) concluded that there were no areas of archaeological interest worthy of preservation within the Authorisation area and consequently no impacts will result in this regard. A representative group of artefacts has been collected for future reference.

Historic Buildings
The Heritage Survey (Document 6 of VOLUME 2) noted three homesteads of historic value close to proposed mining operations. These were the Edinglassie home-

stead, Rous-Lench or Old Edinglassie, and Balmoral which are all classified by the National Trust. The Commission proposes to acquire Edinglassie and Rous-Lench and will maintain these to ensure they are preserved in their existing state. Consequently the structure and fabric of both buildings will not be impaired. Some loss of quality in the setting of the houses will occur as a result of the deviation of the Denman Road nearer to the buildings.

Balmoral and other historic rural homesteads in the vicinity, such as Bengalla, Skellatar and Overton will not be affected by the project except by minor noise and dust effects, and possibly the indirect effects from urban expansion.

Landscape Heritage
The Heritage Survey concluded that there appeared to be no evidence of significant historic landscape features in the locality except for limited exotic plantings around some of the homesteads. Visual impacts of the project were discussed in **Section 7.1.10.**

Town Form and Buildings
The list of historic buildings in Muswellrook is incomplete and no urban conservation study appears to have been undertaken. Nevertheless, various buildings and precincts of heritage significance are apparent. Assessment of the conservation needs require to be identified and integrated with the planned development.

7.1.22 Economic Impacts

The Mount Arthur North project will have economic impacts on both a regional, State and national scale.

Employment
At the project itself, direct employment will be created for up to 500 people during the construction phase. Direct employment for operation of the development is estimated to increase from 300 in 1983 to a maximum of 1 281 in 1992.

In the local community, the project will create further indirect employment in a wide range of occupations and businesses such as railways, mining equipment, maintenance, explosives supply, vehicle sales, consumer supplies, housing construction, retail industry, medical, educational, legal and other consumer service industries.

In the broader community, the project will create jobs in mining equipment supply and manufacture, shipping, insurance, commerce, port handling, and other industries.

The operational workforce annual income when full production is reached is estimated to be $30 million on present day values. Of this, approximately one quarter will be spent in the Upper Hunter region.

Balance of Payments and Foreign Earnings
One million tonnes per annum of the proposed 9.7 million tonnes per annum of coal production from Mount Arthur North will be exported overseas as coking coal. This will earn foreign exchange exceeding $40 million per annum (at present day costs) and will contribute to Australia's balance of payments. This return can be expected to at least maintain and probably increase its value because of likely future increases in the cost of energy.

Financial Benefits
Direct financial benefits to the Commonwealth, State and Local Governments will flow from the project:

Commonwealth of Australia: the Commonwealth Treasury will benefit from income tax of employees, company tax, shipping and production charges. Income tax, and company tax will yield $15 million per annum directly from the operational workforce and associated local industry. Sales tax on mining equipment, and company and income tax from the mining equipment supply industries will also yield additional sums which have not been quantified.

State of NSW: the State Treasury will receive coal royalty monies, payroll tax, port charges and railway freight charges. The royalty payment on all coal of $1.00 per tonne will yield $10 million per annum, payroll tax at 5 percent of payroll will yield $2.25 million, port charges will yield approximately $1 million and railway freight charges, at 5.53 cents/tonne/kilometre or $7.00 per tonne to Newcastle, will yield approximately $10 million. The increase in State revenue from these sources will amount to $23 million per annum.

Local Government: the Muswellbrook Shire Council receives income principally from property rates. Based on a requirement of 628 extra houses and 205 flats for the operational workforce and an average rate of $430 for houses and $300 for flats, the additional rate revenue will be approximately $332 000 per annum. The Commission will make an ex-gratia payment to the Shire equal to the rates that would have been paid by the previous landholders on the lease area. The Local Government Coal Levy will contribute to Shire revenue once the project is operational. Based on the current rate for coal output, the levy may amount to about $112 000 in 1987 and $250 000 per annum in 1990 and thereafter.

7.1.23 Energy Statement

Site Energy Balance
The operation of the project will require inputs of energy to power equipment and plant necessary for the extraction and processing of the coal. The amounts of energy required and produced are summarised in **Table 7.7, Site Energy Balance**, with the different forms of prime energy used stated in equivalent electrical terms.

The main forms of energy input are electricity and diesel fuels. Energy consumption has been estimated for the representative years of 1986 and 1994 based on:

- manufacturers power or fuel consumption figures where available
- assumed equipment operation hours per year
- conversion of diesel fuel usage into electrical energy equivalent assuming 33 percent mechanical efficiency and a specific energy of 45 megajoule per kilogram.

The stated energy requirements allow for all mining operations, on-site haulage of coal and overburden, operation of the coal processing plant, workshops, amenities, lighting and pumping. The options for haulage of overburden in the Whites Creek mine which are discussed in **Section 4.3, Mining Operations**, have considerably different energy needs and are shown separately in **Table 7.7.** Final selection of equipment for the dragline mines, coal processing and ancilliary operations is not expected to change energy requirements significantly.

TABLE 7.7 - SITE ENERGY BALANCE

	Equivalent Annual Electrical Energy (Gigawatt Hours) 1986	1994
Energy Inputs		
1. Electricity:		
All on-site uses - Whites Creek mine overburden hauled by:		
. trucks only	121	214
. crusher-conveyor system	155	279
. trolley assistance to trucks	197	360
2. Petroleum Fuels:[1]		
All on-site uses - Whites Creek mine overburden hauled by:		
. trucks only	93 (76 000)	130 (106 000)
. crusher-conveyor	76 (62 000)	97 (79 000)
. trolley assistance to trucks	85 (69 000)	115 (94 000)
TOTAL for trucks only operation	214	344
Energy Outputs		
Steaming coal[2]		
. 22% ash	10 083	17 646
. 15% ash	2 475	2 475
Coking coal	2 796	2 796
TOTAL	15 354	22 917

Notes:

1. Figures in brackets under Item 2, Petroleum Fuels, are estimated usage of petroleum fuels in litres per day.

2. Equivalent annual electrical energy for energy outputs are based on coal production figures for the years 1986 and 1994 as listed in **Table 4.8, Coal Production Schedule.**

The energy value of the coal produced is given for each of the three grades. Conversion to electrical energy equivalent is based on the use of the coal in thermal power stations with an overall 33 percent efficiency. The coking coal would not normally be used for power generation but has been included on a similar basis for comparison. The ratio of direct site output to input energy, quantified in **Table 7.7**, is of the order of 70 to 1.

Another form of energy which has not been qantified in **Table 7.7** are explosives. Consumption is expected to reach 1 750 tonnes per month.

Mobile mine operating equipment will use petroleum fuel since it is impractical to use gas or electric power under current technology. Major plant equipment such as stackers, reclaimers, electric shovels and draglines will be serviced adequately by electricity. It is proposed for the Whites Creek mine to introduce a crusher-conveyor sysem thereby decreasing the fuel requirements for the haulage trucks. This is the main opportunity for substitution of petroleum fuels that could be considered feasible at present.

Moderate quantities of energy will be used for road transport of personnel and goods to and from the site. An indicative figure for this consumption was estimated at 6 percent of the fuel used on-site. The rail transport of coal was similarly estimated as requiring a further 8 percent of the on-site energy usage.

Construction and Indirect Energy Consumption
Construction of site buildings, plant and infrastructure will require relatively small amounts of energy over a period of a few years. A more significant use of energy comes indirectly in the manufacture of a wide range of equipment and materials for the project. It would occur either as an initial purchase or as a regular consumable item or replacement part. Quantification of these forms of energy use has not been attempted.

7.2 CUMULATIVE IMPACTS

7.2.1 Overview

Impacts evaluated in the preceeding Section have essentially been related to the Mount Arthur North development. However, where possible, these impacts have been assumed in the context of other developments in the area known to be at a forward planning stage. This particularly applies to the socio-economic impacts on Muswellbrook and the Muswellbrook Shire as currently being assessed by the Muswellbrook Shire Community Impact Study. Cumulative impacts assessment related to the more direct site activities has also been attempted.

The main source of environmental change will be the development of at least an additional four new open cut mines in the Muswellbrook Shire all due to commence operations before 1990. In **Table 3.6, Projected Coal Production, Shire of Muswellbrook,** it was estimated that coal production in the Shire could increase from 2 to 30 million tonnes per annum over the next 10 years. A number of environmental impact statements have been already submitted or are about to be submitted with the balance either in the course of preparation, or yet to commence. These new projects will continue the industrialisation of the Upper Hunter and will require furthur developments to support their activities in the form of urban expansion to accommodate the workforce, improved regional infrastructure for water, transport, power and the like, and for regional services and facilities for an expanded population. The combination of all of these factors will result in the region experiencing an environmental change in the broadest sense but will also bring benefits, mainly in economic forms. In short, the major impact will be the localisation of most physical and population-related effects to the Upper Hunter, while the major economic benefits will be dispersed to the Upper Hunter, Lower Hunter, the State and, in some respects, the nation.

7.2.2 Local Cumulative Impacts

Many of the local cumulative impacts have been discusssed or implied in **Section 7.1.** These are reviewed below and are divided broadly into those effects which can be directly attributed to individual projects and those which can be related to individual projects only in terms of a proportion of overall expansion. Most of the latter arise from increased population.

Direct Impacts Related to Geographic Locations
Impacts in this category include dust, noise, vibration, water quality and visual effects. The boundary area between the mines will be the most affected by cumulative effects which, around the Mount Arthur North site, covers part of Mitchell Line of Road and the zones between Mount Arthur North, Bayswater and Mount Arthur South. Of these the northern part of the Mitchell Line of Road is the more sensitive because of public access and local residences.

Cumulative dust concentrations along the Mitchell Line of Road may be higher by about 1 gm/m^2/month than that predicted for Mount Arthur North. Noise levels from each mine will also overlap near the industrial estate, but the resulting levels will normally be below that caused by road traffic. Ground vibration levels from blasting in the boundary zones between mines will be low and the cumulative levels are unlikely to be significant. With regard to water quality, each mine has been planned to provide on-site disposal of polluted water, and negligible cumulative effects are expected.

It is likely that views of parts of several mines at once will be seen from a number of vantage points and to this extent may be considered a cumulative impact. However, the effect on scenic quality will be attenuated by distance. Travellers will be aware of changes in roadside landscape and increased traffic, resulting in a more industrial character to the area.

Although identifiable effects, this category of impacts are of low severity and are usually localised in effect.

Population Growth and Social Impacts
A large number of interactions will flow from the influx of workers for the development projects. In general terms, impacts can be summarised as arising from:

- the timing and numbers of jobs created
- the numbers of induced jobs in support and service industries
- total population increase
- location of residences and distribution of population to different centres
- effects of different wage structures and job opportunities
- displacement of some existing businesses and jobs
- tendency to social segregation for reasons of occupation, background, income or lifestyles
- the speed of change and the time required for physical, social and cultural adaptation to new circumstances.

Other than the references made in **Section 7.1**, to those matters, the full cumulative consequences from a series of major projects are too extensive for assessment in this study. However, it appears that the overall impacts of a social nature, at least at the community level, will be significant and should be further examined. A variety of problems and dissatisfactions are likely to be raised over time requiring political as well as technical resolution.

Urban Expansion and Regional Infrastructure

Population increase will necessarily require expansion of a whole range of urban services and facilities. For Muswellbrook, the implications have been examined in the Muswellbrook Shire Community Impacts Study. Similar effects and consequences are expected for Singleton and other centres at different times in accordance with the establishment of new projects in their vicinity.

Roads, railways and other service networks will also require improvement and expansion to cater for the projects themselves and for the enlarged community around them. Unless coordination and cooperation can be achieved between the development organisations, relevant agencies at all levels of government, and community groups, the inherent problems of development will be exacerbated.

7.3 LONG TERM IMPACTS

Stage I of the Mount Arthur North project will be completed by 2004. At that time the development on the site will be as shown in **Exhibit 4.19, Site Development 2004.** The Whites Creek, Ramrod Creek and Glen Munro mines will be extended under operations proposed in Stage 2. The coal processing plant and other basic infrastructure will remain in use. Further open cut mining will follow on during Stage 2 as described in **Section 4.3.6, Future Mine Development,** which will see the Whites Creek and Ramrod Creek mine voids being combined and developed in the west and a possible extension of the Glen Munro mine. There is also a possbility of underground mining following the open cut phase. Consequently, mining may continue on the Mount Arthur North site for 50 years or more.

The impacts arising from subsequent stages will be generally similar to those described in **Section 7.1**, but may vary in intensity and location depending on the mine plan ultimately adopted. Any voids remaining on completion of open cut operations on Mount Arthur North will either be filled or suitably land-scaped and given over to a non-mining use. In any event, it is intended that the site will be left in a condition environmentally acceptable to the community at that time.

Ultimately the site will revert to non-mining landuses which may include agriculture, recreation, industrial or other types of development. The land will be re-subdivided and sold in parcels appropriate to the future use. Impacts from these changes cannot be usefully assessed at this time. The cessation of mining will also mean a loss of mining jobs. Whether alternative employment will be available in the district at that time is again impossible to predict.

In summary, the extensive period of mining anticipated on the site means that mining related impacts will continue for a long time. The ultimate post-mining situation is too distant in time to realistically assess what may be the community attitudes and requirements existing at that time.

APPROVALS

8. LEGAL APPROVALS NECESSARY FOR COMMENCEMENT OF OPERATIONS

8.1 NSW MINING LEGISLATION REQUIREMENTS

- An application for a Coal Mining Lease is required under the provisions of the Coal Mining Act 1973.

- Notification of the Minister's intention to invite the Developer to apply for a lease is published in the Government Gazette and newspapers.

- Section 9.3 of the Coal Mining Act 1973, requires that environmental impact studies be carried out to enable the Minister to decide whether or not to grant a mining lease.

- Conditions to the coal lease may be imposed under the Coal Mining Act 1973 and the Coal Mines Regulation Act 1912, as amended. Approvals which are required under these Acts include:

  - rehabilitation plans in association with open cut mining
  - power reticulation within the site
  - use of explosives
  - methods of mining
  - design of mine offices
  - workshops
  - bathhouse facilities
  - coal wash plant

  and all other approvals necessary for the safe working and welfare of employees.

- Joint Coal Board - under provisions of the Coal Industry Act, authorisations have to be granted under the relevant orders to enable the development, mining of coal and transportation and export of coal.

8.2 NSW ENVIRONMENTAL AND PLANNING LEGISLATION REQUIREMENTS

Background

- The provisions of the Environmental Planning and Assessment Act 1979, apply to the project. Under the Act, the project is deemed a designated development.

- A direction has been issued, pursuant to Section 342(V)3 of the Local Government Act, which requires that all interim development applications for, or in relation to, coal mining within the Shire of Muswellbrook be referred to the Department of Environment and Planning. In accordance with the miscellaneous Act (Planning) Repeal and Amendment Act 1979, No 205, Schedule 3, Section 8, such direction is now deemed to be a direction given in the same terms under Section 101 of the Environmental Planning and Assessment Act 1979.

Requirements of the Environmental Planning and Assessment Act

- Within the meaning of the Act, the consent authority is Muswellbrook Shire Council and the determining authority is the Minister for Planning and Environment.

- A Development Application is required to be lodged with Muswellbrook Shire Council, which in turn, should refer same to the Department of Environment and Planning in accordance with Section 101(2)(b) of the Act.

- An Environmental Impact Statement is required and approval of the document by the Department is necessary before the Statement can be put on public display.

- The Environmental Impact Statement is required to be made available for public display and public sale, and objections may be lodged.

- Development consent must be obtained before commencement of works.

Other Requirements

- State Pollution Control Commission: approvals and licences to be obtained under the provisions of the Clean Waters Act 1970, Clean Air Act 1961, Noise Control Act 1975, and the State Pollution Control Commission Act 1970.

- National Parks and Wildlife Service: notice of existence of aboriginal relics is required.

- Water Resources Commission: licences to be obtained for dams, watercourse diversions, and the extraction of water from groundwater sources.

- Heritage Council: under the Heritage Act 1977, the Heritage Council, a department within the Department of Environment and Planning, requires the identification and conservation of the State's environmental heritage.

- Other Authorities to be consulted in the environmental approval procedure include:

  - Forestry Commission of NSW
  - NSW Department of Main Roads
  - NSW Department of Agriculture
  - NSW Department of Lands
  - NSW Pastures Protection Board
  - NSW Public Transport Commission

8.3 COMMONWEALTH LEGISLATION REQUIREMENTS

- A Mineral Export Permit to be obtained in respect of the export of coal. The permit is required under Regulation 9 of the Customs (Prohibited Exports) Regulations and authorised by the Minister for Trade and Resources. Prior to approval of the permit, clearance on the environmental aspects of the project will need to be obtained from the Department of Home Affairs and Environment as prescribed under the Environment Protection (Impact of Proposals) Act 1974-75.

REFERENCES

9. REFERENCES

1. The Electricity Commission of NSW
Preliminary Proposal for the Development of Mount Arthur Coal Project
July 1980.

2. State Pollution Control Commission
Pollution Control in the Hunter Valley with Particular Reference to Aluminium Smelting
August 1980.

3. The Electricity Commission of NSW
Eraring Open Cut Coal Project - Environmental Impact Statement
May 1980.

4. The Electricity Commission of NSW
Bayswater Power Station - Environmental Impact Statement
June 1979.

5. Wall, J A
Mining Development of Mount Arthur North and Preliminary Discussion Mount Arthur South Project
in, Muswellbrook: Preparing for Change, Muswellbrook Shire Council and University of Newcastle, February 1980.

6. Golder Associates Pty Ltd
Mount Arthur North Coal Project - Preliminary Geotechnical Investigations for Open Cut Mining, Vol. I
The Electricity Commission of NSW, September 1979.

7. Paul Weir Company
Mount Arthur North Project - Stage 2 Study for Electricity Commission of New South Wales, Vol. 2 & 3
December 1979.

8. Planner West Pty Ltd
The Mount Arthur North Project - Report on Coal Preparation Plant and Associated Coal Handing Facilities
The Electricity Commission of NSW, 10 July 1980.

9. Australian Groundwater Consultants Pty Ltd
Mount Arthur North Coal Project - Groundwater Studies
The Electricity Commission of NSW, August 1979.

10. Sinclair Knight & Partners Pty Ltd
Proposed Black Hill Coal Mine - Environmental Investigation Programme Stage I Report
Mount Sugarloaf Collieries Pty Ltd, June 1980.

11. Soil Conservation Service of NSW
Soil Survey of the Mount Arthur North Lease Area, Muswellbrook
June 1980.

12. NSW Water Conservation & Irrigation Commission
Water Resources of the Upper Hunter Valley, Report No 15
September 1969.

13. The Electricity Commission of NSW
Liddell Climatic Dataset
1979.

14. Bureau of Meteorology
Wind Direction Data for 1979 for Muswellbrook

15. State Pollution Control Commission
Dust Collection Data for Town of Muswellbrook

16. Soil Conservation Service of NSW
Meteorological Data for Scone

17. The Electricity Commission of NSW
Particulate Deposition Rates
1976-79.

18. Australian Bureau of Statistics
Handbook of Local Statistics 1979
October 1979.

19. Australian Groundwater Consultants Pty Ltd
Mount Arthur North Coal Project - Soil, Rock Overburden and Hydrology Studies
The Electricity Commission of NSW, October 1980.

20. Storey R
General Report on the Lands of the Hunter Valley
Land Resource Series No 8 CSRIO

21. Hunter Regional Planning Committee
Hunter Regional Plan 1978
Department of Environment and Planning

22. Ramsland, A
Administrative Aspects of the Coal Mining Act As It Relates to Developments Within Muswellbrook Shire
in Muswellbrook: Preparing for Change, Muswellbrook Shire Council and University of Newcastle, February 1980.

23. Planning and Environment Commission
Hunter Regional Plan, Working Paper No 13
Planning Workshop Pty Ltd, 1977.

24. Sinclair Knight & Partners Pty Ltd
Mount Arthur North Coal Project - Water Management Study
October 1980.

25. Drayton Co-Venture
Environmental Impact Statement, Proposed Drayton Coal Mine, Hunter Valley, New South Wales
Dames and Moore, April 1980.

Borrower's name	Date	Ext