

EIS 1465

AA068108

Millar Coal Mine Oakdale NSW : environmental impact
statement

MINUTE PAPER

Part PAPERS:- L88/507

SUBJECT:-

Comment on Environmental Impact Statement Proposed Millar Coal Mine at Oakdale

Attention is invited to a copy of the letter dated 6th July 1989 received from Wollondilly Shire Council concerning a development application lodged by Clutha Coal Pty. Ltd. accompanied by a copy of the EIS prepared by consultants Mitchell McCotter and Associates.

There does not appear to be a clear plan in the Statement which specifically defines the extent of lands set forth in the development application, however "The Oakdale lease area proposed to be transferred to the proposed Millar Mine" - see Figure 2.6, comprises part of Special (Crown & Private) Lands Leases Nos. 1 and 3 (Act 1969) which incorporate for the most part a 15.24 metre surface exception.

However, the pit top area is thought to be covered by Mining Purposes Lease Application No. 58 Sydney covering some 45 hectares.

The whole proposal presently comprises part of the Oakdale Colliery Holding.

Council supplied one copy of the Statement which is presently with the Senior Inspector of Coal Mines, Wollongong. This day, further copies sought from Clutha Coal Pty. Ltd. have been received.

The deadline for comment is 16th August 1989 and as a consequence it would be appreciated if Environmental Geology Section would peruse the document and report on the environmental aspects as addressed, or indeed, omitted from the Statement, by Friday 4th August.

S. Kinsela 24.7.1989
Regional Manager (Southern and Western)
Coal Resources Administration Branch

*Was sent back in
courier bag to S.
Kinsela on Thurs 27th July.
Report from C. Harvey assessed
and given to S. Kinsela on 4/8/89.*

Director, Policy and Planning (Coal and Minerals)

This section no longer exists. It would be appreciated if the matter could be pursued through the agreed mechanism.

*W. J. ...
25/7/89*

Mr. J. Cross

REPLY TO: SHIRE CLERK
P.O. BOX 21
PICTON 2571
DX 5127
CAMPBELLTOWN
FAX (046) 77 2339



IN REPLY PLEASE QUOTE:
OUR REF U/R1989/4 JLM:JMC
YOUR REF
TELEPHONE: (046) 77 1326
(046) 77 1699

WOLLONDILLY SHIRE COUNCIL

Administration Centre, 62-64 Menangle Street, Picton, N.S.W. 2571

6 July 1989

The Secretary
Department of Mineral Resources
GPO Box 5288
SYDNEY NSW 2001



Dear Sir/Madam,

LOTS 3 AND 4, DP 258639 AND CROWN LAND PO 1969/14 AND 1983/6 AND DP 614116 AND PORTION 154 PARISH OF BURRAGORANG, COUNTY OF CAMDEN, OAKDALE

A development application has been lodged by Clutha Coal Pty Limited for a coal mine on Lots 3 and 4 DP 258639 and Crown land PO 1969/14 and 1983/6 and DP 614116 and Portion 154 Egans Road and Steveys Forest Road, Oakdale. The proposal is a designated development under the provisions of the Environmental Planning and Assessment Regulations 1980.

The attached development application and Environmental Impact Statement will be on public exhibition from Wednesday 5 July 1989 until Wednesday, 16 August 1989. The exhibition locations are the Town Planning Department of the Council of the Shire of Wollondilly and the offices of the Department of Planning (175 Liverpool Street, Sydney and 84 Crown Street, Wollongong).

Your comments regarding this matter would be appreciated prior to the end of the exhibition period. If any additional information is required please contact Miss Jacqueline Meier of Council's Town Planning Department within fourteen (14) days of the date of this letter.

Your advice regarding this matter would be appreciated at your earliest convenience.

Yours faithfully,

G T CLARKE
SHIRE CLERK

Per: *R*

Encl.

Please see me Thursday 13-7-89

Ms. KIDSLA

Small
12.7.89

Discussed
13/7/89



Rural Living - Room to Grow

WOLLONDILLY SHIRE COUNCIL

Administration Centre, Menagle St
Picton



P.O. Box 21 PICTON 2571
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FAX: (046) 77 2339

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979
(SECTION 77 (3)).

OFFICE USE ONLY

Fee: 12,253 Checked: _____

D.A. No.: _____

File No.: _____

Date Received: 26/6/89 Rec. No.: 1518

DEVELOPMENT APPLICATION

APPLICANT'S NAME: CLUTHA COAL PTY LTD TELEPHONE NO: 046-961404

ADDRESS: P.O. Box 12 NARELLAN 2567

hereby apply for development consent to carry out the development described below.

A. Description of the land to which the Development Application relates:

Lot 3 D.P. 258639 AND ^{AND} _{Sec.} CROWN LAND R51860

Street STEVYS FOREST ROAD Town/Locality OAKDALE

B. Description of development or other activity for which development consent is sought:

SURFACE WORKS FOR COAL MINE & COAL PREPARATION PLANT

(To be completed where applicable).

Existing	Proposed Addition
Floor area: _____	Floor area: _____
Car Parking: _____	Car Parking: _____
No. of Employees: _____	No. of Employees: _____
Hours of Operation Mon - Fri: _____	
Sat: _____	
Sun: _____	
Machinery to be used: _____	

C. Plans/drawings and other information (in triplicate) describing the development must accompany the application.

D. Estimated Cost of the proposed development: CIVIL WORKS & BUILDINGS \$18,000,000

E. Environmental Impact of Proposed Development. The application is accompanied by—
 an environmental impact statement;
 information as to the impact of the proposal.
(strike out whichever is inapplicable.)

REFER TO THE INSTRUCTIONS OVERLEAF FOR COMPLETING DEVELOPMENT APPLICATIONS.

[Signature]

Signature of Applicant

DIRECTOR. CLUTHA COAL PTY LTD.

26/6/89.

Date

CONSENT OF OWNER.

NAME: _____

ADDRESS: _____

being the owner of the land to which this application relates, hereby consent to the making of this application.

Signature of Owner

Date

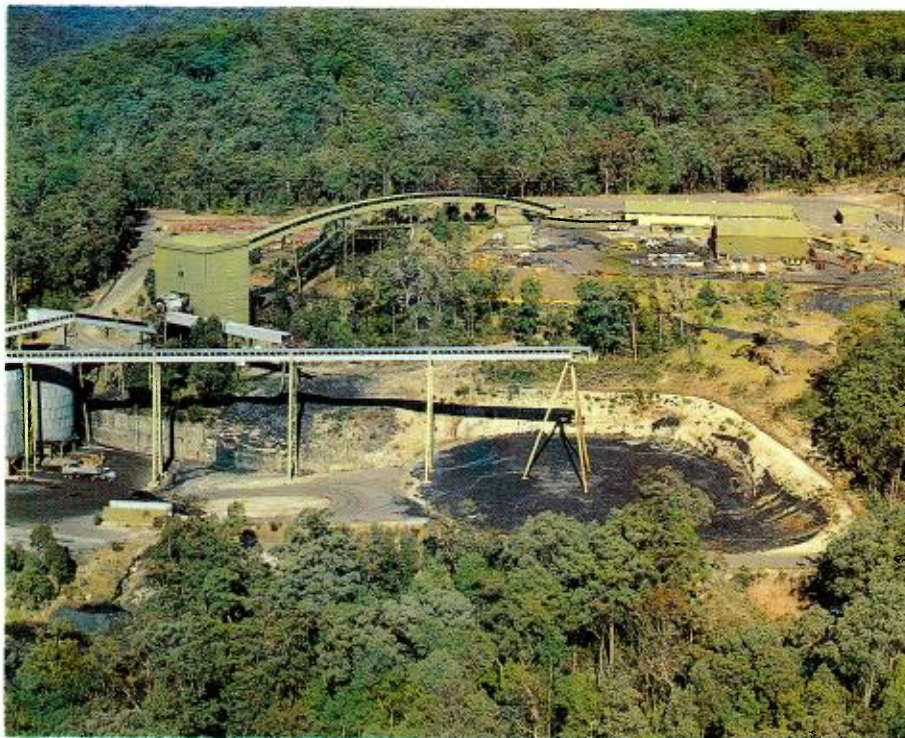
NSW DEPT PRIMARY INDUSTRIES
AA068108



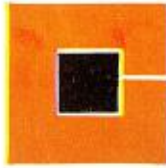
CLUTHA COAL PTY LTD

**MILLAR COAL MINE
OAKDALE NSW**

Environmental Impact Statement



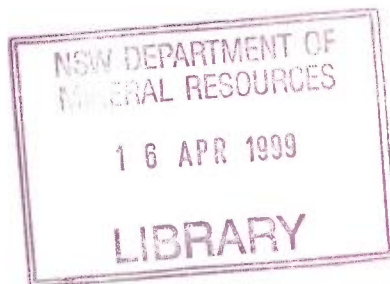
MITCHELL McCOTTER



CLUTHA COAL PTY LTD

**MILLAR COAL MINE
OAKDALE NSW**

Environmental Impact Statement



Prepared for:

Clutha Coal Pty Ltd
19 Queen Street
Narellan NSW 2567

Prepared by:

**Mitchell McCotter
& Associates Pty Ltd**
66 Spit Road
Mosman NSW 2088

Report No. 88037/1HD3

June, 1989

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979 (SECTION 77 (3) (d)).

ENVIRONMENTAL IMPACT STATEMENT

This Statement has been prepared by or on behalf of

.CLUTHA COAL PTY LTD..... being the applicant

making the development application referred to below.

The Statement accompanies the development application made in respect of the development described as follows:-

.MILLAR COAL MINE, OAKDALE NSW.....

The development application relates to the land described as follows:

No Street

Locality/Suburb

Real Property description LOTS 3 & 4 DP 258639 & CROWNLAND PO 1969/14 & 1983/

.6 & DP 614116 & PORTION 154, SHIRE OF WOLLONDILLY, PARISH OF BURRAGORANG, COUNTY OF CAMDEN

(e.g. Lot, D.P./M.P.S., Vol./Fol., Parish, Portion)

The contents of this statement, as required by Clause 34 of the Environment Planning and Assessment Regulation, 1980, are set forth in the accompanying pages.

Name, Qualifications and Address of person who prepared Environmental Impact Statement

COLIN JOHN WRIGHT. B.Sc(Eng),

D.I.C., M.I.E(Aust), M.I.C.E.

66 SPIT ROAD, SPIT JUNCTION 2088

Certificate.

I, COLIN JOHN WRIGHT..... of MITCHELL McCOTTER & ASSOCIATES PTY LTD.....

hereby certify that I have prepared the contents of this Statement in accordance with Clauses 34 and 35 of the Environmental Planning and Assessment Regulation, 1980.

.....

..... 21st June 1985.....

PROPOSED MILLAR MINE
AT OAKDALE

ENVIRONMENTAL IMPACT STATEMENT

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1.0 SUMMARY

Clutha Coal Pty Limited, a subsidiary of Clutha Ltd, is seeking development consent for a new underground mine entry, coal preparation plant and coal handling facilities on a site on Company owned land located on Portion DP 258639 east of Stevys Forest Road, Oakdale in Wollondilly Shire.

Underground coal mining associated with the proposal is within the Company's current Oakdale Mining Lease Area. However, a Mining Purposes Lease (MPL) is required for surface coal haulage access to the new surface facilities. An application for the MPL is currently before the Mining Wardens Court which has instructed the Company to obtain development approval.

Clutha Coal Pty Limited operates three underground coal mines in the Burragorang Valley:

- . Brimstone No. 1;
- . Nattai South; and
- . Oakdale.

The Company employs over 700 people of which 505 comprise the workforce in the three mines and nearby Wollondilly Washery. Raw coal production is 2.5 million tonnes per year yielding about 2.2 million tonnes of saleable coal per year. This is either hauled by road to Port Kembla or Glenlee and then by rail from Glenlee to Balmain and Port Kembla for ship loading and export.

About 65 million tonnes of saleable coal reserves remain in the Clutha Burragorang Valley leases, principally within the Oakdale and Brimstone lease areas, with the majority located east of Oakdale. While these reserves can be reached by underground access from Oakdale and Brimstone Collieries, the underground distance to be travelled by men and materials makes mining uneconomic.

With expanding export coal markets and limited coal reserves remaining in the Nattai Mine, the Company has a need to increase coal production in the Valley. Consequently, the construction of new mine facilities to permit future economic mining is essential. The Company proposes to construct a new mine entry and washery closer to its main reserves, east of Stevys Forest Road, using existing facilities at Oakdale No. 3 shaft where there is a modern mine man access winder and bathhouse currently on care and maintenance. The site is within the catchment of Lake Burragorang.

A new decline drift will be built to convey coal to the surface. It will be about 1.6 kilometres long and driven in a north-easterly direction. Additional surface facilities for handling run of mine coal will be installed on the southern bank of Hurricane Gully. Such coal will be processed at Wollondilly Washery initially. A new coal preparation plant will be built later, coal rejects being transported to the refuse emplacement area near the Wollondilly Washery. Access to Stevys Forest Road will be obtained by a new entrance road over Crown Land.

Longwall techniques will be introduced to optimise coal extraction, the new mine having a capacity to produce up to 2.0 million tonnes of run-of-mine (ROM) coal each year. A longwall mining system is currently being introduced into Brimstone Colliery which will substantially increase coal production in 1990.

The Company's coal output from the Burragorang Valley could increase to between 3.0 and 3.6 million tonnes of saleable (product) coal each year with the establishment of the new Millar Mine. The Company proposes to limit the quantity of road hauled coal direct to Port Kembla via the Picton Road to the present level of 1.2 million tonnes each year, the balance being despatched by rail to the coal loaders for export.

A community consultation program was carried out in the Oakdale area to identify residents' concerns about the proposal so that these might be addressed in the environmental impact statement. Similarly, comments

were sought from various authorities with responsibilities for some aspect or consequence of the development pertinent to the determination of the development application.

Studies were conducted on a number of environmental issues relevant to the project including coal transport, operational noise, water management, air quality, flora and fauna, visual impact, landscaping, subsidence, refuse disposal, land use impacts, archaeology and heritage, and socio-economic considerations.

Coal haulage is an important aspect of future coal production from the Burragorang Valley. A major change in traffic densities will occur along Stevys Forest Road where truck movements will eventually treble current volumes. Increased volumes of heavy traffic may also be anticipated along Burragorang Road both to and from Wollondilly Washery and from Oakdale to Glenlee, although not as large as those generated from the Valley mines in the 1970s. Apart from one section of Burragorang Road at Back Creek, road standards between Wollondilly Washery and Glenlee are good and well maintained and no road improvements are considered necessary.

About 100 residences along Stevys Forest Road and Burragorang Road within the village of Oakdale are susceptible to increased road traffic noise. Many of these are associated with the coal industry and appropriate noise criteria have been established to ascertain acceptable traffic noise levels and constraints which recognise the historic role these roads have had in coal haulage from the Valley. The socio-economic benefits of the project have been considered in relation to transportation impacts for immediate residents.

Operational noise at the pit head, particularly the coal preparation plant, will be acceptable during daytime. However, at night it may not be possible to use dozers or front-end loaders on stockpiles without exceeding the acceptable noise criterion and the Company may resort to tunnel reclaim from the run of mine stockpile if required. The washery building and conveyor components will be acoustically treated to improve

noise insulation to acceptable State Pollution Control Commission standards.

The proposed mine site is located on the south bank of Hurricane Creek. This is within the Monkey Creek sub-catchment which forms part of the catchment of Warragamba Dam. Its impact on water quality is therefore of concern to the Water Board. Monkey Creek has been classified as Class P - Protected Waters by the State Pollution Control Commission, and the licencing conditions will constrain the quality of discharge as appropriate from the pit head facilities into Hurricane Creek. Specific controls have been incorporated in the design and layout of the mine to minimise potential pollution of receiving waters. Domestic and washdown wastes will be collected, treated and disposed of on site by land irrigation. Contaminated runoff will be passed through sedimentation ponds before discharge to Hurricane Creek. Mine water will be pumped to storage to meet pit head water demands, excess overflowing into Hurricane Creek at a rate of up to 40% less than at present. Minimal impact from the quality and quantity of discharge is anticipated on receiving waters.

A study of the effects of dust generated by the construction and operation of the proposed development has been carried out. This accounts for background air quality and monitoring, the generation of meteorological data and likely dust sources, emission rates and air quality safeguards, modelling procedures and assessment of dust deposition and total suspended particulates. Regard has been paid to the results of the community consultation programme and to the need to account for the impact of the development and its associated coal haulage requirements on local residents and orchardists. The results of the modelling study show that neither residential amenity nor public health will be affected by the proposal. A range of air pollution safeguards will be implemented at the proposed mine to minimise generation of atmospheric dust.

2 FAUNA
A full survey of flora and fauna was undertaken of the pit head site and plant species of conservation importance and fauna species of concern identified. The site is within an area zoned as environmentally

significant lands by the Department of Planning, and safeguards to protect the impact of the proposal on flora and fauna are recommended including for bushfire hazard potential which is considered to be high.

The visual characteristics and scenic quality of the site have been explored. It is currently unseen from all nominated viewing positions and will remain so even when it has been cleared for construction. The surface works plan for the mine is compact and will result in minimal surface disturbance. However, the site is in an area of high scenic quality and has been classified as having a moderate concern for visual resource. Appropriate visual safeguards have therefore been incorporated in the proposal.

The Company's coal resources are not in a prescribed subsidence district. The mine will be extracting the Bulli Seam at an average thickness of two metres with a depth of cover ranging from 300 to 500 metres using longwall techniques, and the amount of subsidence to be experienced is estimated to be in the range 600 to 700 mm only. Any damage to surface improvements caused by mining will be subject to compensation under the Mine Subsidence Compensation Act 1961. X

CHECK WITH
E.T.O.

No reject disposal will take place on the pit head site. Coarse rejects from the coal preparation plant will be combined with dewatered tailings and conveyed to an on site bin for transport by truck along Stevys Forest Road and Burragorang Road to Brimstone Gully near the Wollondilly Washery for emplacement. Total annual tonnage of rejects from the Millar Mine will be 440,000 tonnes at peak production. Proposals for long term washery reject emplacement at Wollondilly have received development approval.

Medium sized rural properties surround the site, the closest resident being about 0.5 kilometres away. The majority of local residences are located along Stevys Forest Road and Egans Road about 0.75 to 1 kilometres away. Other residents live further away in the village of Oakdale and along the Burragorang Road. Grazing and fruit growing are the major agricultural activities within the mining lease area and its environs. Dense native bushland covers the major creeks and gullies.

The main impact of the new mine on land use will relate to the impact of coal and reject haulage from the pit head site. Subsidence of 700 mm over the mine lease area will not be significant.

A site archaeological survey has identified one potential archaeological deposit in relation to the proposed development. No items of heritage significance exist within the proposed mine site and lease area.

Coal mining is a major industry in the local supporting environment which is a growing rural/urban fringe district showing less emphasis on traditional rural pursuits. The socio-economic impacts of the proposal will primarily concern impacts on the workforce and the economy. The construction workforce will not exceed 60 people per day for Stage 1 and 95 people per day for Stage 2 of which up to 48 and 75 per day respectively will come from outside the region, a significant number will commute daily from the nearest urban areas. The proposal will not include either recruitment or retrenchment of the current operational workforce in the Burragorang Valley.

The capital cost of construction and mine development will be about \$80 million of which \$20 million is the cost of surface works and buildings subject to development application. Approximately 80% of the cost will be expended on goods and services produced in Australia. Operating costs of the new mine are expected to amount to \$19 per tonne of run of mine coal produced. Export earnings generated by the Burragorang Valley will be increased by up to 60%. The annual wages bill will be about \$14 million which will be injected into the local and regional economies.

The environmental impact statement assesses alternatives investigated for pit head locations, mining procedures and coal transport. It justifies the proposal in terms of its ability to optimise coal production and continue employment of the Company's current workforce under increasingly competitive market conditions. In conclusion, it identifies the consequences of not proceeding in terms of mine closure, lost resource, unlikelihood of future reactivation, unemployment, and loss of revenue to the Federal and State Governments.

2.0 INTRODUCTION

2.1 THE COMPANY

The name Clutha has been associated with the production and export of coal from the Burragorang Valley of NSW for the past 30 years. The publicly listed Company, Clutha Limited resulted from a rationalisation in the coal industry and was formed by a group of Australian investors to carry on the production and sale of washed coking and steaming coal. Its principal assets comprise three operating coal mines at Nattai, Oakdale and Brimstone, coal washeries at Wollondilly and Glenlee, and associated coal production and transport infrastructure as well as administration facilities. Their location within the Illawarra Region is shown in Figure 2.1.

The holding Company, Clutha Limited is a public company listed on the Sydney Stock Exchange. It has five subsidiary companies of which Clutha Coal Pty Limited is responsible for coal mining activities, while Clutha Services Pty Limited is responsible for marketing, administration and workshop activities.

Operational control is effected from Narellan where stores, laboratories, workshops and road transport garages are located. 505 people are currently employed in the Company's mines and 203 people are engaged in transport, administration and workshop activities. The workforce lives within a 30 km radius of the Company's operations.

Clutha is currently producing and marketing about 2.2 million tonnes of washed medium volatile coking and steaming coal of various grades. Coal is either transported by road to Port Kembla or by rail from Glenlee to Port Kembla and Balmain for export.

2.2 THE BURRAGORANG VALLEY

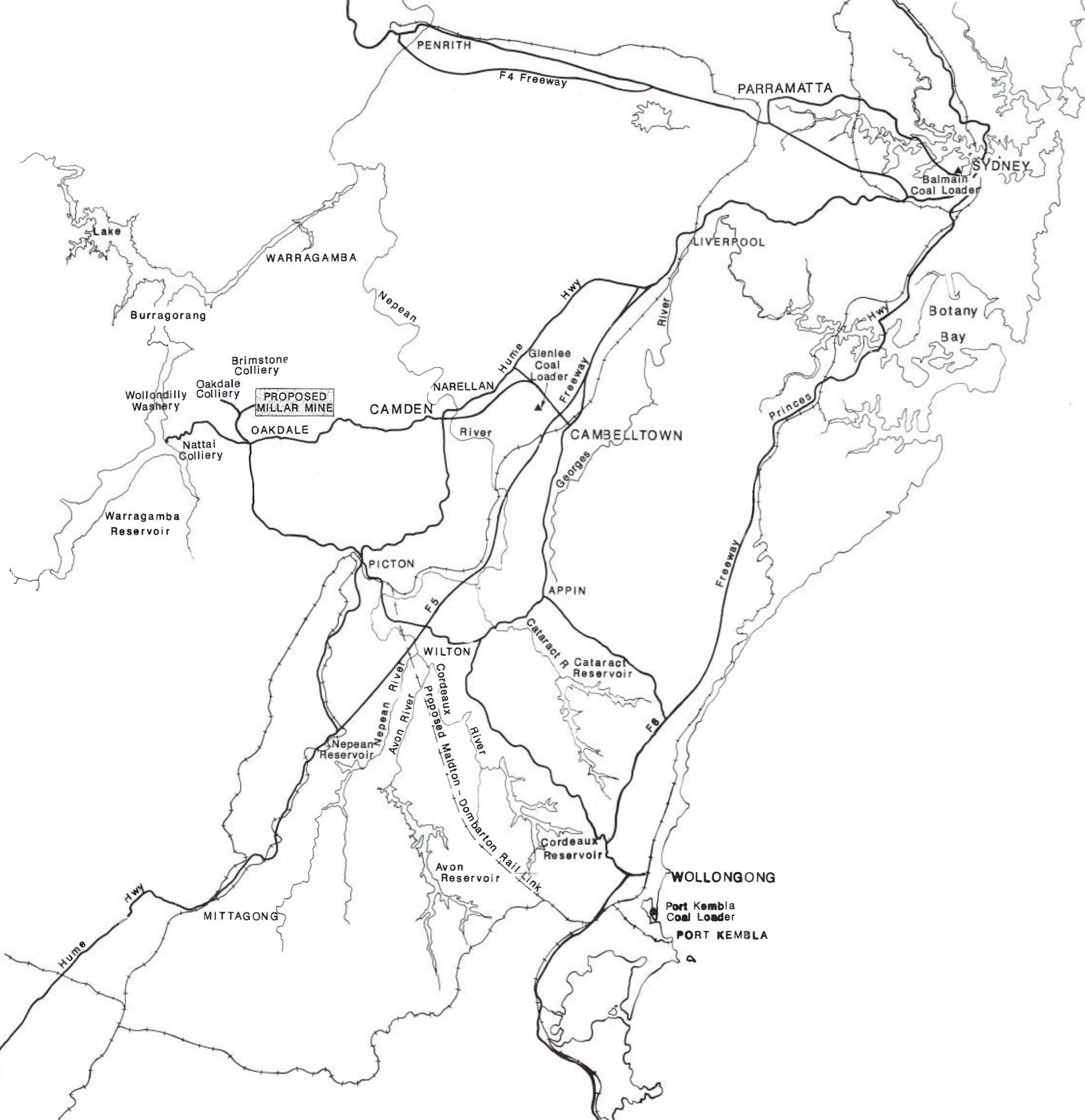
The Burragorang Valley lies about 95km by road south west of Sydney and some 35km west of Camden. It is over 80km in length and varies in width from under 3km to over 16km. It is a water worn valley formed by the dissection of an uplift in the south western portion of the Sydney Sedimentary Basin. The rivers have cut their way through triassic sandstone and shales and through rocks forming the Permo-Carboniferous series which includes good quality coal seams.

The name Burragorang is derived from the native name Burro for Kangaroo, which abounded on flats adjoining the Wollondilly River. The area was originally a popular camping and hunting ground for Aborigines. It was officially discovered in the early nineteenth century by the explorer William Howell and was used as a stock run by the first European landholders. Settlement extended rapidly and development for agricultural and grazing purposes began. Silver mining commenced at the end of the nineteenth century and continued until the 1950s.

Coal was first discovered in the Warragamba Gorge in the early nineteenth century, but coal mining did not develop until the 1930s when the Nattai Bulli Colliery commenced simple mining operations, mechanisation following through the war period.

The first samples of coal from the Nattai-Bulli Colliery were sent to the Japanese steel mills in 1955, a coal preparation plant was commissioned at Glenlee in 1959, and Clintons Nattai Collieries signed the first five year term contract with the Japanese steel mills in 1960. Mine ownership was transferred to the Rio Tinto Group in 1961 who sold to Universe Tankships Inc. (D.K. Ludwig) in 1965.

Development of the Wollondilly Colliery to the north occurred during the same period. Mine ownership was transferred to Placer Development in 1960 who subsequently sold out to Universe Tankships Inc in 1965, a company associated with D.K. Ludwig.



0 5 10 15 km

Figure 2.1

REGIONAL LOCALITY PLAN

BP Coal Australia Limited later purchased the mines from D.K. Ludwig and announced a closure in 1985 due to over supply and poor prices. The mines were sold to the present group who undertook to keep them operating and they retained the Clutha name.

Both the Brimstone and the Oakdale lease areas form part of Clutha's current coal operations interests in the Burragorang Valley, the extent of which are shown in Figure 2.2. All existing mines operate within the boundaries of the Sydney Water Board's Warragamba Catchment.

Construction of the Warragamba Dam commenced in the early fifties to provide a major water resource for the Sydney Water Board, and resulted in the clearance of more than 7,700 ha of the Burragorang Valley and the provision of 350km of foreshore up to the eventual top water level. Flooding of the Valley required property acquisitions and re-erection of homes in the Oakdale area where some are now occupied by miners engaged in work in the local coal mines.

The Valley Collieries in the southern most part of the coalfields, to the west of the Nattai River and east of the Wollondilly River commenced operations in 1957 with the opening of the No. 1 Colliery. This was affected by the flooding of the Valley in 1958, on completion of the Warragamba Dam, when the waters rose to cover the old bridge across the Nattai River across which the Colliery's coal production was transported. A new bridge was built in 1959 above the higher dam level, and in 1961 the Valley No. 1 Colliery was purchased by the Rio Tinto Group along with all of Clintons' new mining interests. In 1960, the Valley No 2 Colliery was opened, but subsequent difficulties resulted in development of a new entry in 1965; it was amalgamated with Valley No 1 Colliery in 1966. During 1970/71, a new road was built to develop Valley No 3 Colliery to the south.

Oakdale Colliery was established in 1948 and was originally known as the Burragorang State Coal Mine. It was developed under the State Mines Control Authority until it was purchased by Clutha Development Pty Ltd in 1969.

The Brimstone Collieries are also part of the Clutha Group and are located on the north side of economic Bulli Seam development in the Burragorang Coalfield. Brimstone No 1 Colliery started production in 1968 and lies to the north and east of Brimstone Gully. It has significant insitu coal reserves and is scheduled for a major increase in coal production in the immediate future. Brimstone Colliery No 2 is located to the north of Brimstone Colliery No 1; it commenced production in 1969 and was in operation until 1982.

The Burragorang Valley may therefore be seen to have played a historic role in the development of the coal industry in the Illawarra Region.

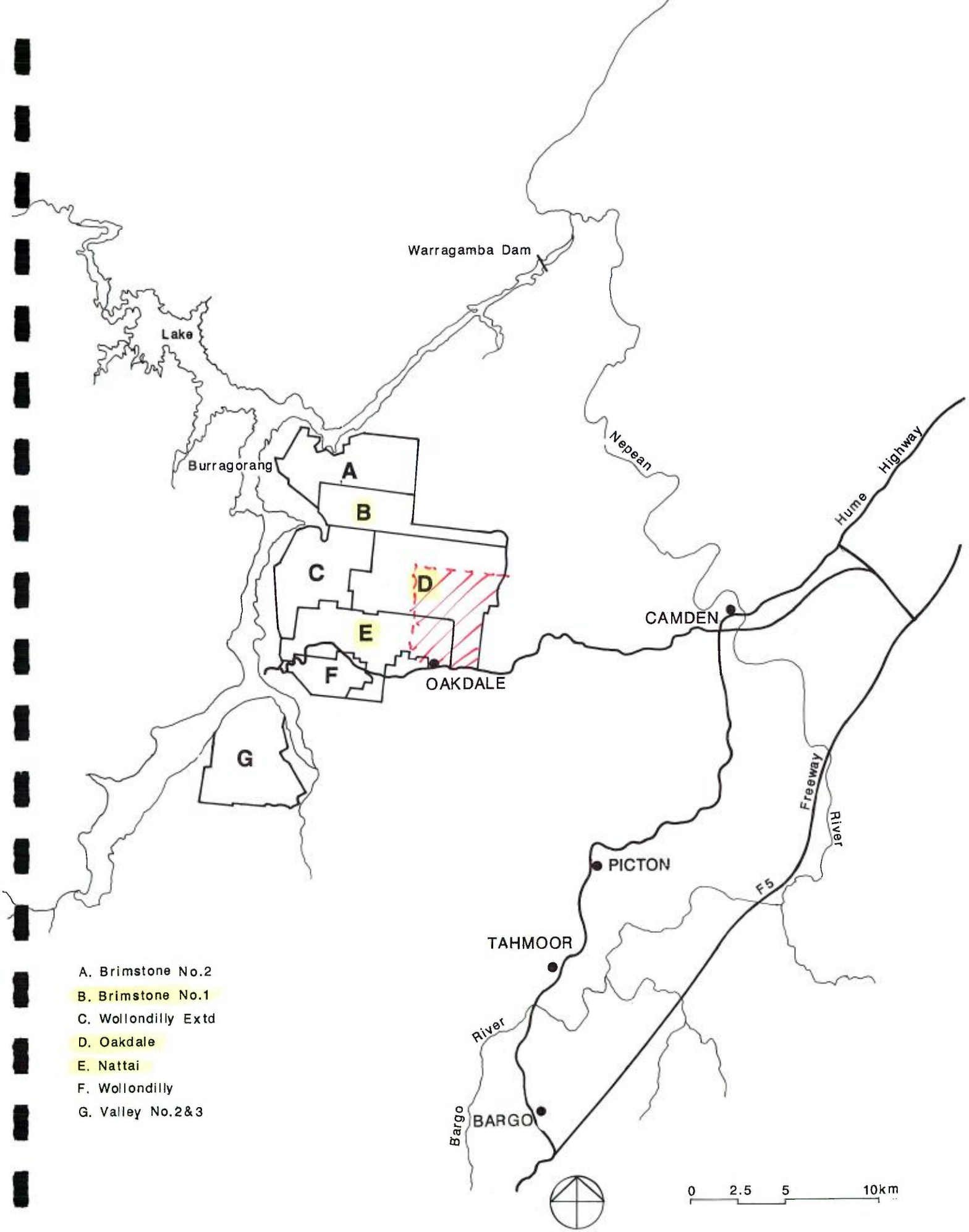
2.3 DEVELOPMENT OBJECTIVES

Clutha Coal Pty Limited currently operates three underground mines in the Burragorang Valley:

- . Brimstone No. 1;
- . Nattai South; and
- . Oakdale.

These mines and the nearby Wollondilly Washery are shown in Figure 2.3 and employ 505 people, with a further 11 contractor's employees at the Company's Glenlee coal preparation plant. Production is about 2.2 million tonnes of saleable coal each year.

The Nattai North mine closed in December 1988, the coal reserves being exhausted. Limited coal reserves remain in the Nattai South mine which will continue until 1991. However, about 65 million tonnes of saleable coal reserves remain in the Burragorang Valley, principally within the Oakdale and Brimstone lease areas. Most of these reserves are located east of Oakdale. While they can be reached by underground access from Oakdale and Brimstone Collieries, it would take miners over two hours per shift to travel from the surface to the working area, and coal would also have to be transported by very long conveyor routes entailing high

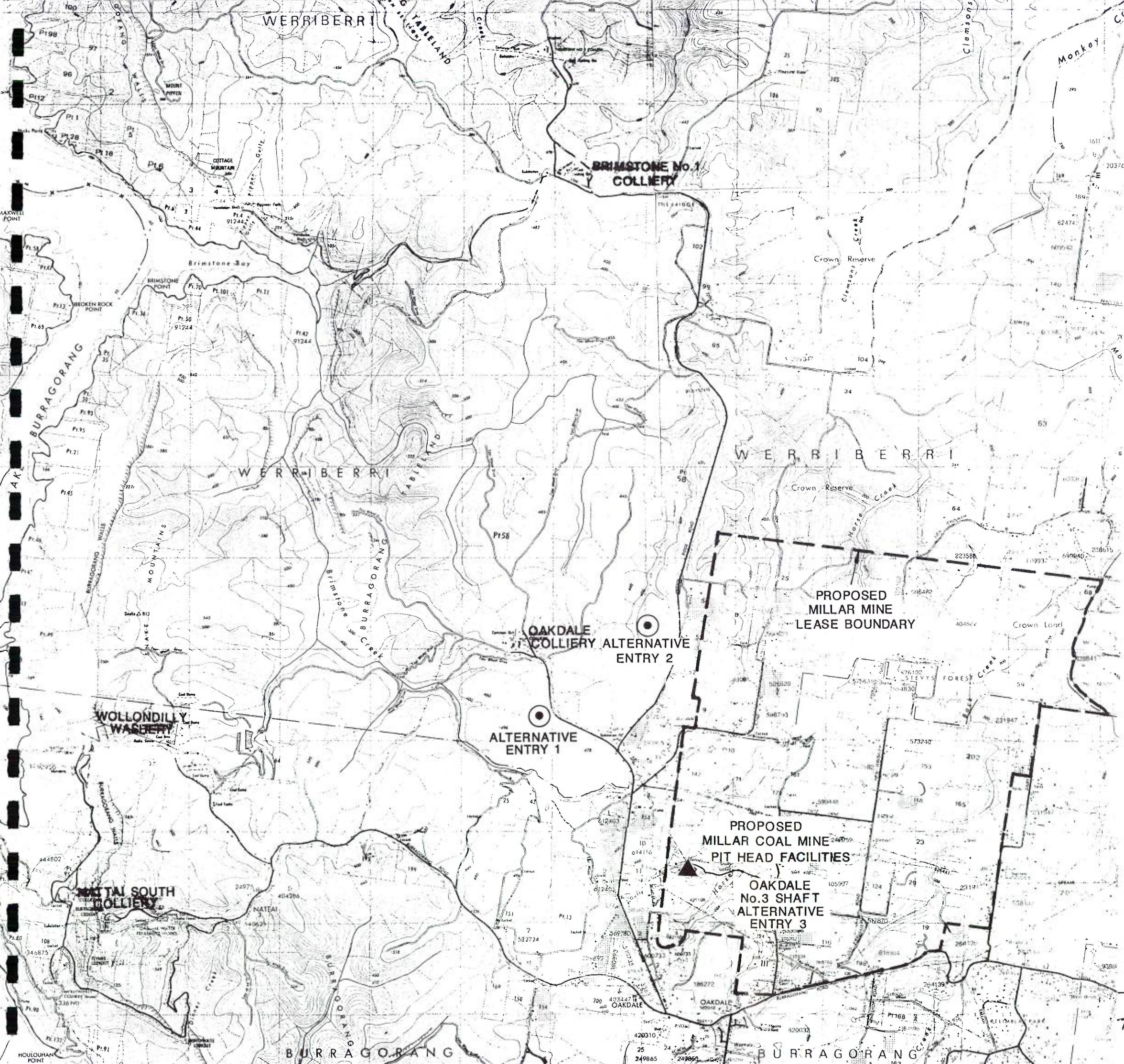


- A. Brimstone No.2
- B. Brimstone No.1
- C. Wollondilly Extd
- D. Oakdale
- E. Nattai
- F. Wollondilly
- G. Valley No.2&3

Figure 2.2

MINING LEASE AREAS

MILLAR COAL MINE



0 0.5 1 2km

Figure 2.3
SITE LOCATION

maintenance costs. The resulting unproductive time and high coal handling costs would make the operation uneconomic.

Accordingly, the Company proposes to construct a mine entrance closer to the remaining coal reserves. It is considered that the new entry is best located east of Stevys Forest Road and the optimal solution is to upgrade the existing facilities at the Oakdale No. 3 shaft.

The new mine access and facilities will be known as the Millar Mine. They will enable coal to be extracted more efficiently from the Bulli coal seam from within the existing Oakdale Colliery leases currently held by Clutha Coal Pty Ltd.

The total Burragorang Valley recoverable underground reserves are in the order of 82.4 million tonnes of which Oakdale has 51.5 million tonnes. A major part of the Oakdale lease will be transferred to the Millar Mine for extraction of 36.1 million tonnes of run of mine coal, over the life of the mine, of which 28.5 million tonnes will be saleable.

The objective of establishing the entry is to maintain coal output from the Burragorang Valley with some increase above the depressed level of the early 1980s, well below the peak production achieved in the 1970s. This will permit the continued employment of the Company's current workforce. Specifically, with the commissioning of the new mine, increased production from Brimstone No. 1 Colliery and progressive decommissioning of the Nattai South Mine, output from Burragorang Valley will be maintained and then increased subject to the availability of markets. Depending on the phasing of these transitions, output from the Valley could increase from the current 2.2 mtpa of saleable coal to between 3.0 and 3.6 mtpa.

Export coal will continue to be shipped from Port Kembla and Balmain. The Company has made a public commitment to haul 1 million tonnes of saleable coal from its nearest rail head at Glenlee to the Port Kembla and Balmain Coal Loaders. It proposes to increase this amount so that

the quantity of coal road hauled direct to Port Kembla is limited to the current tonnage of 1.2 mtpa.

2.4 EXISTING BURRAGORANG VALLEY COAL MINING FACILITIES

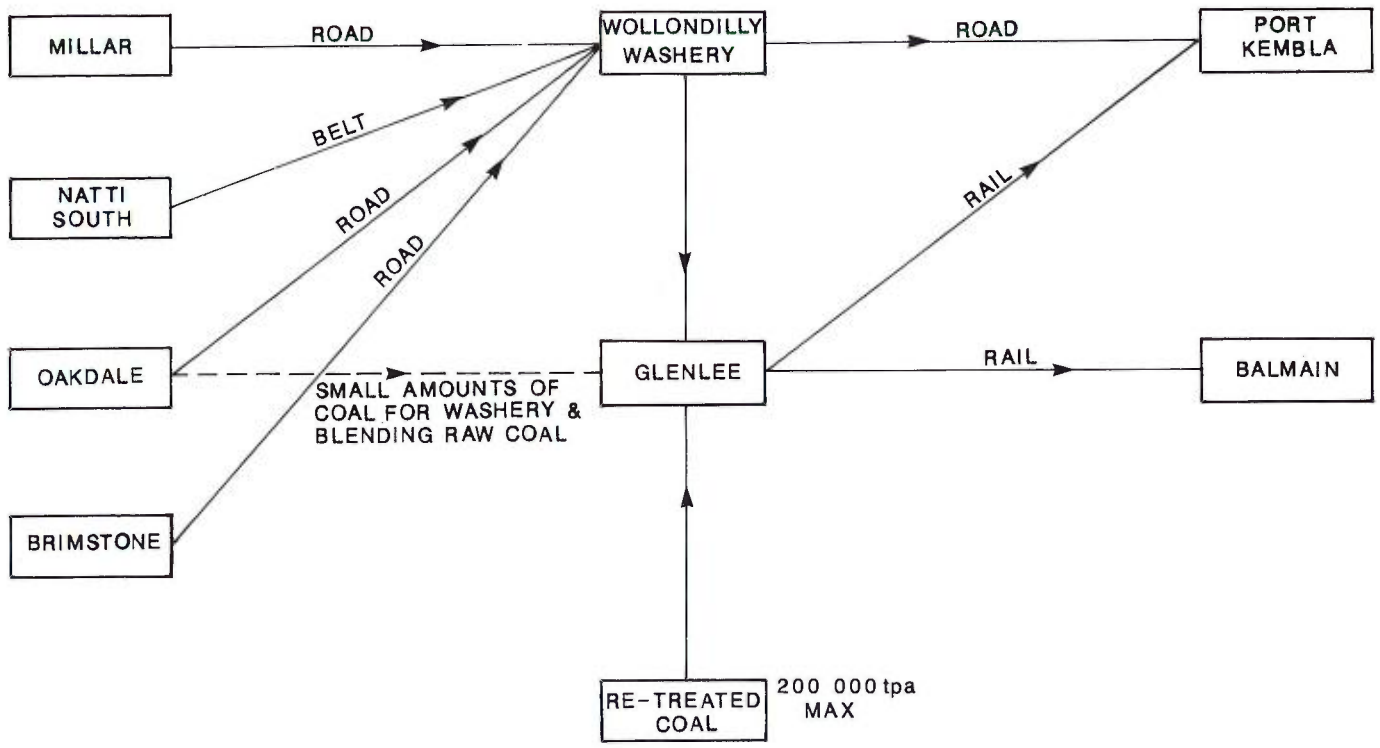
2.4.1 Existing Coal Mines

The three existing underground coal mines operated by Clutha Coal Pty Ltd, in the Burragorang Valley produce coal from the uppermost, or Bulli Seam, of the Illawarra Coal Measures. The coal is of Permian age overlain by triassic sediments. The Bulli Seam outcrops along the west facing cliff of the Valley, dipping at about 1 in 20 to the east. Bulli Seam coal characteristics and specifications for coking and steaming coal varieties are described in Section 3.2.6.

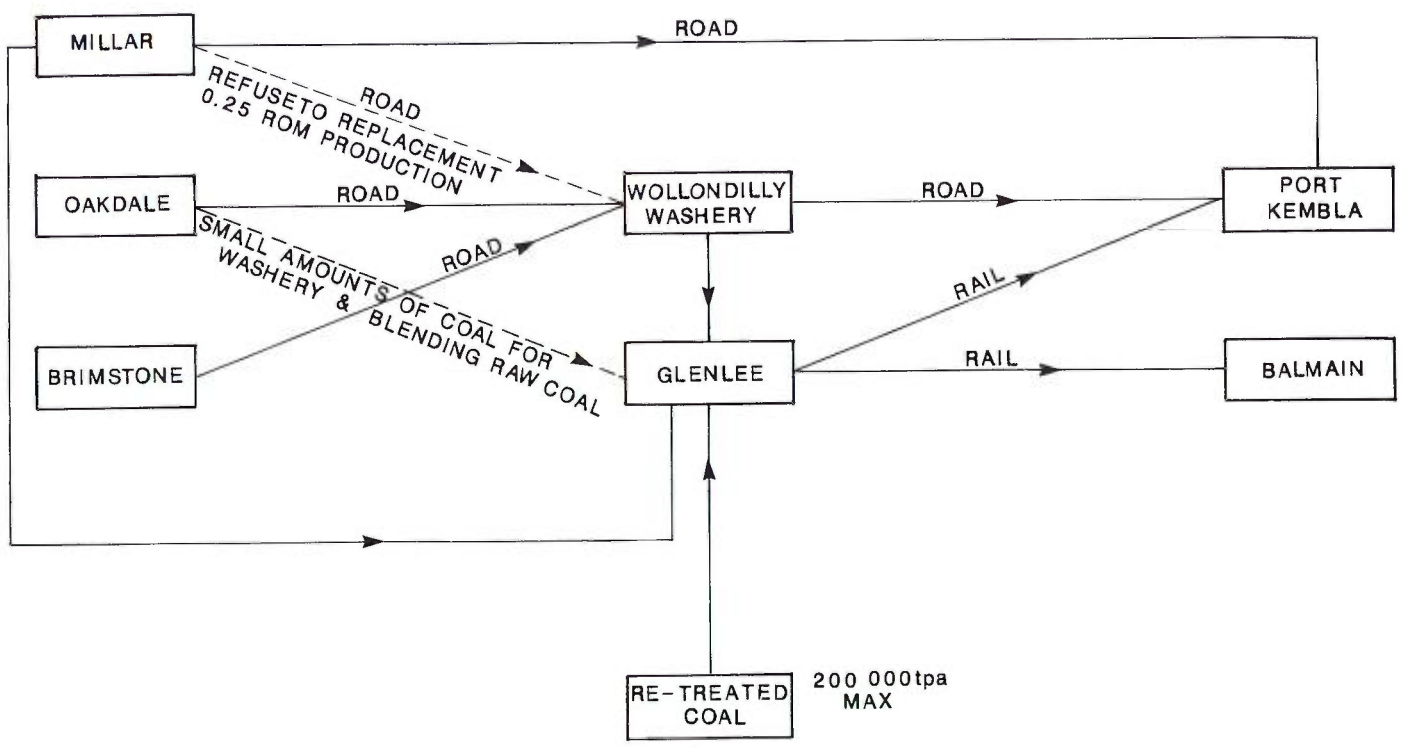
Raw coal from the Nattai South Mine is transported by a conveyor belt system up the escarpment, for processing at Wollondilly Washery. Output from Brimstone and about 80% of that from Oakdale Colliery is road hauled for processing at Wollondilly Washery. The remaining production from Oakdale Colliery is road hauled as run-of-mine coal to Glenlee and is blended there with washed coal for export.

Product coal is either hauled by road from Wollondilly Washery to Port Kembla via Picton, or to Glenlee for transfer to rail for transport to the Port Kembla and Balmain Coal Loaders along with coal blended or re-treated at Glenlee. A materials flow diagram for the Burragorang Valley Mines is shown at Figure 2.4. In the current year, up to 1 million tonnes of coal will be carried by rail from the Glenlee rail head and remaining production will be transported by road. The various haulage routes are shown in Figure 2.5.

The mining lease areas within which the Company's mines are operating are shown in Figure 2.2. Recoverable reserves are given in Table 2.1. The Bulli Seam thickness over the four mining areas varies from 1.8 to 2.8 metres, and all coal less than 1.5 metres in seam thickness has been excluded from the reserves.



BEFORE CONSTRUCTION OF MILLAR WASHERY & CLOSURE OF NATTI SOUTH



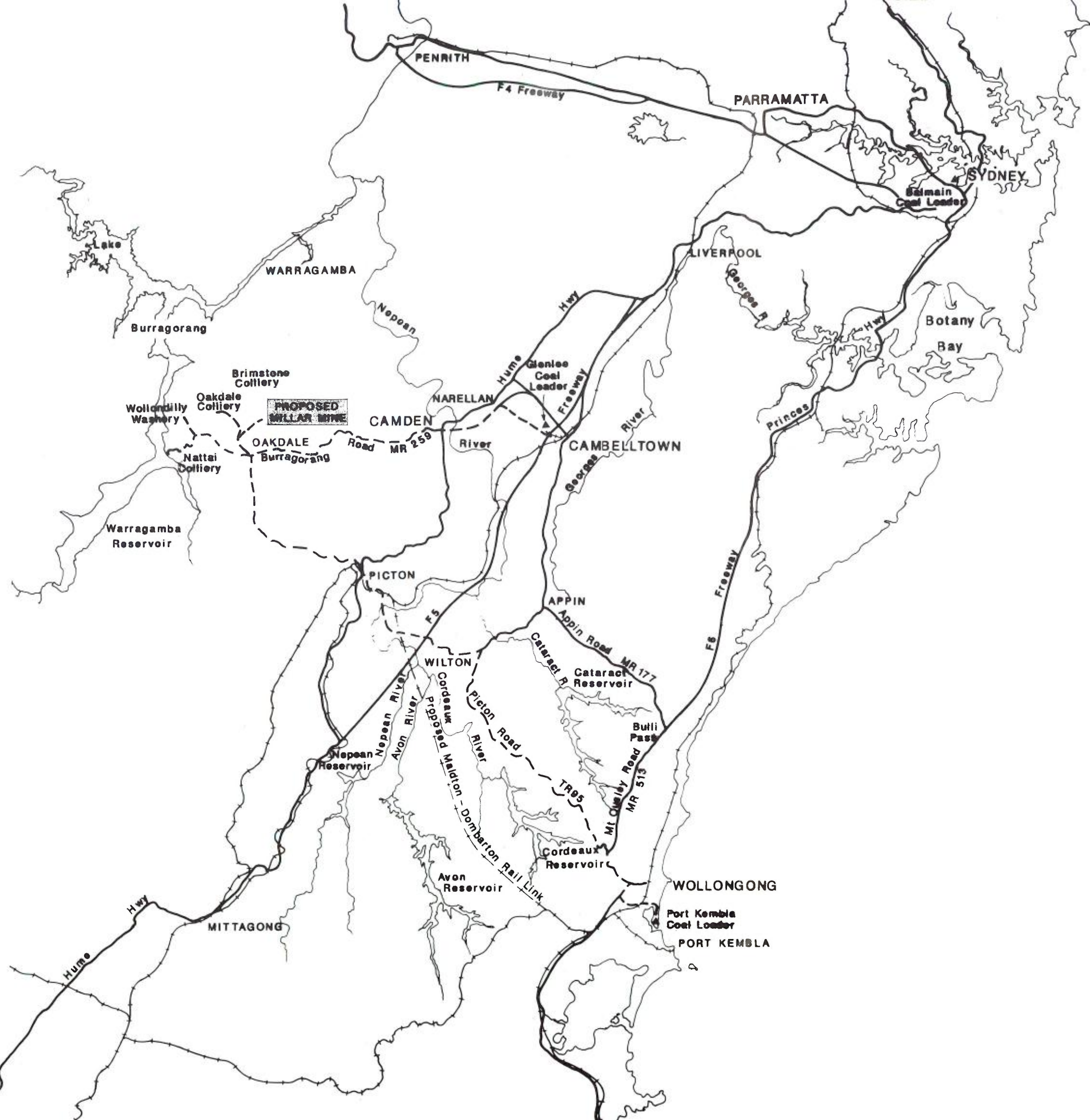
AFTER CONSTRUCTION OF MILLAR WASHERY

Figure 2.4

MATERIALS FLOW DIAGRAMS

MILLAR COAL MINE

--- Proposed Coal Haulage Routes



0 5 10 15km

Figure 2.5
COAL HAULAGE ROUTES

TABLE 2.1
COAL RESERVES MILLION TONNES

Mine	Reserves		
	Insitu	Recoverable	Saleable
Brimstone No 1	44.3	28.8	22.5
Nattai South	3.0	2.1	1.6
Oakdale:	(83.0)	(51.5)	(40.7)
Millar	58.1	36.1	28.5
Oakdale (Balance)	24.9	15.4	12.2
Sub Total	<u>130.3</u>	<u>82.4</u>	<u>64.8</u>
Glenlee Retreatment	4.5	2.8	0.9
Total	<u>134.8</u>	<u>85.2</u>	<u>65.7</u>

The Bord and pillar method of working is used, pillars being extracted by the Wongawilli technique. Coal is extracted by continuous miners and is transported underground by shuttle cars to feeder breakers and then by belt conveyors to the surface, except at Oakdale where a shaft installed skip-winder system is used. A longwall mining system is being introduced into the Brimstone Colliery to improve production. The extent of areas that have been fully extracted, contain pillar reserves, and have yet to be exploited are shown in Figure 2.6.

Mining conditions are good, faulting and igneous intrusions are rare, and mine gases are in low concentrations. Current recoverable reserves are at depths of 350 metres, while future reserves extend down to 450 metres.

2.4.2 Wollondilly Washery and Refuse Disposal

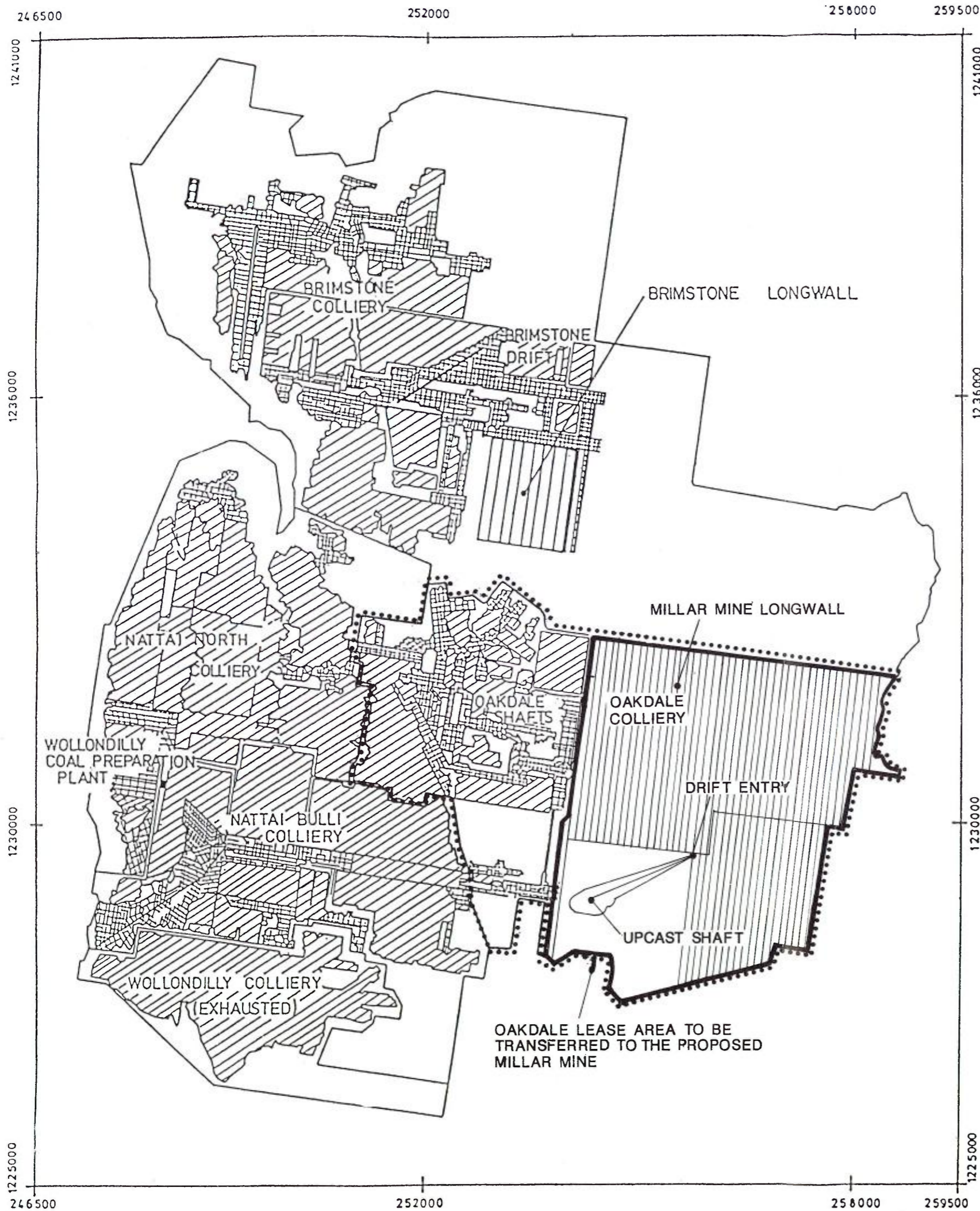
The Wollondilly Washery consists of a 500 tph plant using jigs, water washing cyclones, a dense medium system and froth flotation to meet the 7.9 per cent ash coking coal specification and the variable ash controls for steaming coals. Average yield for 7.9 per cent ash coking coal is 75 per cent and for 16 per cent ash steaming coal is 85 per cent. Adequate storage facilities exist at the washery site for raw and product coal. Rejects are currently emplaced near the Washery. A proposal for a new emplacement in Brimstone Creek capable of accommodating about 25 million tonnes of reject (dry mass) has been approved by Wollondilly Shire Council. This capacity is based on estimated recoverable reserves of above 82 million tonnes of coal from the Bulli Seam and an estimated long term average of 22.5 per cent total rejects.

2.4.3 Oakdale No. 3 Shaft and Facilities

The proposed Millar Mine pit head site shown in Figure 2.3, already has a vertical shaft known as the Oakdale No. 3 shaft which is equipped with ventilation fan and man access. It also accommodates existing workshops and bathhouse facilities and appropriate utility services and back up infrastructure. Vehicular access is currently from Egans Road.

These site facilities were established in 1979 and extended the surface facilities of the Nattai-Bulli Colliery now known as the Nattai South Colliery. The Oakdale No. 3 shaft was located to allow access to limits of the reserves which would otherwise be uneconomic in view of the time required to transport men to the coal face from the existing pit top area. It also provided much improved ventilation to the workings.

In 1985/86, Nattai-Bulli Colliery ceased advancing to the east with development and started full extraction on the retreat towards the Burragorang Valley escarpment. Headings were driven from the Oakdale Colliery to connect with Nattai Bulli, and the remaining eastern lease



MILLAR COAL MINE

- Existing Oakdale Lease
- Proposed Millar Mine Lease



Figure 2.6

area of Nattai-Bulli Colliery was transferred to Oakdale Colliery. The site facilities then became redundant as Oakdale Colliery did not need to use the shaft for man riding. The fan was also not required since the shaft, which was originally an upcast shaft, is now only used for downcast air.

2.4.4 Glenlee Washery and Coal Loader

The Company's washery and coal retreatment facility at Glenlee handles coal washery rejects emplaced from previous operations over the years. It is served by a Company owned train loading facility which is currently used as the rail head for all its Burragorang Valley operations. About 150,000 tpa of retreated rejects are blended with coal production from the Valley mines.

2.4.5 Coal Export Arrangements

Export coal from the Company's operations is transported to Port Kembla and Balmain for ship loading. Coal to Port Kembla is despatched by road via Picton using the Company's articulated highway trucks or by rail from Glenlee. Coal is also sent to Balmain by rail from Glenlee. The Company's trucks are used to transport product coal from Wollondilly to Glenlee and raw coal between its various facilities. Most domestic coal sales are also carried by the Company's trucks. Contractors are also used to supplement the Company's transport fleet at times of peak demand when carting coal to Port Kembla.

About 80 per cent of coal produced by the Company is exported through the Port Kembla coal loader which has facilities for accommodating larger deep draft ships. Balmain Coal Loader berth, within Sydney Harbour, has ship capacity limitations. Coking coal is exported to Japan, South East Asia and Far Eastern countries, while steaming coal sales also extend to Europe, as well as Japan and South East Asia. Small quantities of steaming coal are sold on the domestic market.

2.5 OUTLINE OF PROPOSAL

The new Millar Mine pit head facilities are to be built in two stages: Stage 1 will consist of the construction of a coal and materials decline drift, surface conveyors and coal handling facilities including provision for a run of mine stockpile, product stockpiles, product bins and a new haulage road for coal and rejects with access to Stevys Forest Road. Provision will be made for construction of a new downcast shaft at a future date. Stage 2 will involve the construction of a coal preparation plant and associated facilities.

Vehicular access for personnel and commercial purposes will continue to be from Egans Road. Appropriate environmental control measures are to be incorporated in the proposal and its operations that have regard for its location within the catchment of Warragamba Dam and its vicinity to residential development along Steveys Forest Road and Egans Road.

The new mine will produce up to 2.0 million tonnes of raw coal output each year and will employ about 150 personnel. Coal production will be using a longwall mining system and a combination of continuous miner units with either flexible conveyor train or shuttle car haulage using breaker line supports on pillar extraction.

Ventilation for the Millar Mine will be provided by the existing centrifugal fan fitted to No. 3 shaft which will revert to its original use as an upcast shaft. This shaft, already equipped with man riding facilities is the preferred access to the mine for mining personnel who will be transported to the working faces by rubber tyred, diesel powered vehicles.

The Company's future coal transport strategy is to continue its existing transport arrangements to cover an increase in production from its Burragorang mines, including the proposed Millar Mine, from 2.2 mtpa to between 3.0 and 3.6 mtpa. It will provide for road haulage of product coal to Port Kembla via Picton, but limited to its current level of 1.2 mtpa. The balance of between 1.8 and 2.4 mtpa will be road hauled to

Glenlee along the Burragorang Road for transfer to rail for transport to Balmain and Port Kembla for export. All run of mine coal will be road hauled to Wollondilly Washery for processing prior to transport of product coal from the area. However, Millar Mine coal will be subsequently processed on site after commissioning of its coal preparation plant during Stage 2 of that project, rejects being road hauled to the Wollondilly Washery for emplacement.

A materials flow diagram for future operation of the Burragorang Valley mines is included in Figure 2.4. The Company's coal production schedule for these mines is given in Table 5.10.

2.6 APPROVALS REQUIRED

The proposed development is the subject of an application for a Mining Purposes Lease for surface facilities pursuant to Section 43 of the Mining Act. It is also the subject of an appeal to the Mining Wardens Court and the Company has been instructed by the Court to obtain development approval because of objections to the granting of the Mining Purposes Lease from adjoining land owners.

The proposed development is permissible under Interim Development Order No 17 - Shire of Wollondilly. However, development consent under the provisions of the Environmental Planning and Assessment Act is required from Wollondilly Shire Council with concurrence of the Director of Planning. Underground coal mining associated with the proposal is within the Company's current Oakdale mining lease area, and no mining approvals are necessary other than normal compliance with the Coal Mining Regulations Act 1982. The development application is not subject to determination by the Minister for Planning unless he specifically decides to intervene subsequently under the provisions of S101 of the Environmental Planning and Assessment Act.

The proposal is designated development within the meaning of Schedule 3, Item (i) of the Environmental Planning and Assessment Regulation. An environmental impact statement is therefore required to accompany the

development application to Wollondilly Shire Council. The development application and environmental impact statement will be processed in accordance with the relevant provisions for designated development under Part IV of the Environmental Planning and Assessment Act. Determination by Council will be in accordance with S91 of that Act and will be subject to appeal to the Land and Environment Court by the applicant or an objector as provided for in the legislation, unless the Minister for Planning directs that he will determine the matter, in which case the proposal could be subject to a Commission of Inquiry under S119 of the Act before his determination.

Following any development consent and grant of a Mining Purposes Lease by the Minister for Mineral Resources, other approvals and licences must be obtained before either construction or coal extraction through the subject surface facilities can be proceed:

- . Wollondilly Shire Council - for building approval under the provisions of the Local Government Act (matters may be specified under development consent conditions);
- . Water Board - the area proposed for the surface facilities is within the Warragamba Catchment Area proclaimed under S55 of the Metropolitan Water Sewerage and Drainage Act 1924, and as such the provisions of the Board's By-Law 13 apply in full;
- . Metropolitan Lands Office - the area proposed for the surface access road to the facilities is Crown Land for which a permissive occupancy is currently held for grazing purposes. The location of the access road is on part of the Crown reserve and will require "owners consent" from the Metropolitan Lands Office;
- . State Pollution Control Commission - the premises will be scheduled under the Clean Air Act and the Noise Control Act and as a result approval of the Commission will be required prior to commencement of the works. Further, drainage and water pollution control measures will require the Commission's approval in accordance with obligations under S19 of the Clean Waters Act.

Appropriate licences to operate will also be required from the Commission prior to commissioning of the works on completion;

- . Department of Minerals and Energy - mine safety and detailed mine management by the Coal Mines Inspectorate;
- . Joint Coal Board - Order No 27 approval regarding the Company's mining plan, maintenance of coal quality, coal and refuse transportation, and the stability of the proposed coal market;
- . Department of Arts, Sport, Science and Technology (Australian Government) - assessment under the Environment Protection (Impact of Proposals) Act; and
- . Department of Trade - issue of export licence.

2.7 ENVIRONMENTAL IMPACT STATEMENT

This environmental impact statement has been prepared in accordance with the requirements of the Environmental Planning and Assessment Act 1979 and Regulation 1980 (as amended 1985). These include preparation of contents pursuant to Clause 34 of the Regulation and meeting the requirements of the Director of Planning, pursuant to Clause 35 of the Regulation.

Comments and requirements sought and obtained from various authorities that have a statutory responsibility for some aspect or consequence of the proposal have been reflected in the environmental impact statement. Such input was received from the following sources:

- . Department of Mineral Resources;
- . Joint Coal Board;
- . Metropolitan Lands Office;
- . Sydney Water Board;
- . State Pollution Control Commission;
- . Department of Main Roads;

- . Soil Conservation Service;
- . Department of Agriculture; and
- . Wollondilly Shire Council.

A community consultation programme was conducted in the Oakdale area providing for a community information newsletter introducing the proposed development, and circulation of a questionnaire to provide information on resident's concerns for input data to the environmental impact statement.

The environmental impact statement is presented as a single document. The contents are made up as follows:

- . Chapter 1.0 Summary - this section comprises a review of all sections of the report - principally the reason why the project is being developed, details of the development, and its interaction and impact on the environment.
- . Chapter 2.0 Introduction - this section provides a profile of the Company, an overview of the historic role of the Burraborang Valley in coal production, the objectives of the development, a description of the existing facilities, an outline of the proposal, approvals required and aspects of environmental impact statement compilation.
- . Chapter 3.0 Proposed Development - this section presents a detailed description of all components of the proposed development as the basis for subsequent assessment of environmental effects.
- . Chapter 4.0 Description of Bio-Physical Environment and Impact Analysis - this section provides a description of the various bio-physical characteristics of the site and surrounding environment along with an assessment of changes that will occur as a consequence of the development. It address mine

subsidence and all aspects of transportation of coal and reject material from the washery.

. Chapter 5.0 - Description of Socio-Economic Environment and Impact Analysis - as for Chapter 4.0 regarding the socio-economic environment including the planning framework, archaeology and european heritage, land use and socio-economic impacts as well as the energy efficiency of the project.

. Chapter 6.0 - Assessment of Alternatives - this section addresses strategic options, alternative entry locations, mining and transport alternatives, and the loss of opportunities by not proceeding with the proposal.

. Chapter 7.0 - Validation of Proposed Development - this section provides a justification of the proposal and accounts for the consequences of not proceeding.

The study personnel involved in the preparation of the document and supporting studies were as follows:

Mitchell McCotter and Associates and subconsultants;

. R. McCotter	Project Director
. C. Wright	Assistant Project Director
. L. Palfreeman	Pollution Controls and Safeguards, and Transport
. D. Hee	Planning Framework and Visual Assessment
. S. Cole	Land Use and Physical Geography and Geology
. D. Snashall	Community Consultation and Socio-Economic Impacts
. P. Zib	Air Quality
. R. Tonin	Acoustics
. K. Mills	Flora and Fauna
. E. Rich	Archaeology

Background information on the project was supplied by Clutha Limited. This included policy matters, a description of the proposal including mine planning and entry considerations, coal quality and washery design

data, water and power supply, traffic generation and transportation aspects. Key Company personnel were:

- . C.R. Longworth General Manager, Planning and Development
- . M. Kelly Project Engineer
- . G. Bush Property Manager

3.0 PROPOSED DEVELOPMENT

3.1 LAND TITLES

Land ownership details within the vicinity of the pit head facilities are shown in Figure 3.1.

The proposed pit head facilities are to be located on land owned by Clutha Coal Pty Ltd. Three options are being considered for access into the site from Stevys Forest Road as described in Section 3.5.3. Option "A" to the north traverses Crown land; Option "B" to the south traverses land owned by K. Gapes for which a corridor through the Gapes property for road access is the subject of current negotiations for purchase by the Company; Option "C" is a gazetted, but not yet constructed parish road between the other routes, which bisects land owned by K. Gapes.

Most of the land in the Oakdale Lease Area is privately owned except for small areas in the north and northeast of the lease area which are Crown Land. A portion of the Oakdale Lease Area will be transferred to the Millar Mine.

3.2 REGIONAL GEOLOGY

3.2.1 Regional Geology

The Burragorang Valley region is situated in the southern section of the Sydney Basin. Coal reserves in this region are contained within the Illawarra Coal measures, which are late Permian in age and are overlain by Triassic strata. These coal measures contain economically productive coal seams, including the Bulli Seam which has been extensively worked throughout the Southern Coalfields. The Bulli coal seam outcrops near the base of the Triassic sandstone cliffs along the Burragorang Valley. The coal seam varies in thickness from 0.6 to 3.0 metres and lies at depths varying from the surface in the west to over 500 metres in the east.

3.2.2 Exploration

Exploration of the Clutha leases, in the Burragorang Valley has taken place over a long period, with the last major programme completed in 1982. The number of boreholes drilled within the lease areas is more than 138, with most of the drilling undertaken in the period 1970 to 1982. The average borehole spacing throughout non-mined areas is less than one kilometre.

These exploration programmes have allowed the Company to establish subsurface geological conditions and to determine the characteristics of the coal seams. These investigations have furnished reserves estimates and provided a basis for detailed mine planning.

3.2.3 Local Geology

General subsurface geology of the Oakdale area is shown in Figure 3.2.

The local geological structure is relatively simple with a regional dip of 1 in 15 to 1 in 20 trending slightly north of east, with minor and infrequent faults. The only nearby significant tectonic structure is the Oakdale Monoclinial Flexure, which has a NNW SSE trend and passes through the proposed Millar mine area. The Oakdale Monoclinial Flexure develops in places into a faulted structure, but the displacement is relatively small and does not restrict mining.

From past experience in the area and recent drilling, the roof and floor conditions throughout the proposed mine are good and igneous intrusions are rare. However, it has been found that with increasing depth to the east gas quantities increase, and also residual strata stresses increase with depth east of the Oakdale Monoclinial Flexure.

3.2.4 Mineable Coal Seams

A number of coal seams of Permian age are present within the Illawarra Coal measures, as shown in Figure 3.2. The only seam which is economic

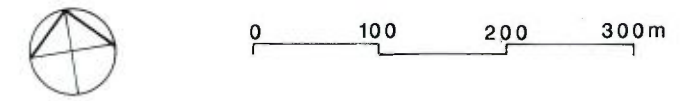
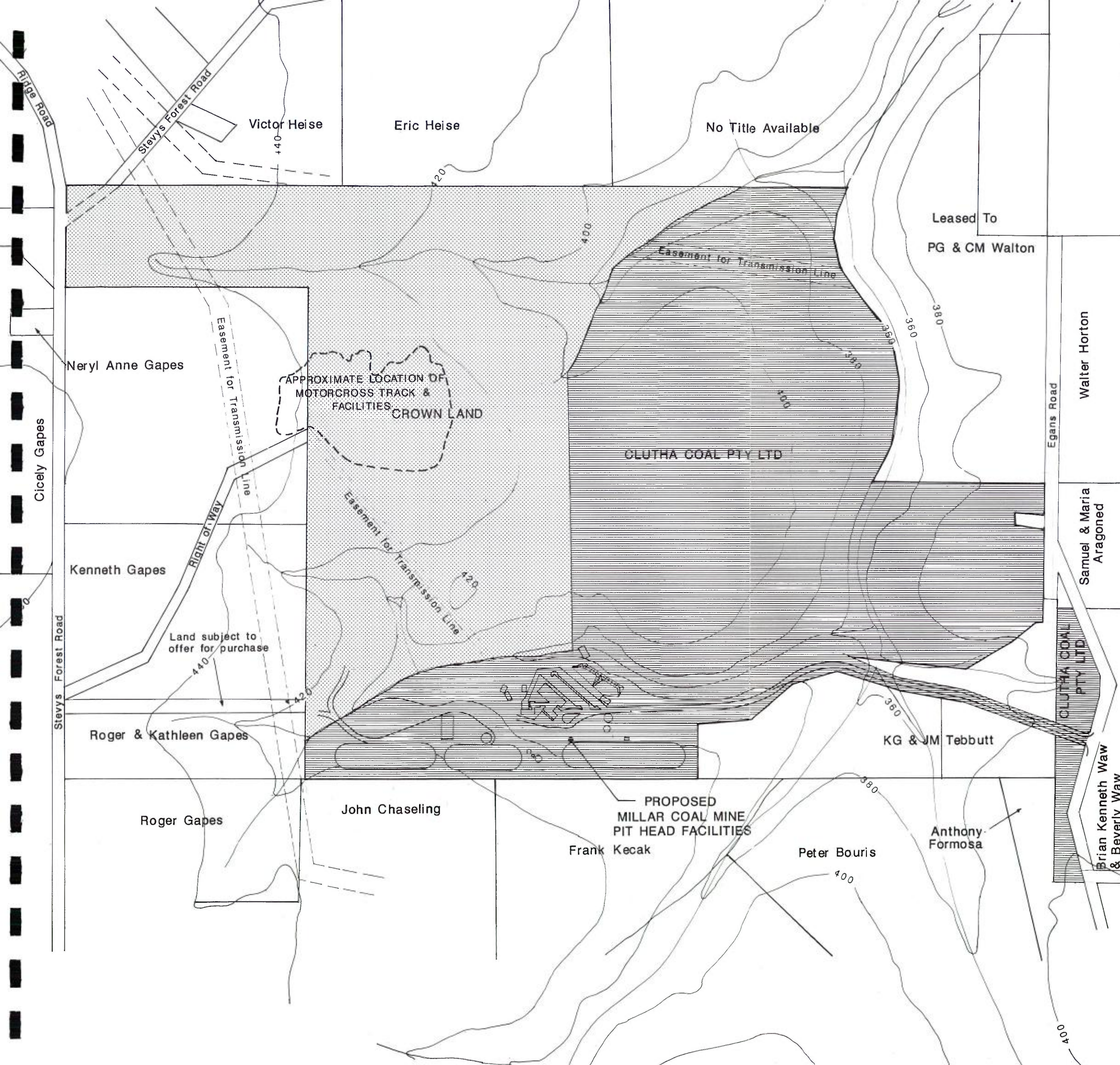
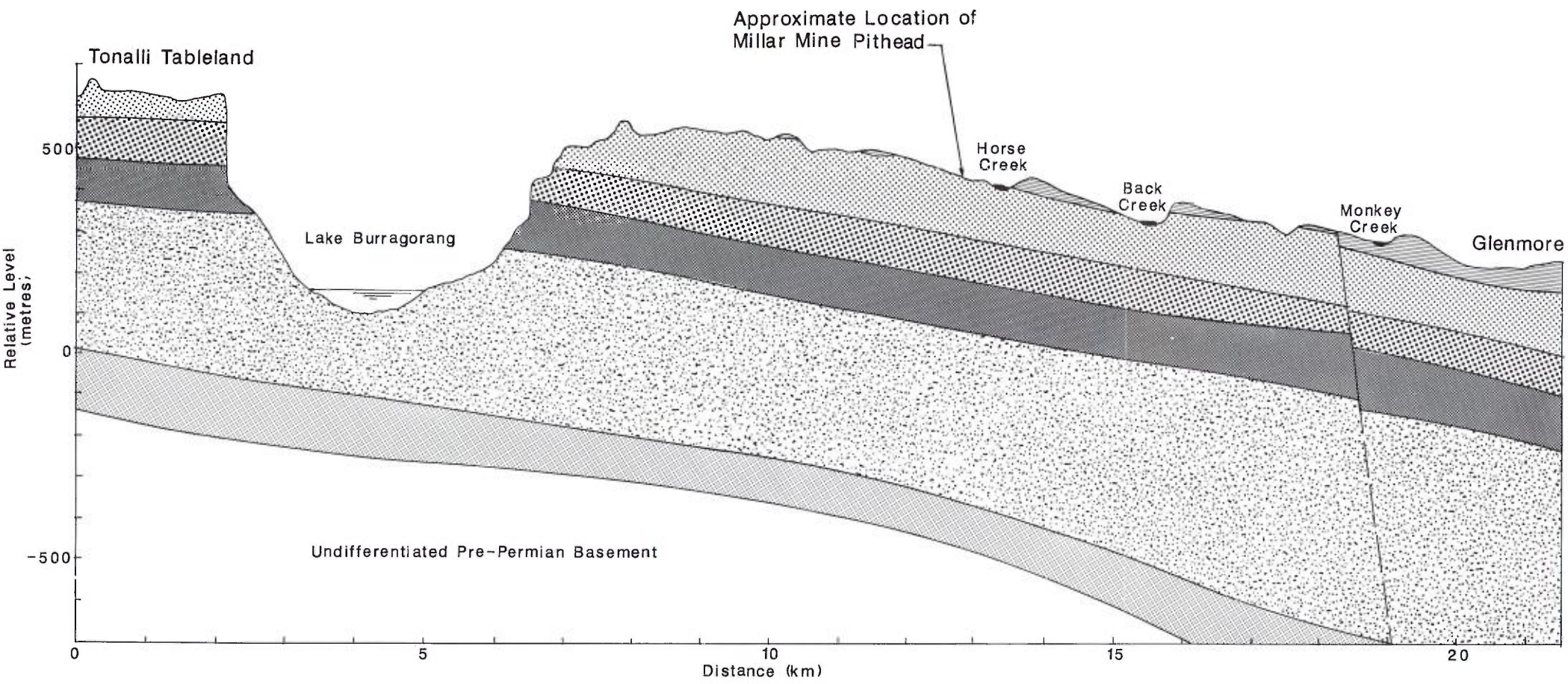


Figure 3.1
LAND TITLES



GENERALIZED GEOLOGICAL CROSS-SECTION








QUATERNARY			Alluvium, gravel
TRIASSIC	LIVERPOOL SUB-GROUP		Shale, with some sandstone beds
	HAWKESBURY SANDSTONE		Quartz sandstone with some shale
	NARRABEEN GROUP		Sandstone, siltstone, claystone, shale, and tuffaceous claystone
PERMIAN	ILLAWARRA COAL MEASURES		Shale, sandstone, conglomerate, tuff, chert, coal and torbanite seams
	BERRY FORMATION (Undifferentiated)		Siltstone, shale, sandstone
	MEGALONG CONGLOMERATE		Quartz sandstone, siltstone and conglomerate

Figure 3.2

GEOLOGICAL CROSS-SECTION

to mine is the Bulli Seam which is the uppermost seam and has an average working thickness of 2 metres, within the proposed mine area. Other seams below the Bulli Seam comprise the Balgownie, Wongawilli, American Creek, Tongarra and Woonona.

3.2.5 Coal Reserves

Results from the drilling programme have enabled estimates to be made of the insitu resource and the recoverable and marketable coal reserves of the Burragorang Valley lease area. In determining the coal reserves, a minimum seam thickness of 1.5 metres has been adopted for measurement purposes. As shown in Table 2.1, the Oakdale Colliery area has 83 million tonnes of insitu reserves, of which 51.5 million tonnes are recoverable, and 40.7 million tonnes are saleable. Within this area, the Millar mine has 58.1 million tonnes of insitu reserves, of which 36.1 million tonnes are recoverable and 28.5 million tonnes are saleable.

3.2.6 Coal Quality

Coal from the Bulli Seam is mined principally as a medium volatile coking coal and also as a high energy medium volatile steaming coal. Insitu ash varies from 10 to 20% over the four colliery areas. Because ash levels tend to slightly increase towards the east of the lease area, it is expected that the coking coal yield will decrease slightly and the steaming coal produced will increase. The raw coal ash content over the Millar Mine lease area ranges from 12-22%. The Bulli Coal has a volatile matter content on an air dry basis of 27.5% at a 8% ash level. There is a decline in the reactive content of the seam towards the east.

Three coking coal brands and four steaming coal brands are produced. Table 3.1 gives an abridged product specification for the highest quality coking coal currently exported.

TABLE 3.1
AVERAGE PRODUCT SPECIFICATION

Typical Clutha Wollondilly Coking Coal Specification

Size	50 mm x 0
Total Moisture on Shipment	8.0%
Proximate analysis (air dried basis)	
Inherent Moisture	1.5%
Volatile Matter	27.5%
Fixed Carbon	63.1%
Ash	7.9%

Total Sulphur	0.42% max
Crucible Swelling No.	5
Roga Index ISO	60

Specific Energy	Gross Air Dried Basis	7,595 Kcal/Kg
	Gross As Received	7,170 Kcal/Kg
	Net As Received	6,895 Kcal/Kg

Ash Fusion Temp (reducing temperature)	
Initial Deformation	+ 1600°C
Fusion	+ 1600°C

Phosphorus	0.06%
Chlorine	0.01%
Hardgrove Index	58
Reflectance (All Vitrinite)	
Ro. Max.	1.01%
Gieseler-Max. Fluidity (automatic determination)	800 dd/min

Gray King Coke Type	G
---------------------	---

JIS DI 30 - 15	93
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JIS DI 150 - 15	82
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Typical Steaming Coal Specification for Clutha Burragorang Valley Steaming Coal

Size	50 mm x 0
Total Moisture on Shipment	8.5%
Proximate Analysis (Air Dried Basis)	
Inherent Moisture	1.5%
Volatile Matter	27.0%
Fixed Carbon	62.0%
Ash	9.5%

Total Sulphur	0.42% max
Crucible Swelling No.	3-4
Roga Index ISO	47

Specific Energy	Gross Air Dried Basis	7,450 Kcal/Kg
	Gross As Received	6,220 Kcal/Kg
	Net As Received	6,555 Kcal/Kg

TABLE 3.1
AVERAGE PRODUCT SPECIFICATION (Continued)

Ash Fusion Temp. (reducing temperature)	
Initial Deformation	+ 1600 ^o C
Flow	+ 1600 ^o C
Phosphorus	0.06%
Chlorine	0.01%
Hardgrove Index	58
Reflectance (All Vitrinite)	
Ro.Max	1.01%
Gieseler - Max. Fluidity (automatic determination)	200 dd/min
Gray King Coke Type	F-G
JIS D1 30-15	89.8
JIS D1 150-15	73.2

3.3 MINING CONSTRAINTS AND OPTIONS

The Company's remaining coal reserves are essentially located in the eastern portions of its existing leases. While such coal could be mined from workings driven from the Oakdale and Brimstone Collieries, its extraction will be optimised by the provision of a new access closer to the location of these reserves. Accordingly, the Company proposes to establish a new colliery called the Millar Mine over the eastern part of

its existing Oakdale lease with pit head facilities located at Oakdale No. 3 shaft.

Coal for extraction is contained within the Bulli Seam. This is only one of six seams forming the Sydney Subgroup which belongs to the upper 100 metres of the Illawarra Coal Measures, but the remainder are either too thin to be mined economically or their in-seam quality is unacceptable.

The Company has examined various options for mining the remaining reserves in its Oakdale lease and for establishing access thereto. These are addressed in Section 6.0. One of the most important factors influencing mine development is the production cost to ensure economic viability. This dictates entry location and mining techniques to be used, how and where the coal is to be processed, and transport options for export.

The depth of the coal deposit dictates the use of underground mining. Therefore, the Company is essentially concerned with optimising the use of longwall equipment within the lease to extract the resource and achieve maximum productivity per employee. The extent of mining is dictated by the boundaries of the existing lease, seam thickness, coal quality and mining conditions. Mining techniques to be used in the new mine are described in Section 3.4.

A number of options were investigated for the location of the access drift and surface facilities. Essentially, this is dependent on optimising access to the eastern reserves from an economic point of view, with emphasis upon capital and operating costs. The ability to secure land ownership, ensure the environmental integrity of coal handling operations at the surface, provide the necessary pit head infrastructure for mining employees, obtain ready access to public roads, and achieve an acceptable transport capability are other significant factors influencing the site selection of the mine's surface facilities at the proposed site. A description of the mine's infrastructure and proposed surface facilities is given in Sections 3.5 and 3.6.

The adequacy of the local transport infrastructure to service the mine's requirements, is a major consideration in the assessment of the impact of the new mine on the local resident population. The nearest railway is the Main Southern Line and the most accessible rail head is at Glenlee 25 kilometres away. Truck haulage is therefore the only viable option for the transport of coal to that rail head and Port Kembla. Problems in accommodating washery reject at the pit head and the capacity available at Brimstone Gully also indicates the need to transport the material by road to Wollondilly. A description of the Company's coal transport proposal is given in Section 3.7.

3.4 PROPOSED MINE PLAN

3.4.1 Introduction

The proposed mine plan for the new colliery, including sequence of extraction, is shown in Figure 3.3. Its projected coal production is included in Table 5.10. The development program is addressed in Section 3.11. Coal production is scheduled to commence in 1992/93 at about 30% of the full production rate of 2.0 mtpa of raw coal. At least two years will be required to establish and introduce the full complement of men and machines to attain target production.

The total recoverable reserves of Oakdale Colliery amount to 51.5 million tonnes of which 70% are accessible from the new colliery entry. Assuming such coal is contained in the Bulli Seam within the current lease boundaries, a raw coal production rate of 2.0 mtpa represents a life of 20 years for the Millar Mine.

3.4.2 Mining Strategy

The strategy behind the mine plan shown in Figure 3.3 is based on several factors. The longwall will extract long narrow blocks of coal, as the major source of production. Hence, large uninterrupted areas of the lease need to be set aside for the longwall. Due to the longwall

being the major source of production, downtime, especially face changeovers, need to be kept to a minimum. Within the practical realms of roadway development time, roadway maintenance and conveyor length, the longwall blocks should be as long as possible, and in the Millar Mine have a block length of around 2 kilometres.

Past experience and research has determined a generalised horizontal stress field orientated in a general north-south direction. Long term stability of the gate roads necessitate the orientation of the longwall faces in an east-west direction. This preferred orientation is also suited to the existing Oakdale Colliery workings.

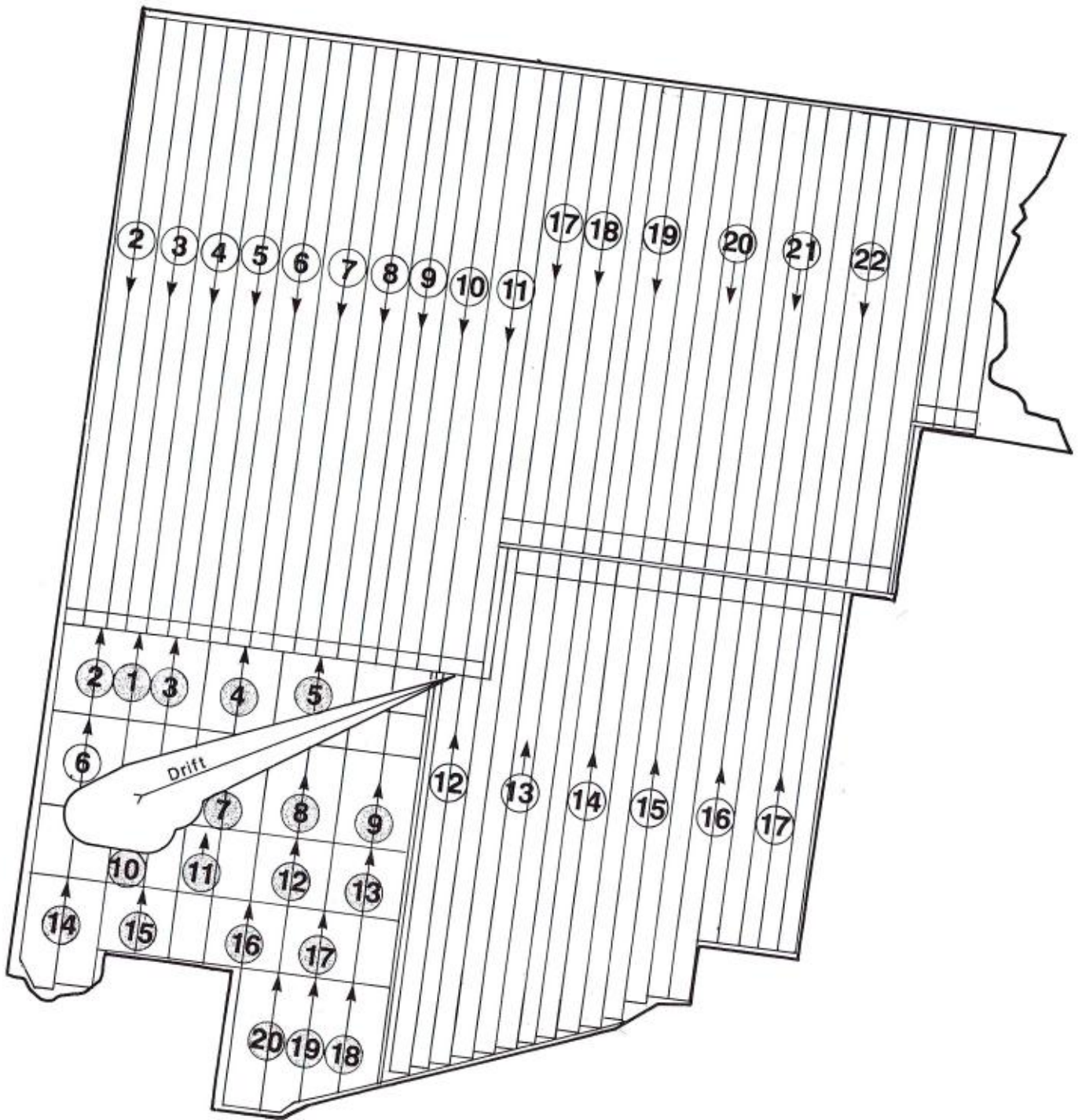
With this mine layout, longwall development is possible from the existing Oakdale workings until the new drift at the Oakdale No 3 shaft site is developed, hence shortening lead times needed to reach full production of the Millar Mine.

Continuous miner units will be used both to develop the longwall blocks and to extract those areas of the lease which due to their size/shape preclude the use of longwall mining techniques. The use of continuous miners in the Burraborang Valley has proved to be a productive and flexible mining method appropriate for the geological constraints to coal seams in that region.

3.4.3 Outline of Mining Methods and Supporting Infrastructure

Coal will be extracted using the following underground mining techniques:

- . longwall;
- . full face miner and flexible conveyor train; and
- . continuous miner and shuttle car using breaker line supports for extraction.



- Longwall Extraction
- Continuous Miner Extraction
- ② Year and Direction of Extraction



0 0.5 1km

Figure 3.3

PROPOSED MINE PLAN

M I T C H E L L M c G O T T E R

As shown in Figure 3.3, a longwall unit will be the primary source of production, extracting blocks of coal of nominal size 100 metres wide by 2000 metres long. It consists of a single drum shearer which traverses the 100 metre face, cutting off 300 mm slices of coal at a time. The cut coal falls onto an armoured face conveyor and is then fed onto the mine conveyor system via a crusher and stage loader.

A full face miner and flexible conveyor train will be used to develop the blocks of coal by mining roadways on either side. The full face miner is a continuous miner fitted with a wider cutter drum which allows it to mine roadways in a single pass. The flexible conveyor train is a special conveyor belt that follows the miner and transfers cut coal to the mine conveyor system.

A continuous miner and shuttle car mining unit will be available to provide extra production and extract coal in those areas that are unsuitable for the longwall unit. The continuous miner cuts the coal and loads it into the shuttle car, which then transports and discharges it onto the conveyor belt system. Two shuttle cars operate with each continuous miner.

Adjoining roadways called headings are connected by roadways called cut throughs. Blocks of coal formed by the intersection of headings and cut throughs are known as pillars. Roadways afford access to mine workings for both men and materials. They also provide passageways for ventilation and by appropriate blocking off can provide for direction of fresh air to the working face as well as the exhaustion of contaminated air from mining operations to the surface.

Coal which is unsuitable for extraction by longwall will be removed by pillar extraction in two stages. Sufficient pillars of nominal size 60 m x 30 m will first be formed by mining roadways using the continuous miner. Systematic extraction of pillars will follow to cause roof collapse. The introduction of hydraulically operated breaker line supports will eliminate the need for much of the traditional timber prop

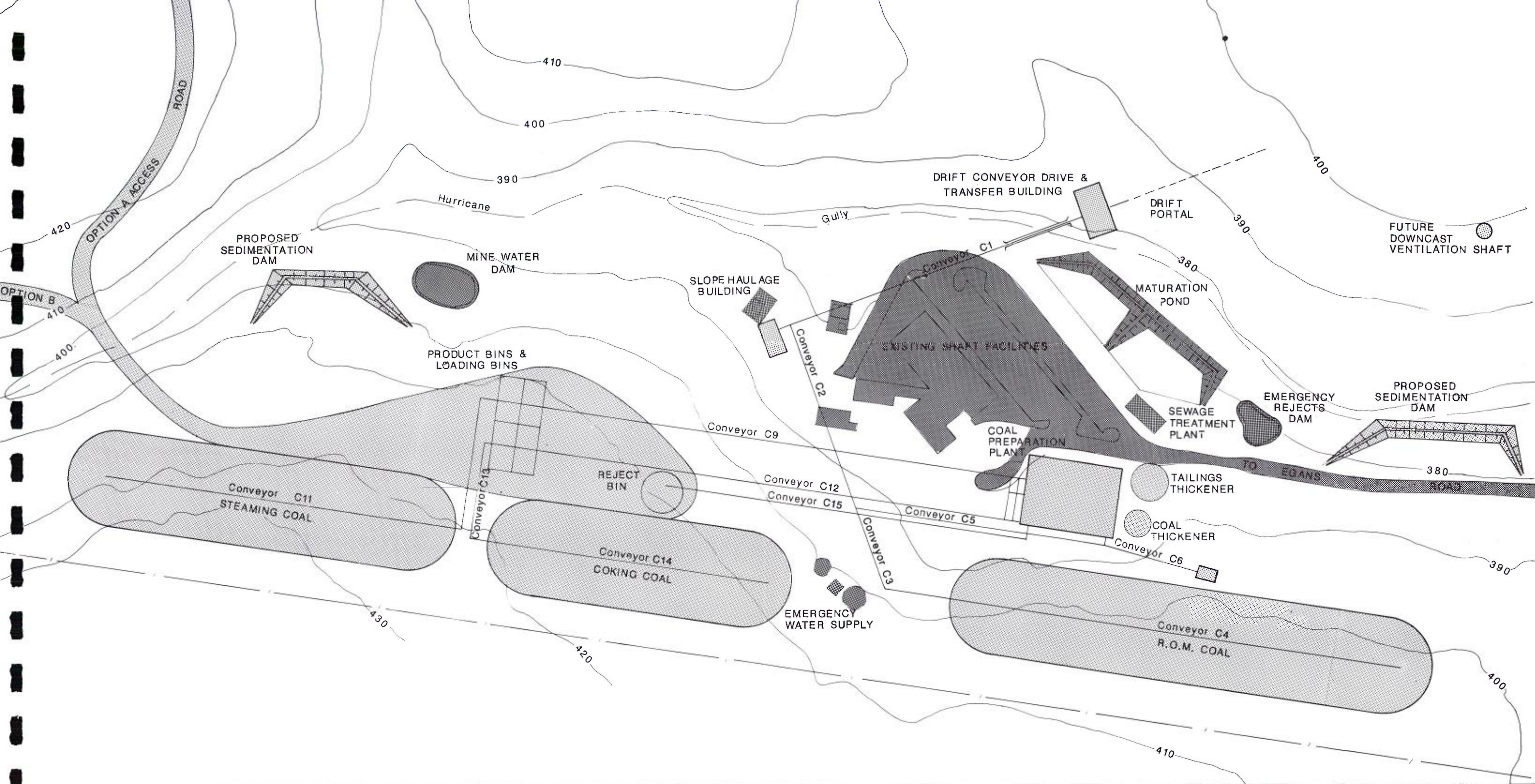
supports and will provide cost savings, increased safety and increased production.

A conveyor belt system will carry coal from mining areas to a 2000 tonne capacity above seam underground bin which will act as a buffer to even out the peak surges in coal flow and enable a more uniform flow to the drift conveyor. Coal in the underground bin will be transported from the mine to the surface by a drift conveyor suspended from the roof of the new drift decline as described in Section 3.5.

Mining supplies and machinery will be delivered underground through the drift via a slope haulage system. Man access will be via the existing Oakdale No. 3 shaft, which is already equipped with man riding facilities, and personnel will be transported to the working faces by rubber tyred, diesel powered vehicles. Optional man access will be available via the drift decline.

Water for fire fighting, dust suppression and general use will be reticulated throughout the mine from a storage dam at the surface of the pit head. Power will be reticulated throughout the mine at 11,000 volts from an underground feeder station supplied from a surface substation. Panel transformers will reduce voltage to 1000 volts to power coal mining equipment.

Ventilation for the Millar Mine will be provided by the existing centrifugal fan fitted to the existing Oakdale No. 3 shaft which will revert to its original role as an upcast shaft. Fresh air supply to the working faces will be supplied from existing downcast shafts at the Oakdale Mine. However, provision will be made for a future new downcast shaft to be sunk as shown in Figure 3.4 in order to complete the ventilation circuit for later operations at a future date.



MILLAR COAL MINE

- Existing
- Proposed

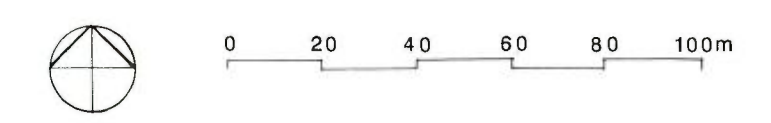


Figure 3.4
PITHEAD FACILITIES
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3.4.4 Detailed Description of Mining Methods and Equipment

(i) Longwall Mining System

The longwall mining system now proposed operates a smaller, single drum shearer on a shorter face width than a conventional longwall and comprises:

- . 300 mm wide ranging single drum shearer;
- . armoured face conveyor (AFC);
- . powered hydraulic supports along faceline;
- . stage loader; and
- . crawler mounted belk tailpiece.

The shearer consists of a 300 mm wide, 1800 mm diameter cutter drum mounted on an arm that allows the drum to be moved vertically. The unit traverses the coal face, in two passes, to remove a 300 mm slice of coal which falls into the AFC.

. The Armoured Face Conveyor

The 830 mm wide armoured face conveyor (AFC) extends along the entire width of the coal face. It consists of a series of 1.5 m length sections, called pans, which are linked together. The AFC not only carries all coal cut from the face, but also guides and supports the shearer along the face. It is therefore of rugged construction. Coal from the AFC discharges into the stage loader where it is crushed and loaded onto the panel conveyor belt. The AFC can cope with peak discharge rates of 1000 tonnes per hour.

. Power Supports

The mine roof will be supported along the entire faceline by hydraulic powered two leg-shield supports. A total of 69 supports will be required. Each 1.5 m wide support has the capacity to exert 540 tonnes transmitted between the floor and roof through a rigid base and canopy.

The face area is protected from broken roof material by rear and side shielding and provides a safe environment for the mine workers.

The powered supports are connected to the AFC pans via hydraulic rams. These rams are activated to move the AFC to the newly formed coal face as each subsequent slice of coal is taken. The supports can be advanced separately by lowering from contact with the roof and being dragged forward hydraulically.

Supports are adjustable in height which allows them to close to 1.4 metres or extend to 2.4 metres. This allows for variations in coal seam thickness and enables collapse for easier transportation within the mine.

. **Stage Loader**

Coal that is removed from the coal face may be in large lumps and fluctuates in quantity such that the conveyor belt system may be unable to adequately handle the output without spillage. The stage loader accepts coal from the AFC at whatever size and rate it is discharged (within limits of the design capacity of the stage loader), crushes the coal, and then evenly distributes it onto the panel conveyor belt for transport out of the mine.

(ii) **Full Face Miner and Flexible Conveyor Train**

The full face miner (FFM) and flexible conveyor train (FCT) will be used to drive the mine roadways which form the longwall block of coal. Each roadway has a nominal width of 4.8 metres and height dependent on seam thickness. The cycle of operations for driving any of the roadways includes cutting out the coal and exposing the roof, supporting the roof, and advancing the brattice for ventilation.

The FFM can cut a roadway to 4.8 metres wide in a single pass. As coal is cut, it is loaded into the receiving hopper of the FCT. After the FFM advances 2 to 3 metres, it stops cutting and mineworkers erect roof supports. For main development roadways of the proposed Millar Mine,

primary roof support will be with steel "W" - straps held to the roof by five 1500 mm steel roof bolts anchored with chemical resin. These will be erected transversely across the roadway at a spacing of about one metre, unless closer support is found necessary.

Roof bolts are installed by drilling a 27 mm hole in the roof to a depth of approximately 1500 mm in two stages, then placing the bolt with a chemical resin in the hole. As the bolt is pushed up and spun, the resin hardens in about 3 to 10 seconds enabling the bolt to be tightened to refusal.

(iii) Breaker Line Supports

During pillar extraction, when coal is removed, timber props are traditionally erected to provide roof support. However, apart from the material cost of timber supports, this operation is time consuming, interrupting production whilst timber is brought in and erected.

The introduction of breaker line supports (BLS) will remove the need to use timber props. The BLSs are self-propelled hydraulic roof supports mounted on caterpillar tracks. Each BLS comprises a canopy, 4 hydraulic cylinder jacks, and a track mounted base which contains an electric motor and hydraulic pump.

Operation of the breaker line supports (BLS) is simple. There are two modes of BLS operation depending on whether two or three BLS units are used. With the Wongawilli method of extraction, 90 metre long splits are driven perpendicular to the headings out into a virgin block of coal adjacent to the panel. These splits are at 12-15 metre centres. Between each split and the retreating goaf, a long narrow width block of coal, called a fender is formed. Fenders of coal are also created by splitting the pillars at the same distance as the long splits.

Extraction of the fender of coal is by continuous miner (CM). The CM travels to the end of the split and cuts slices of coal from the fender of coal with single passes of the CM. Traditionally after each slice of

coal is taken, breaking off timber props are erected. Two BLS are in this case substituted for the timber.

As each slice of coal is taken and the miner retreats ready to take another slice, each BLS is lowered, driven forward and then set to the roof. The workmen/operators can do this from a point of safety via a radio controller.

An adaption of this extraction technique involves the additional extraction of the next adjacent fender simultaneously with the first. The CM takes alternate slices, left and right, off the centre split. Three BLS are used, one in the middle of the split and one BLS each side. Usually as each slice of coal is taken from alternate sides, two out of the three are lowered, advanced and reset to the roof.

3.5 MINE INFRASTRUCTURE

Clutha Coal Pty Ltd proposes to upgrade existing facilities at the current Oakdale No. 3 shaft site for mine access of men, materials and coal. Development will require the integration of existing and proposed facilities.

It is anticipated that the Millar Mine will produce around 2.0 million tonnes per annum (mtpa). Coal production will be from a combination of continuous miner units with either flexible conveyor train or shuttle car haulage. Breaker line supports will be used during pillar extraction in areas insufficient in length for longwall extraction. The dominant production will come from the longwall mining system. A total of approximately 215 people will ultimately be employed at the mine site.

The Oakdale No. 3 shaft site comprises a shaft equipped with ventilation fan and man winder, amenities and administration building, effluent treatment works, carpark and vehicular road access from Egans Road. The site is connected with power and telephone, and water is available from the mine workings pumped from the shaft within the existing Oakdale

Colliery workings. The mine will be developed to its full potential in two stages. Stage 1 requires the construction of a materials decline drift with slope winder, conveyors and coal handling facilities, stockpile areas (both emergency and run of mine), truck loading product bins and a coal and refuse haulage road. Stage 2 of the proposal will include the construction and commissioning of a coal preparation plant.

Access to the site is currently available to light vehicular traffic via Egans Road. The coal and refuse haulage road is proposed to access the existing coal haulage route along Stevys Forest Road via Crown or privately owned land that links land owned by Clutha Ltd and Stevys Forest Road. A layout of the mine site is shown in Figure 3.4.

3.5.1 Existing Facilities

The existing development at Oakdale No. 3 shaft site was commissioned in 1979 and ceased operations in 1986. The facilities are located east of the proposed mine and remain in good order and suitable for use by the new mine. They comprise the following:

- . a vertical shaft with a diameter of 6.8 metres and extending to the Bulli Seam 370 metres below the surface;
- . an upcast ventilation fan (Richardson 2480CY centrifugal type fan) which is capable of producing 105 cubic metres of air per second at 370 revolutions per minute;
- . an automatic man winder (GEC) and single deck platform which is capable of transporting 80 personnel at one time up or down the shaft;
- . an amenities and administration complex which is joined at the top of the shaft via an airlock and can accommodate up to 300 personnel. The amenities layout is divided into clean and dirty sections separated by rows of showers. A number of offices are provided for mine management, supervisors and clerks. There is also a lamp cabin and storage area;

- . a package sewage treatment plant and maturation ponds with a storage of 0.9 megalitres;
- . mine water is presently being pumped from the existing Oakdale Colliery working to a sedimentation basin before overflowing to Hurricane Creek. Two 20,000 litre tanks are supplied by mine water and used for an emergency fire fighting supply;
- . potable water is available from rainwater storage tanks;
- . 11kV electricity supply is from the Prospect County system and provides power to the man winder, ventilation fan, lights, power and other ancillary functions;
- . vehicle access to the amenity/administration complex is by right of way which connects to Egans Road in the east approximately one kilometre from the Burragorang/Egans Road intersection. The road is suited only to light vehicular traffic; and
- . a sealed car and bus parking area is located near the shaft site and can accommodate up to 80 vehicles.

3.5.2 Manning Levels

Initial and ultimate workforce requirements for both the colliery and coal preparation plant (CPP) are given in Table 3.2. When full production is reached in 1995, there will be a total of 215 employees of which 177 will work in the mine and 38 in the coal processing plant. It is anticipated that colliery workers will work a nine hour shift on a six day non-rotating roster system, Monday to Saturday. There will be 3 daily shifts, these being night (11pm-8am), day (7am-4pm) and afternoon (3pm-12pm) periods which allows for a one hour total travelling time for each shift. Colliery workers will be rostered on a repeating three week cycle so that at any one time a third of the workforce is rostered off.

Coal processing plant and administration personnel are likely to work an eight hour shift.

TABLE 3.2
PROJECTED MILLAR MINE WORKFORCE REQUIREMENTS

Year	1992	1993	1994	1995/2014
Colliery				
Manager	1	1	1	1
Clerk	1	1	1	1
Engineers	2	2	2	2
Surveyors	1	2	2	2
Undermanagers	3	3	3	3
Deputies	10	15	20	20
Fitters	15	18	26	26
Electricians	15	18	26	26
Federation	57	81	96	96
Total	105	141	177	177
Coal Preparation Plant				
Manager		1	1	1
Engineers/Supervisors		3	4	4
Fitters		6	8	8
Electricians		6	8	8
Federation		10	16	16
Total		26	37	37
Grand Total	105	167	214	214

3.5.3 Proposed Mine Expansion

The design layout shown in Figure 3.4 identifies the location of stockpiles, drainage controls and coal handling facilities.

For Stage 1 development, the proposal requires the establishment of the following:

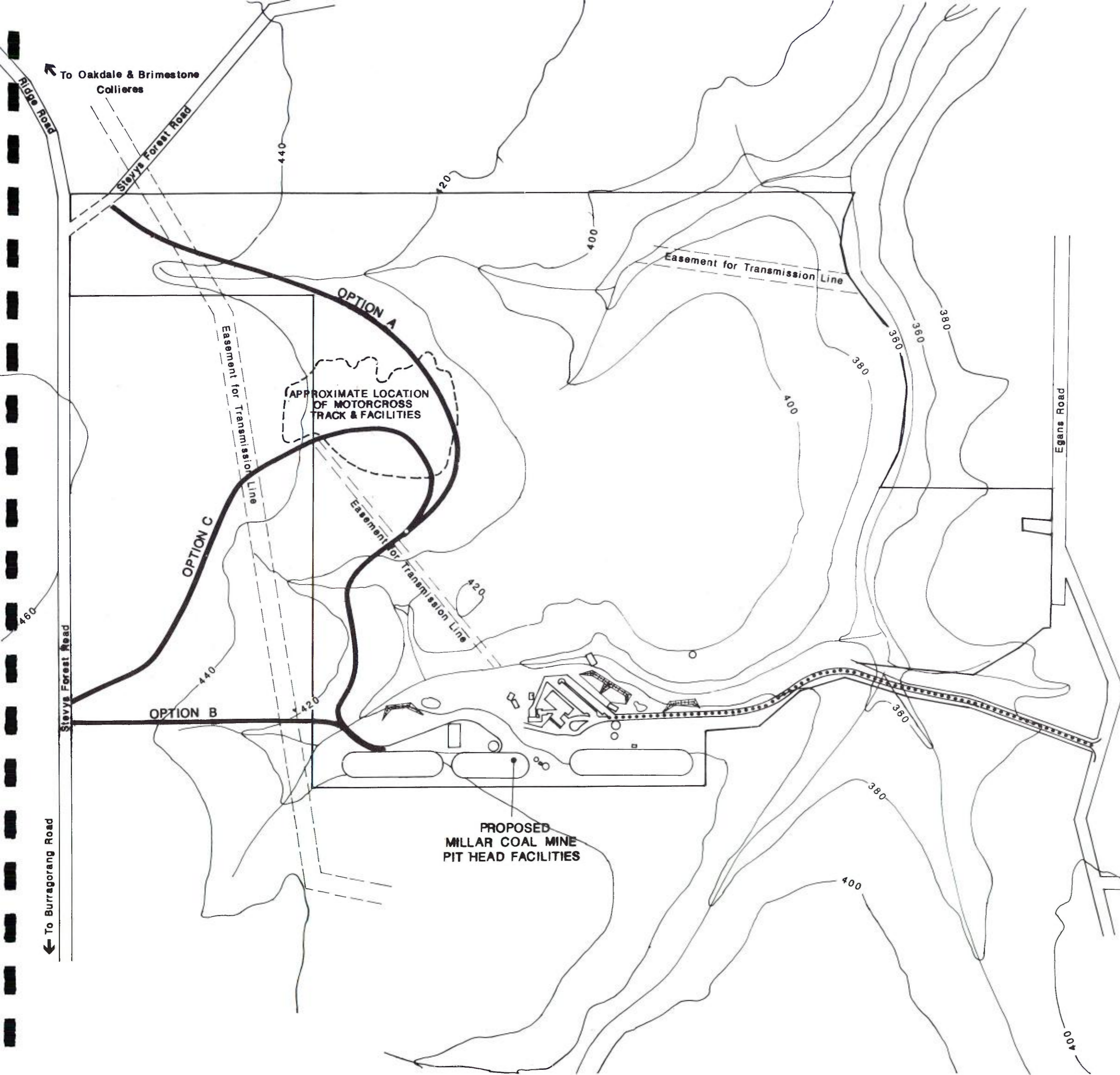
- **Haulage Road**

A coal/refuse haulage road will link the site and the existing truck route via Stevys Forest Road. Three options have been proposed for the haulage route between the mine site and Stevys Forest Road as shown in Figure 3.5. In Option "A", the road proceeds north approximately 0.9 kilometres and then northwest across Crown land for 0.5 kilometres to intersect with Stevys Forest Road. The road corridor is held under a permissive occupancy and is currently under an application for a mining purposes lease. Option "A" would require modification to the intersection of Stevys Forest Road and Ridge Road. For Option "B", the road would traverse privately owned land for approximately 0.6 km to connect directly with Stevys Forest Road 0.5 kilometres north of its intersection with Burragorang Road. Option "C" is gazetted a parish road between land owned by Mr Kenneth Gapes, orchardist.

Option "B" is preferred but is subject to purchase of the required land from Mr. Kenneth Gapes. Option "C" is the Company's second preference because of its ability to shorten the haul route by almost 1km compared to Option "A"; it would

MILLAR COAL MINE

- Haul Route Options
- Existing Mine Access



0 100 200 300m

Figure 3.5

PITHEAD HAUL ROAD OPTIONS

MITCHELL McCOTTER

therefore be adopted by the Company as its proposed access route to the pithead site if the easement for Option "B" cannot be purchased.

Drift

The drift decline is a sloping tunnel that provides access to the Bulli Seam from the surface. The drift has dimensions of 4.2 by 4.9 metres and a slope of 1 in 3.4. Its length extends almost 1600 metres from the surface to the Bulli Seam, although extra driving of the drift will be necessary to include an above-seam bin. The primary functions of the drift are coal haulage via the drift conveyor and provision of equipment and materials handling access. The conveyor belt and structure will be suspended from the roof of the drift which leaves the floor free for the rail mounted materials handling haulage system. The drift conveyor will be designed to operate at 800 tonnes per hour.

The slope haulage system for materials handling access consists of rail mounted rolling stock retained by a wire rope which is wound on and off a drum. A driver located on the dolly car controls the slope hauler via radio control to a fully automatic drum winder. Various flat top rail cars are connected to the dolly car and for carrying mine supplies such as roof bolts, timber etc which are loaded onto trailers placed on the flat tops and held secure with chains. All mine equipment can also be loaded directly onto the flat top cars.

A special heavy-duty flat top is required to transport the heavier pieces of mining equipment such as continuous miners, shuttle cars and the shearer and supports. This system of transport allows rapid and efficient movement of materials and machinery in and out of the mine.

If the need arises, man-riding carriages can be attached to the slope hauler and used for transporting personnel. The decline

also provides a second means of egress for mine personnel in emergency circumstances.

Access to the mine can be via the proposed drift decline or the existing upcast shaft. This shaft is already equipped with man-riding facilities and is the preferred option. Personnel will then be transported to the working faces by rubber tyred, diesel powered vehicles.

Water

Water will be reticulated throughout the mine for fire fighting, dust suppression, general use and coal preparation. Water will be obtained from an existing storage dam which will be supplied with mine water pumped up the existing No. 3 shaft. Drinking and bathing water will be from the Oakdale town water supply, through a connection with the main located along Stevys Forest Road.

Power

Provision of power throughout the mine will be from the existing 11kV power supply. Although this is adequate for the proposed operations, the existing substation will need to be relocated to allow the proposed surface facilities to be built. From the substation, power will be fed to an underground feeder station and then to the various points of the mine. Panel transformers will reduce the voltage to 1kV to supply coal mining equipment.

Ventilation

Ventilation for the Millar Mine will be provided by the existing centrifugal fan fitted to No. 3 shaft. A downcast air shaft will be provided from the Oakdale No 1 shaft in order to complete the ventilation circuit. Provision has been made for a new downcast shaft when the Oakdale Mine area is finally sealed off. Air will be circulated, using the negative pressure created by the fan, down the downcast shaft and throughout the mine then through the

fan via the upcast incline. Brattice cloth screens will be used to direct fresh air over mining machines at the working faces.

. Pollution Control Measures

Pollution controls are discussed in Section 3.8 and are summarised below:

- . a catch drain will divert clean surface runoff around the site facilities and stockpiles;
- . contaminated runoff from stockpiles, truck loading pad, site facilities, coal preparation plant and drift portal will be diverted to sedimentation ponds;
- . sewage will be treated in an existing package sewage treatment plant;
- . contaminated runoff containing oil and grease from the slope haulage building and mine equipment washdown area will drain through grit and oil traps and then treated in the sewage treatment plant;
- . effluent from the sewage plant will be directed to a maturation pond with a 15 day detention capacity before being spray irrigated; and
- . mine water will be pumped to a storage dam for a minimum two hour detention period and then released to Hurricane Gully.

. Fire Fighting Facilities

A fire station accommodating a fire engine and appropriate fire fighting equipment will be located adjacent to the existing administration complex. The fire fighting system will require 0.4ML of stored water which will be available in a raw water reservoir tank fed from the mine

water storage dam and which will provide storage for four hours fire fighting in accordance with the Coal Mines Regulation Act (CMRA) Regulations 1982. Booster pumps will be provided to ensure sufficient flow rates and pressures are available even in the event of a power cut. A maximum demand of seven litres per second at 700 kilopascals head will be allowed for in accordance with CMRA 1982 Regulations 16(3)(a). The supply will be fed by a 100mm diameter ring main with hydrants, complete with hoses and nozzles, around all the pit top installations. Water carts will also be able to directly fight a fire or supply water to the fire engine.

3.5.4 Civil Works

Earthworks to be completed in Stage 1 will be required for the haulage road, stockpile areas, water pollution control structures and foundations for the drift drive head building, the slope hauler building and conveyor gantries.

Stage 2 will not require additional infrastructure and will be essentially associated with the provision of additional coal handling facilities and construction of the coal preparation plant.

(i) Road Haulage

The options for haulage road routes to Stevys Forest Road are discussed in Sections 3.5.3 and 5.6.7 They describe a preferred shorter route running west and a longer and less direct route directed north. The road will be suitably designed to accommodate frequent truck movements. The road formation will have a width of 12 metres and have a sealed eight metre wide pavement. Base courses will be nominally 600mm and subsoil and dishdrains will be provided.

Option "A"

The overall distance for this route is about 1400 metres with grades of up to 5%.

Option "B"

The shorter route will be approximately 600 metres long and will be almost straight with a near constant upward grade to Stevys Forest Road. The maximum grade will be about 8%.

Option "C"

Option "C" is about the same length as Option "A" with grades of up to 5% over its common length with the latter and as it climbs the hill as it turns to double back to an entrance on Stevys Forest Road.

For all three options, earthworks will be based on an equal cut and fill design. Both routes will cross Hurricane Creek which will require a culvert and approximately 10,000m³ of fill which will be obtained from site works associated with the location of the coal stockpiles.

For Option "A", an additional smaller culvert crossing will need to be constructed. The required amount of fill is available from cuttings elsewhere along the route.

(ii) Clearing and Site Preparation

The area to be occupied by the coal handling facilities on the southern slopes of Hurricane Gully is heavily forested as described in Section 4.4 and shown in Figure 4.4. Having regard for the erosion and water pollution potential of the site once it is cleared and for bushfire hazard potential described in Section 4.11, it will be necessary to ensure minimum clearing of vegetation, appropriate methods of disposal of cleared timber, and implementation of adequate erosion and water pollution control measures during the construction stage prior to final rehabilitation of the site. These are addressed in Section 3.9.

(iii) Earthworks

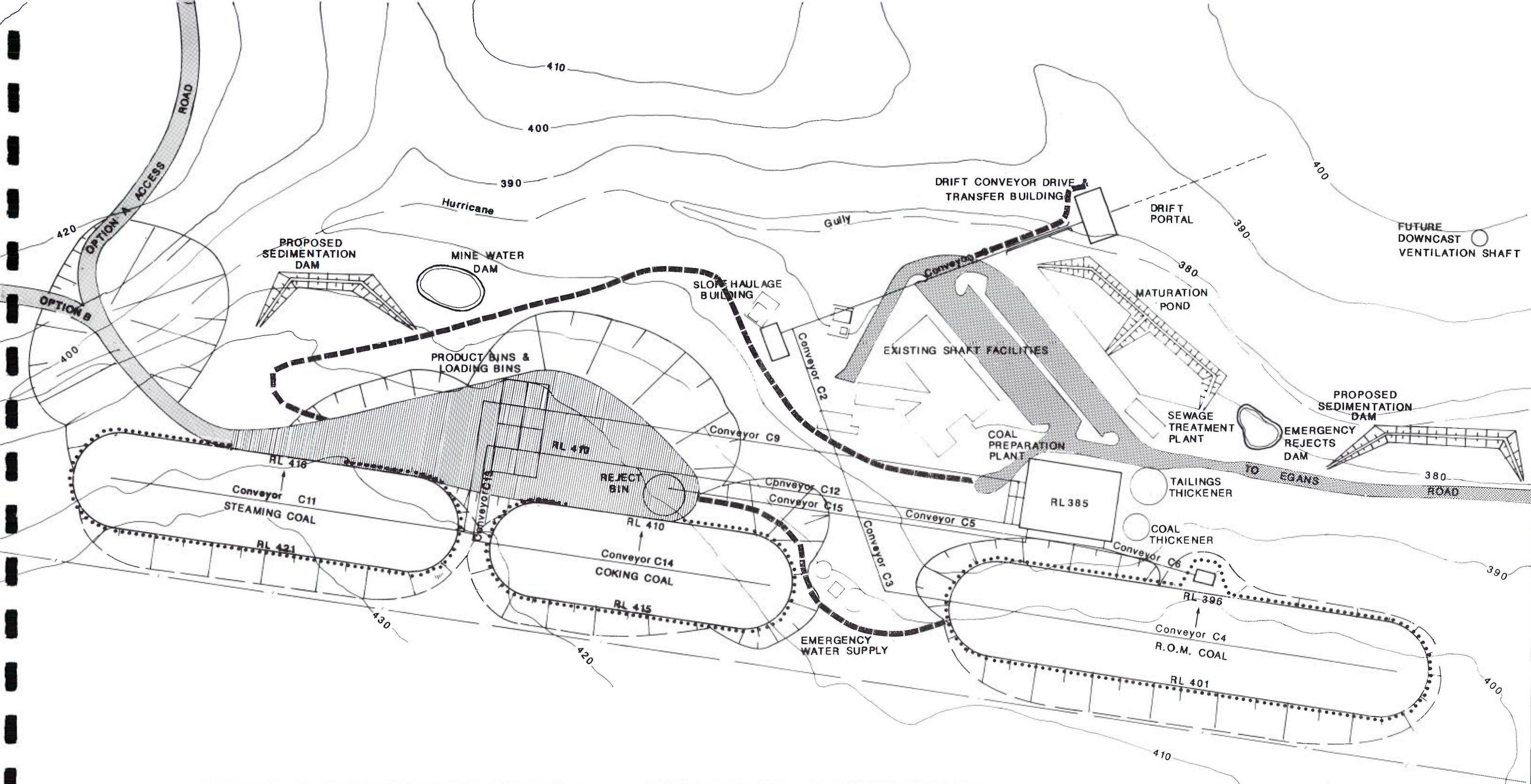
The coal handling facilities will be essentially located along the upper slopes of Hurricane Gully adjacent to the southern boundary of the site. The layout of the stockpiles has been designed to ensure a minimal surplus or deficit of excavated material. The total volume of excavated material is estimated to be 80,000m³.

The extent of the earthworks and foundation levels of the various components are shown in Figure 3.6. To minimise cut and fill, the stockpile pads have been designed with a 12% lateral slope or five metres cross fall, with the upper base levels of the steaming, coking and run of mine stockpiles at RL 421, 414 and 401 respectively.






The truck loading pad will be located to facilitate truck loading directly from the north side of the product stockpiles by front end loader. The surface level of the southern edge of the pad will coincide with that of the northern edge of the stockpiles descending from RL417 to RL410 and will have a 3% crossfall for drainage purposes. The lower section will also accommodate the product and reject bins. The run of mine stockpile will be located near the coal processing plant, and an inground hopper will be provided at the same level (RL 396) to enable loading of coal by front end loader.

Base levels of the coal processing plant, slope haulage building and drift conveyor drive building will be near ground level at RL 385.

The maximum slope in cut will occur on the southern edge of the stockpiles and will be about 1 vertical to 1.5 horizontal. The excavation will be principally in sandstone so that retaining structures will not be required. Fill batters will be necessary around sections of the stockpiles and truck turning/loading pad. In general, the natural slope is relatively steep, particularly in areas near Hurricane Creek around the north western corner of the steaming coal stockpile and the northern section of the truck loading/turning pad. Where batters are greater than 1 vertical to 3 horizontal, rip rap will be required to



MILLAR COAL MINE

-  Internal Access & Service Roads
-  Front-End Loader Access
-  Site Facility Access
-  Truck Haul Road
-  Truck Loading Pad

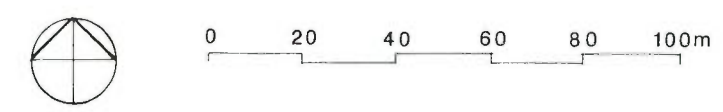


Figure 3.6
INTERNAL ACCESS & EARTHWORKS
 MITCHELL MCCOTTER

stabilise the slope and minimise erosion. The maximum batter will be about 1 vertical to 2 horizontal, although a steeper section between the run of mine stockpile and coal processing plant will require a structural retaining wall.

(iv) Internal Access

The road layout is presented in Figure 3.6 and incorporates both existing and proposed vehicle access.

The existing sealed roadways include light vehicular access from Egans Road, carparking areas, and access to the amenities/office building and proposed coal processing plant. There is also a helipad and ambulance bay.

Provision will be made for upgrading and sealing the service road between the site facility area, near the coal processing plant, and the truck turning/loading pad.

Access by front end loader to the product and run of mine stockpiles will be by a 5 metre wide roadway incorporated on the edge of the stockpile pads.

In addition, service roads will be provided to the drift portal conveyor and downcast and ventilation shaft, run of mine conveyor and slope haulage building.

(v) Drainage

A schematic of drainage flows is given in Figure 3.12 (Section 3.8.3). Catch drains for contaminated runoff will be located around the perimeter of each stockpile between the coal stockpiles and access way, the edge of the truck loading area and around the coal processing plant. Runoff will be directed through sumps and underground pipelines to sedimentation ponds located north east of the product bins and north west of the run of mine stockpile. Ponds will have volumes of approximately 1.2ML and 2ML each. In addition, a 1ML clarified water

storage dam will be constructed north west of the existing maturation ponds by expanding the existing sedimentation ponds. A small sedimentation pond will accept runoff from around the portal building, and the existing maturation pond will be augmented from 0.9ML to 1.6ML. Contaminated runoff from the slope haulage building and washdown area will drain to grit and oil traps, and then treated in the sewage treatment plant.

A small tailings dam with a storage capacity of 0.6ML will be constructed near the coal preparation plant.

Catchment runoff will be directed east and west around the stockpiles and drained into the natural water course of Hurricane Gully.

3.6 COAL HANDLING AND BENEFICIATION

The proposal requires the receipt of 800 tonnes per hour of ROM coal from the drift conveyor.

The conveyor will carry coal from the areas in which it is mined to an underground bin of nominal capacity 2000 tonnes. The bin will act as a buffer between the surges experienced with coal production and the fixed capacity of the drift conveyor. Coal in the bin will be transported from the mine by the drift conveyor to surface handling facilities.

3.6.1 Handling Facilities

Coal handling facilities for Stage 1 will include all ROM conveyors, the ROM stockpile and inground hopper, and a product conveyor to four 2500 tonne product bins. A small cross-belt will distribute the raw coal carried on the product conveyor to each of the bins for loading into trucks for transport off site to Wollondilly Washery. The ROM stockpile will have dimensions of 42 x 210 metres with a nominal capacity of 50000 tonnes.

Stage 2 requires the commissioning of a coal preparation plant (CPP) and its associated materials handling facilities. These will include two product conveyors (coking coal and steaming coal), one of which will have already been used for ROM coal in Stage 1. Conveyors from the product bins to the steaming and coking coal stockpiles will also be constructed. Once the product bins are filled, coal can then be conveyed onto the respective product stockpiles.

Under normal operating conditions, ROM coal will be processed continuously and transported from the site to Glenlee or Port Kembla. It will only be when interruption occurs to the washery process or transport that product coal will be placed on the storage pads.

The nominal capacities of the coking and steaming stockpiles are 30,000 tonnes and 40,000 tonnes respectively. Coal will be recovered from these stockpiles by front end loaders for transfer into trucks for transport off site.

In Stage 2, ROM coal will be conveyed from the mine direct to the CPP, or to the ROM stockpile from which it will be reclaimed by front end loader and fed into an inground hopper for conveying to the CPP. In the event of the need to maintain a run of mine washery feed at night for which the use of front end loaders may generate unacceptable noise, the Company would install a tunnel reclaim system for supply from the ROM stockpile. The CPP will produce 2 products from the raw coal feed, these being coking and steaming coal.

Reject is the by-product and together with the dewatered tailings will be combined and conveyed to a 2000 tonne bin. From the bin, the reject will be transported to Brimstone Gully near the Wollondilly Washery for emplacement. The capacity of the reject bin in relation to the throughput of the CPP is equivalent to 1 days washing so that daily removal of reject from the bin will be necessary whilst the CPP is operating. If the reject bin is emptied daily, the restrictions placed on truck movements at night will not affect the CPP operation.

The layout of the conveyors and materials flow sequences is presented in Figures 3.7 and 3.8. Figures 3.9 and 3.10 show the individual conveyor systems servicing the plant, bins and stockpiles.

Salient parts of the coal handling systems are:

- . three way chutes are proposed in preference to shuttle conveyors or moving heads. This will effectively minimise the extent of the conveyor network;
- . transfer chutes will be arranged to direct scrapings to the main material flow and also to facilitate the installation and maintenance of belt scrapers;
- . spillages will be minimised by having the receival chutes fully covered, fitted with skirting with directional chute sections, minimum slopes (max. 10 degrees) and greater than standard edge distances;
- . conveyor capacities will be 10% greater than the maximum proposed useage;
- . all ROM and product conveyors will have weather covers, lifting facilities and designed for ease of inspection and maintenance;
- . stacking conveyors will be fitted with automatic trippers which will limit the free fall height of material;
- . a spray system attached to the underside of the conveyors will suppress dust in the stockpile area. Nozzles on either side of the discharge chute will be activated by the tripper or alternatively can be controlled manually from the control room to spray selected zones;

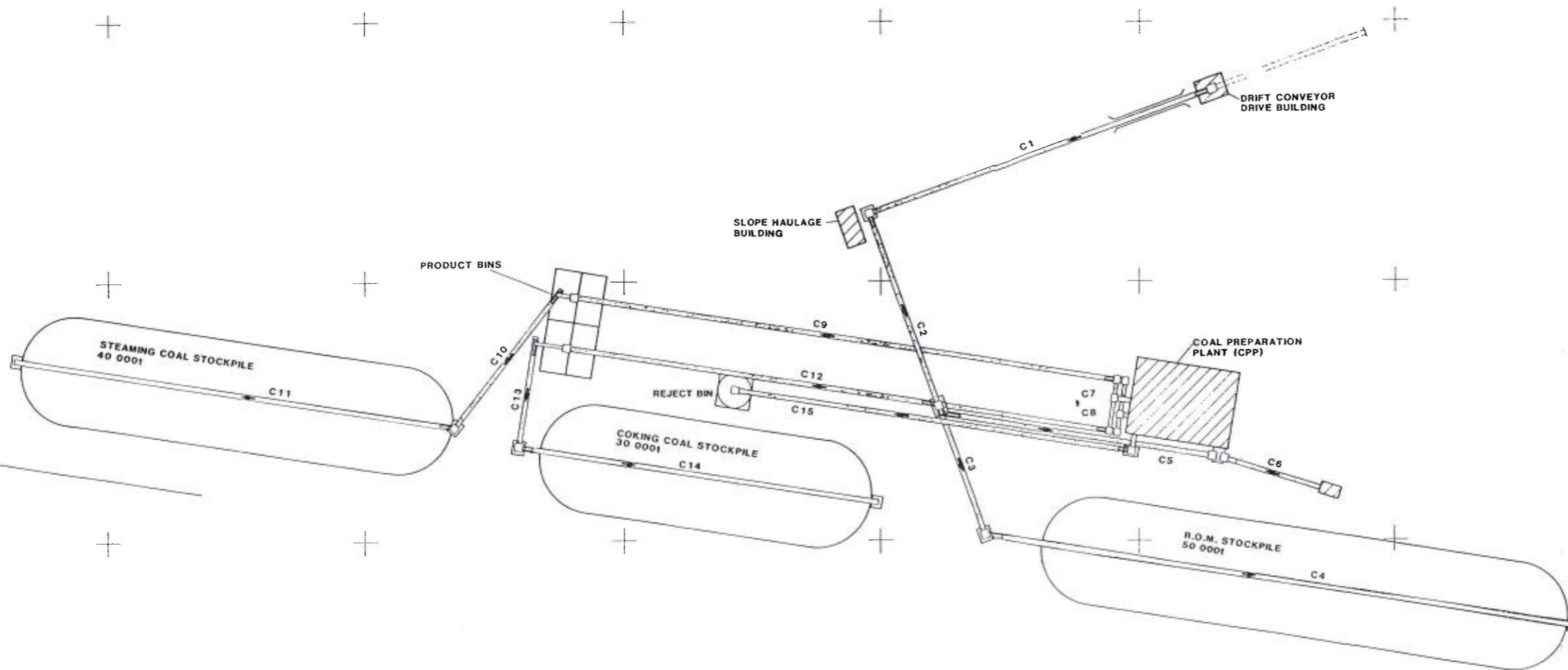


Figure 3.7
CONVEYOR LAYOUT

MATERIAL FLOW		EQUIPMENT ITEM NUMBER																							
SEQUENCE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
FROM	TO	C1	C2	C3	C4	C5	C6	CPP	C7	C8	C9			C10	C11		C12		C13	C14		C15			
MINE	COAL Prep Plant	0	1	2			3	D																	
	ROM Stockpile	0	1	2	3	4																			D
	TRUCK Bins	0	1	2									D					3							
ROM St.pile	COAL prep Plant							1	D																0
CPP	STEAM Coal Bin								0	1		2	D	3											
	STEAM Coal Pile								0	1		2		3	4	5	D								
	COKING Coal Bin								0		1		D					2	3						
	COKING Coal Pile								0		1							2	3	4	5	D			
	REJECT Bin								0															1	D
	NOTE:	Numbers indicate Flowpath with 0 being Origin and D Destination																							
		Items numbered 3, 13 and 18 are 3 way Chutes																							
		Items 12 and 23 are Bins, Items 16,17 and 24 are Stockpiles																							

Figure 3.8

PITHEAD MATERIAL FLOW SEQUENCE

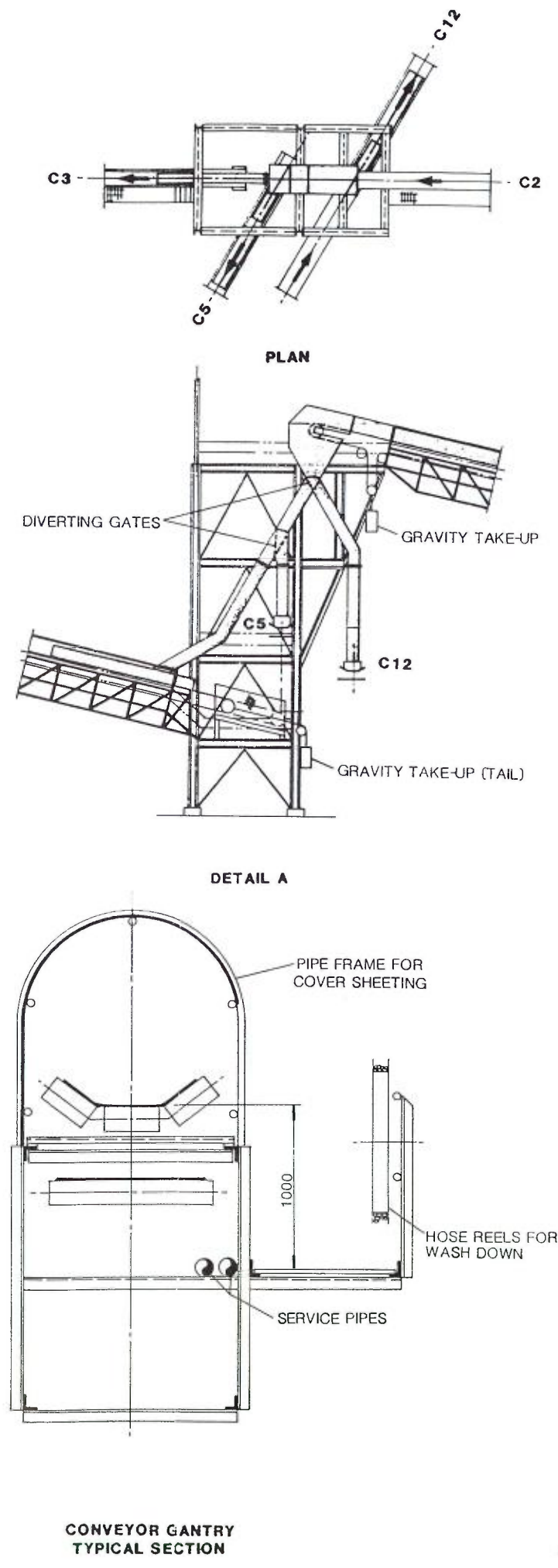
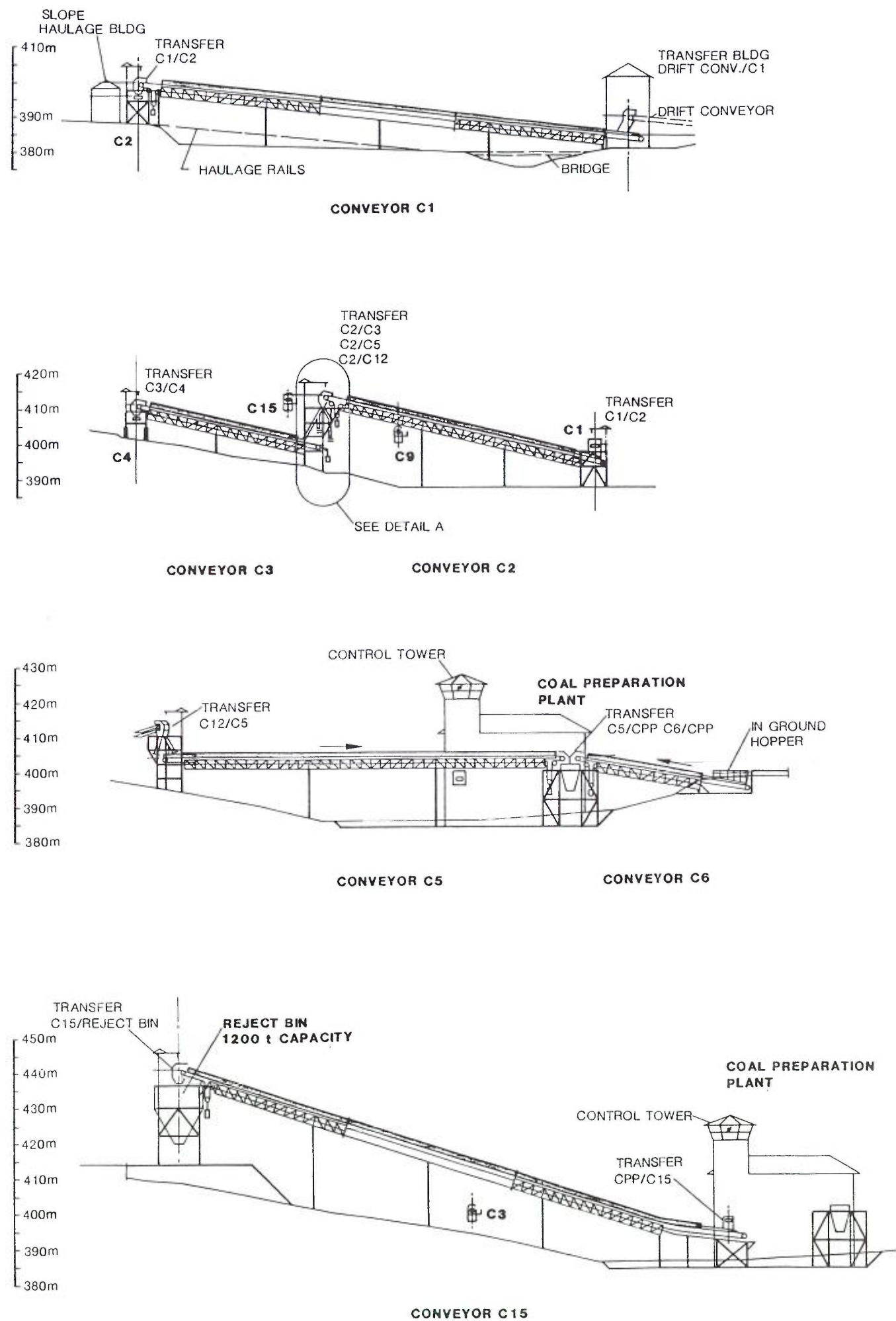


Figure 3.9
CONVEYOR CROSS SECTIONS & DETAILS
 Source: ANDREW G. GELLERT January 1989

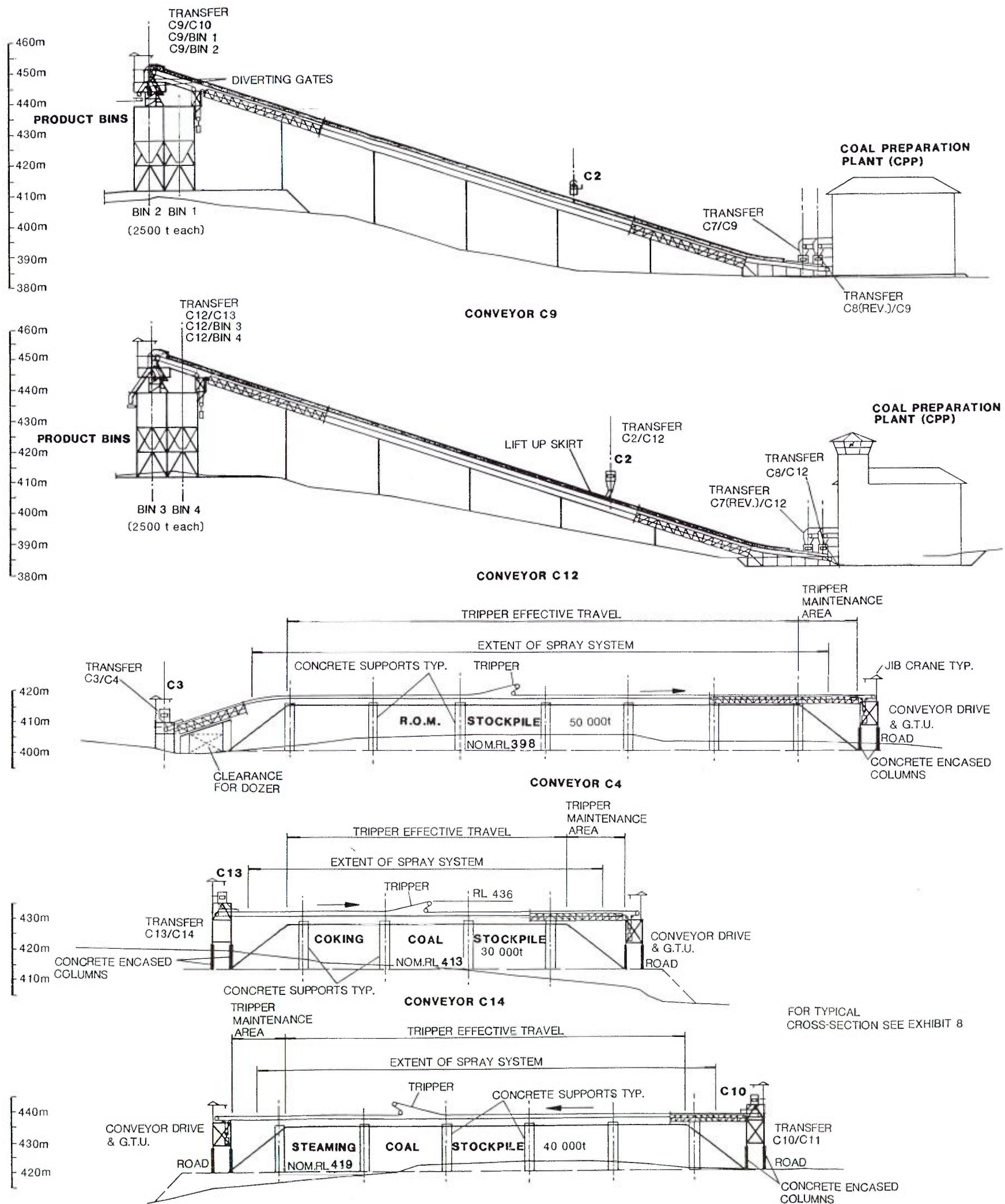


Figure 3.10
CONVEYOR CROSS SECTIONS

Source: ANDREW G. GELLERT January 1989

- . for wash down purposes, water supply and hoses will be provided along the conveyors and at transfer points. Where conveyors cross trafficable areas, spillage plates will be fitted; and
- . state of the art control system will effectively manage the system.

3.6.2 Coal Beneficiation

The Millar Mine Coal Preparation Plant (CPP) will be designed to operate at a feed rate of 500 tonnes per hour of raw coal.

Raw coal will initially be screened into two size fractions of greater than 0.5mm and less than 0.5mm. A two staged dense media system will gravity separate the greater than 0.5mm fraction into coking coal, steaming coal and coarse reject. The less than 0.5mm coal will be treated by froth flotation, dewatered and then added to the coking coal product while the reject will be dewatered and mined with the coarse reject.

The coal preparation plant flowsheet is shown in Figure 3.11 and may be described as follows:

- . Process

1. Gravity Separation

Raw coal enters the plant onto double decked sizing screens with apertures of 50mm and 0.5mm. Coal greater than 50mm is crushed and, together with coal greater than 0.5mm, enters the raw coal sump from where it is pumped through desliming screens to further remove particles less than 0.5mm. The smaller particles less than 0.5mm are passed to the flotation sump.

Dense media separation is dependent on the particle specific gravity relative to that of the fluid in the media. Specific gravity is

normally higher with increasing ash content, so that by regulating the fluid specific gravity, the separation of product and reject is facilitated. The fluid specific gravity is achieved by regulating a mixture of water and magnetite.

There are two cycles in the dense media process, the first separates coal into reject and feed, and the second separates the feed into coking and steaming coal. Product coals and reject are drained and rinsed through separate screens. Magnetite that is washed off during the rinsing process is recovered using magnetic recuperators so that, except for the small amount that is not rinsed off, magnetite is circulated and continually reused.

Product coals are dried using centrifuges prior to being conveyed out of the plant.

2. Froth Flotation

The fine coal of less than 0.5mm is treated with a chemical frothing agent in flotation cells and a collector, usually dieselene, is added which coats the coal particles. During aeration, air bubbles stick to the coated particles and float them to the surface where they are paddled off and collected. The froth concentrate is then dewatered using a string discharge drum filter, then mixed with the coking coal. Reject from the flotation cells will be dewatered using a band press filter then mixed with the coarse reject.

Water used in the washing process is recirculated through the plant with additional requirements being available from the clarified water storage dam.

. Process Controls

The main process controls to be implemented in the plant are specific gravity control in the dual media circuit, level control of all sumps and sequencing of conveyors and washing units. Controls may also be necessary for reagent addition to flotation cells and controlled dosage

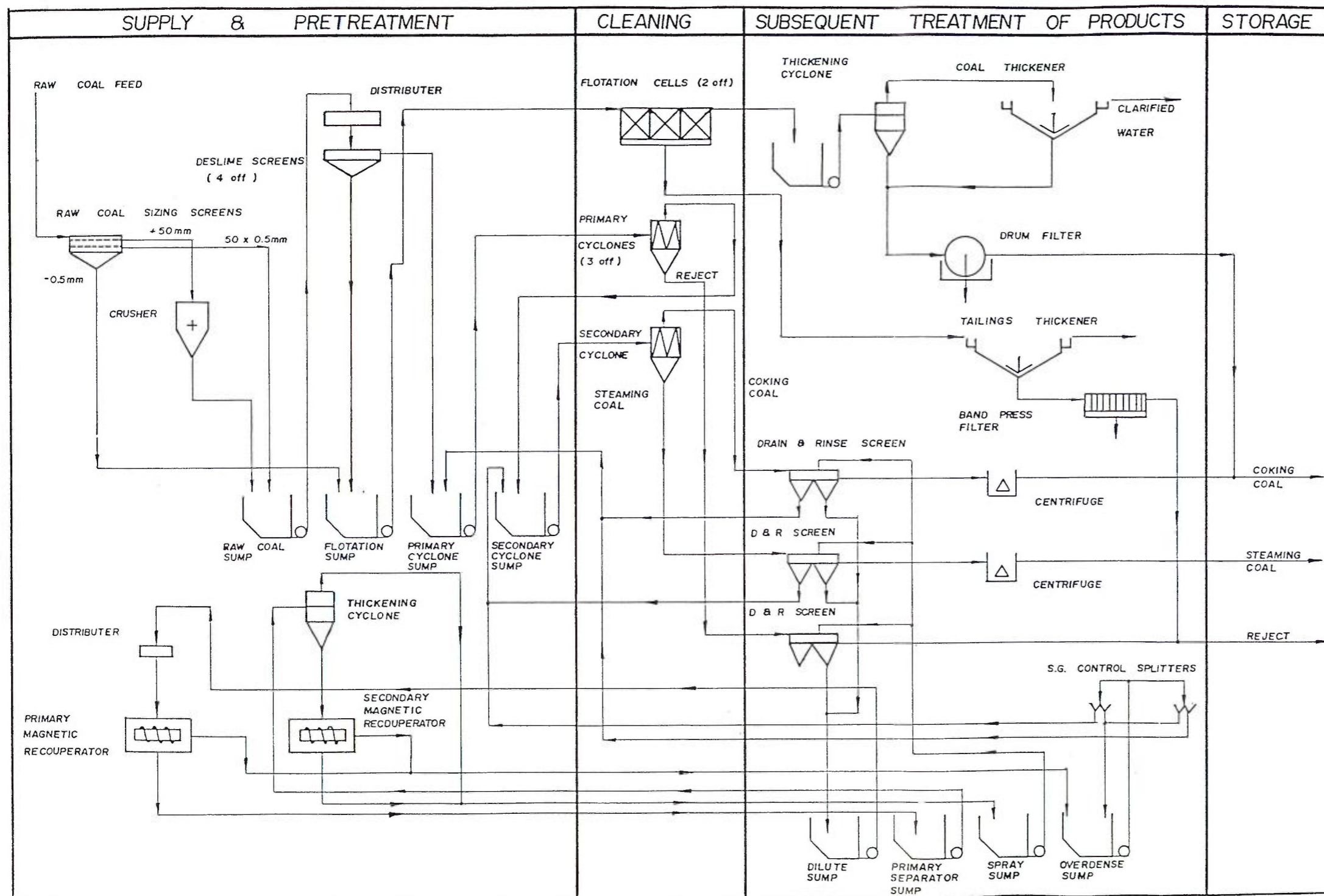


Figure 3.11

of flocculants in the coal and tailings thickeners. In the event of an emergency, provision is made to pump from the thickening tanks to the emergency storage dam and for later recycling back to the system.

The Company is confident of its ability to implement a competent mechanical dewatering system in its coal preparation plant having regard for the low clay content of the Bulli Seam and for the satisfactory performance experienced at the Tahmoor Colliery where such a system has been used for some years for coal from the same seam.

3.6.3 Refuse Disposal

As indicated in Section 3.6.1, coarse rejects from the coal preparation plant will be combined with dewatered tailings and conveyed to a 2000 tonnes bin located adjacent to the coking coal stockpile as shown on Figure 3.4. From the bin, reject will be transported by truck along Stevys Forest Road and Burragorang Road to Brimstone Gully near the Wollondilly Washery for emplacement.

Assuming an average yield of 78% from total coking and steaming coal production, the total annual tonnage of rejects from the Millar Mine will be 440,000 tonnes at peak production. Daily removal of reject from the bin will be necessary.

The long term washery reject emplacement at Wollondilly has been granted development approval from Wollondilly Shire Council. Provision exists for an emplacement at the southern end of an unnamed tributary of Brimstone Creek with a capacity of 16×10^6 cubic metres sufficient to store 25 million tonnes of total reject.

The proposal is the subject of a report (Longworth and McKenzie Pty Ltd, March 1988). This establishes the environmental integrity of the proposed method of construction by progressive uphill emplacement which minimises the active exposed area, and expedites progressive rehabilitation albeit will some construction disadvantages. Adequate provision is made for drainage control based on rainfall intensities for storms with a 100 year recurrence interval. Stability analyses indicate

satisfactory factors of safety under all conditions, including earthquake loadings. Following an archaeological investigation of the site, the Director of the National Parks and Wildlife Service has consented to the destruction of aboriginal relics found thereon and for a salvage operation to be carried out by a qualified archaeologist authorised by the Director and subject to specific conditions of consent.

3.7 COAL TRANSPORT PROPOSAL

Current transport arrangements for the Company's Burragorang coal mines located as shown in Figure 2.3 are given in Figure 2.4. They are described in Section 2.4 and essentially relate to processing of run of mine coal at the Wollondilly Washery and the haulage of product coal by road to Port Kembla via Picton or to Glenlee for transfer to rail for transport to Balmain and Port Kembla for export. Regional coal haulage routes are shown in Figure 2.5.

The Company's preferred future coal transport strategy including for the proposed Millar Mine, closure of the Nattai South Mine, and changes in production from the Brimstone and Oakdale Collieries involves a continuation of its existing transport arrangements to cover an increase in production from 2.2 mtpa to between 3.0 and 3.6 mtpa. Production and road haulage estimates for this scenario are given in Section 5.6.3.

The Wollondilly Washery will continue to be used for processing coal from the Nattai South Mine until mine closure in 1991. It will also continue to be used for processing run of mine production from the Oakdale and Brimstone Collieries, details of which are given in Table 5.10, as well as run of mine production from the initial years of the Millar Mine prior to commissioning of its on-site washery.

Run of mine coal will be road hauled from Brimstone and Oakdale Collieries along Ridge Road and Stevys Forest Road to Oakdale and thence along Burragorang Road to Wollondilly Washery. Millar mine coal will also be hauled along this route until its washery is commissioned.

Product coal will be road hauled from Wollondilly Washery along Burragorang Road back to Oakdale, after which 1.2 mtpa will be road hauled direct to Port Kembla via Picton and the balance will be trucked to Glenlee for transfer to rail to Balmain and Port Kembla. The increased production of 0.8 to 1.4 mtpa will all be directed to Glenlee. Road haulage to Port Kembla will be limited to the current 1.2 mtpa.

On completion of the Millar Mine coal preparation plant, product coal will be road hauled along Stevys Forest Road to Oakdale to join the product stream from Wollondilly for road transport to Port Kembla and Glenlee. Rejects will be road hauled to Brimstone Gully near Wollondilly for emplacement.

Predicted annual truck haul tonnages along each section of road are given in Table 5.11. Local coal transport routes are shown in Figure 5.4. Predicted daily truck movements for coal and reject haulage for maximum production 1984/85 are given in Table 5.16.

Coal traffic generated by the proposed Millar Mine is discussed in Section 5.6.7. Its impacts are analysed in Section 5.6.8 with an identification of measures for mitigating such impacts to acceptable levels. Transport noise, a significant component from road transport of coal, is discussed in Section 4.7. Transport alternatives are examined in Section 6.5. There are no economically viable alternatives to the Company's preferred coal transport strategy.

3.8 WATER MANAGEMENT

3.8.1 Introduction

The objectives of water management will be twofold, these being the provision of consumption requirements and minimising impacts on downstream watercourses. A management proposal is described in the following sections.

3.8.2 Water Demand and Supply

Principal water requirements are:

- . make up water for the coal processing plant;
- . dust suppression on the coal conveying and stockpile areas;
- . fire fighting; and
- . potable supply for bathing and other domestic uses.

Water in the coal preparation plant will be continually recycled in a closed water circuit. Tailings will be dewatered, and based on a feed rate of 500 tonnes per hour, the required water make up is estimated to be 0.5ML per day.

Water for dust suppression will be from sprays located on the outer boundaries of stockpiles, tripper gantries and transfer points. For average conditions, water demand will be about 0.15ML/day and up to 0.3ML/day during strong wind conditions.

Potable water will be made available via a water main connected to the existing town water supply along Stevys Forest Road. When both the mine and coal processing plant are fully operational, the estimated demand will be 0.12ML/day.

Emergency water demand will be provided by two existing 0.38ML tanks located between the coking coal and ROM stockpiles and supplied by the mine water rising main.

A summary of water demands is given in Table 3.3.

TABLE 3.3
WATER REQUIREMENTS

	ML/d
Potable Supply	0.12
Non Potable Supply	
Coal Processing Plant	0.5
Dust Suppression	0.3
Mine Equipment Washdown	0.06
	0.86
Total	0.98

The analysis presented in Section 3.8.4 shows that there is a nett surplus in the site water balance. The total water demand for mine pit head operations is 0.86 ML/day and this will be supplied from the mine water storage dam and sedimentation ponds.

3.8.3 Polluted Water Treatment

Contaminated waters will be generated during dry weather as part of normal operations as well as during wet weather conditions. Catchment runoff from undisturbed areas will be diverted around the mine area into the natural water course of Hurricane Gully while contaminated water will be treated according to the nature of the water source.

The types of polluted waters requiring different levels of treatment and disposal are:

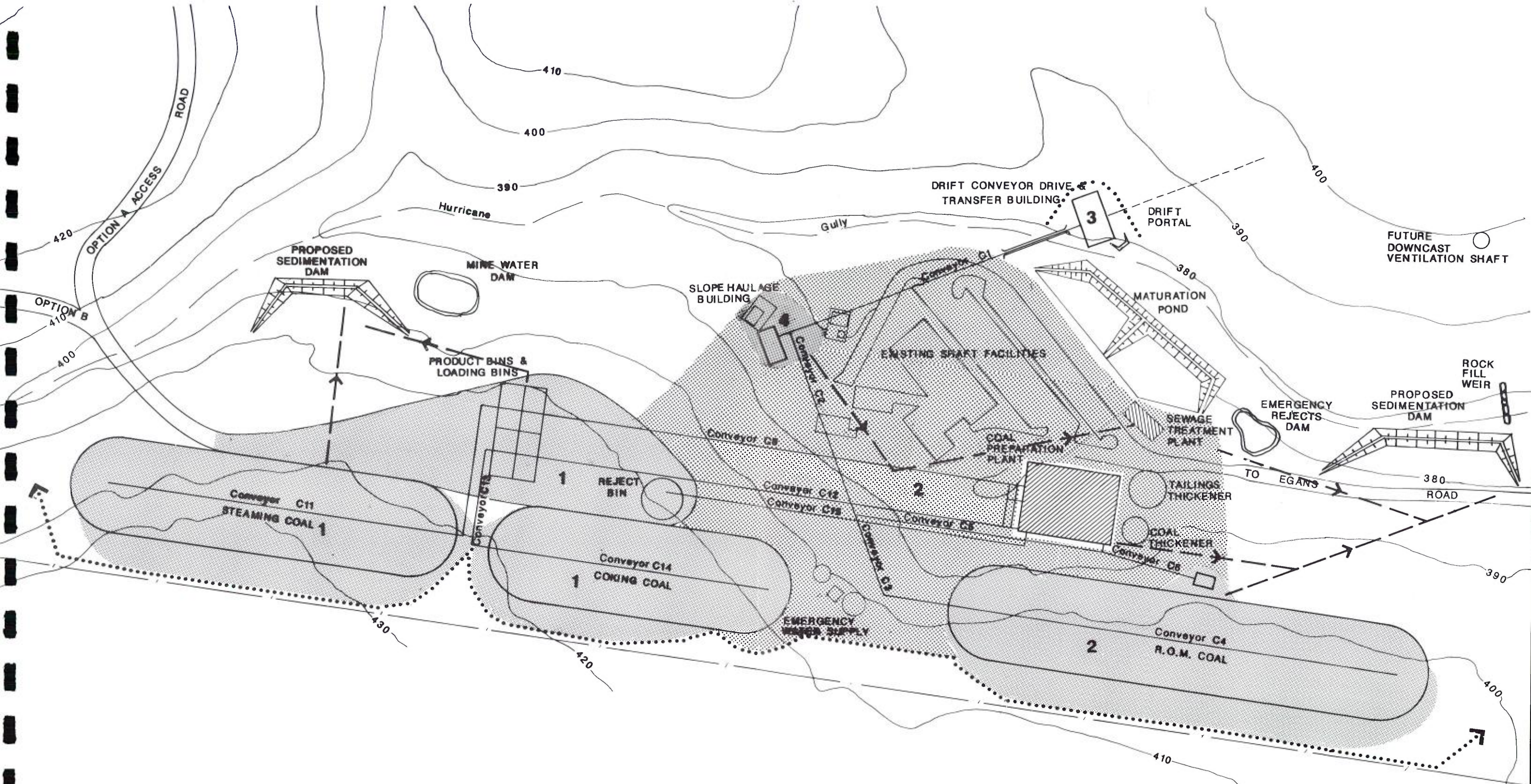
- . runoff from stockpiles, truck loading pad, coal preparation plant, mine portal building, site facilities and under conveyors;

- . runoff from the slope haulage building and mine equipment washdown area;
- . wastewater from the sewerage system; and
- . mine water.

A summary of catchment and storage volumes is given in Table 3.4, and the areas are shown in Figure 3.12.



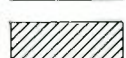
TABLE 3.4
CATCHMENT AND STORAGE



Catchment Water Yield	Area ² m	Storage Capacity (ML)	Type of Storage
1. product stockpiles, truck loading pad	25010	1.2	Sedimentation Pond (proposed)
2. run of mine stockpile, site facility area	42645	2	Sedimentation Pond (proposed)
3. portal building	565	0.03	Sedimentation Pond (proposed)
4. slope haulage building mine equipment washdown area, sewage from amenities (to include 15 days detention)	1025	1.6	Maturation Pond (existing)
5. mine water	-	1	Storage Dam (existing)



MILLAR COAL MINE

SEDIMENTATION POND CATCHMENTS

-  Coal Stockpiles
Truck Loading Pad
-  Site Facilities
-  Coal Processing Plant

-  Clean Water Catch Drain
-  Underground Pipe
- 3** Catchment Number

MATURATION POND CATCHMENTS

-  Slope haulage & Washdown Area
-  Sewage Treatment Works

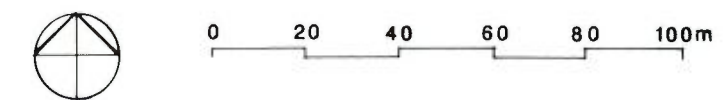


Figure 3.12
WATER MANAGEMENT
 MITCHELL McCOTTER

1. Sedimentation Ponds (Catchments 1, 2 and 3)

Surface rainfall from the stockpiles, truck turning pad, portal building area and coal preparation plant will be collected via catch drains and directed to sedimentation ponds via grit sumps and underground pipes with a minimum gradient of two percent. The existing site facilities catchment and areas under conveyors will drain directly to sedimentation ponds.

Sedimentation ponds will have sufficient volume to cater for a 1 in 10 year, 1 hour duration storm with additional storage provided for the accumulation of silt. It is assumed that all runoff is harvested and that the coefficient of runoff is 1.0. Water from these ponds will supplement demand for dust suppression or provide make up water to the coal preparation plant as estimated from the water balance given in Section 3.8.5. However, these ponds will be empty for much of the time so that the effectiveness of the ponds in trapping sediment during the design storm will not be diminished. The 1 in 10 year, 1 hour duration storm at Oakdale is about 44mm/hour (refer to S.4.5, Figure 4.5) and from catchment area data given in Table 3.4, the required storage volumes for sedimentation ponds in catchments 1, 2 and 3 are 1.2ML, 2ML and 0.03ML respectively.

Three sedimentation ponds will be provided. The product stockpiles and truck turning pad in catchment 1 will drain into a 1.2ML pond located north west of the product bins and a 2.0ML pond will accept runoff from catchment 2 which consists of the run of mine stockpile, coal processing plant and the existing site facilities (including under conveyors). This pond will be situated north east of the run of mine stockpile. In addition, a small sedimentation pond of approximately 0.03ML will cater for contaminated runoff from around the portal building.

2. Maturation Ponds (Catchment 4)

Catchment 4 incorporates the mine equipment washdown bay and slope haulage building. Drainage will be potentially more contaminated due to high levels of suspended solids and quantities of oil and grease.

Water from these areas will drain to a grit trap which overflows to a collection sump. Water will then be pumped to an oil separator and then drained to the sewerage system. Collected oil will be retained in a separator storage tank. Should flows occur in excess of the system capacity, then discharge is via a baffled overflow to the stockpile sedimentation pond east of the ROM stockpile.

Washdown runoff is estimated to be about 0.06ML/day and sufficient storage will be provided in the existing maturation ponds. Discharges from the pond to spray irrigation areas will be controlled by a baffled underflow/overflow weir to retain any oil.

Wastewater from the amenities and office block will total approximately 43,000 litres/day and will be treated on site by a package sewage treatment plant. For discharge into Hurricane Creek, the State Pollution Control Commission effluent requirements are 10ppm Biochemical Oxygen Demand (BOD) and 15ppm Suspended Solids (SS). Alternatively, partial treatment of sewage with up to 100ppm SS may be spray irrigated onto neighbouring land. It is anticipated that effluent will remain in the maturation ponds for 15 days before being spray irrigated.

The existing storage capacity is 0.9ML and this will be enlarged to 1.6ML to provide for a 15 day detention period for catchment 4 runoff and wastewater production.

3. Mine Water Storage (Pond 5)

Underground water originates from the existing Oakdale Colliery and is presently being pumped to two small sedimentation ponds, north west of the product bins, at a rate of 2.2 ML/day. These will be extended to a

new 1ML dam which will act as a sedimentation and storage dam with overflows discharged to Hurricane Creek. This will be the main water source for dust suppression, water make-up for the coal processing plant, and as an emergency fire fighting supply.

3.8.4 Water Balance

From the previous sections, the total water demand is 0.86ML/day for mine operations and 0.12ML/day for potable use. Water for mine operations will be supplied from the mine water storage dam and supplemented from sedimentation ponds. The mine storage dam will have a capacity of 1ML which will be supplied by mine water being pumped from the existing colliery at the rate of 2.2ML/day. The sedimentation ponds will be designed for a 1 in 10 year, 1 hour duration storm which gives a total storage volume of 3.2ML.

To check whether a water surplus or deficit occurs during different meteorological conditions, a comparison has been made between available pit head water demands and annual water yields for dry, average and wet years. The annual yields have been estimated from the following information:

. Rainfall and Evaporation

There are 82 years of rainfall data available for the nearest meteorological station which is located at Picton. A frequency analysis has been used to estimate the annual rainfalls for dry, wet and average years. In the analysis, rainfall ranges were estimated by fitting a log Pearson type III distribution to the available data. The following annual rainfalls with a 90% confidence range have been estimated:

- . dry year 270 to 390 mm, mean 320 mm;
- . average year 710 to 840 mm, mean 775 mm; and
- . wet year 1250 to 1580 mm, mean 1415 mm.

Dry, average and wet years have been defined as:

- . dry year, an annual rainfall which has a probability of exceedance of 90%;
- . average year, an annual rainfall which has a probability of exceedance of 50%; and
- . wet year, an annual rainfall which has a probability of exceedance of 10%.

From Table 3.5, the mean annual evaporation is 1506 mm. Catchment data is given in Table 3.4 and annual yields in Table 3.5.

TABLE 3.5
ANNUAL YIELD

Catchment	Annual Catchment Yield (ML)		
	Dry Year	Average Year	Wet Year
1	8	19	35
2	14	33	60
3	0.2	0.4	0.8
4	0.3	0.8	2
Minewater	803	803	803

Comparison of the yields with the pit head operation demands of about 314ML/year indicates that water supply will be almost entirely from the minewater storage dam, leaving sedimentation ponds empty for much of the time. The sedimentation ponds will, then, effectively operate in retaining sediment from a 1 in 10 year, 1 hour storm while an adequate water supply is available from the minewater storage dam.

3.9 LANDSCAPING AND REHABILITATION

3.9.1 Objectives

The objectives of landscaping and rehabilitation proposals are two fold:

- . retention as near as possible of the form, line, colour and texture of the natural landscape; and
- . stabilization of slopes and prevention of erosion.

All plant species used in landscape works will be selected from native vegetation at the site. During the initial stages of development, local species will be harvested to obtain a seedstock for future rehabilitation work. Seeds and/or tube stock of identified local species will be obtained from commercial suppliers, if available, to augment the harvested stock.

3.9.2 Landscaping Procedures

(i) Preliminary Works

. Clearing

Prior to clearing, timber suitable for such uses as fence posts will be selectively removed. Remaining timber will be cleaned, windrowed, and the surplus removed from site or burned in accordance with the requirements of the local bushfire brigade.

. Topsoil

Topsoil will be stripped, stockpiled and reused prior to revegetation.

. Erosion Control and Surface Preparation

Short contour banks will be incorporated where necessary to prevent erosion. These will discharge into stable outlet points such as ponds or areas of native vegetation. The surface will be left uncompacted before topsoiling material is applied.

(ii) Landscape Works

- . cut and fill batters will be hydroseeded and planted with tube stock at 3 metre centres. This will effectively separate stockpiles and the coal preparation plant from the surrounding landscape;
- . all circulation routes and vehicle work areas will be suitably screened;
- . areas not required for process operations will be landscaped;
- . all buildings, conveyors and structures will be painted olive green to minimise visual contrast with surrounding forest; and
- . tree planting along the southern edge of the stockpiles will serve as a visual screen from adjacent pastures.

3.10 ENVIRONMENTAL MANAGEMENT

The Company has adopted a policy of incorporating appropriate environmental safeguards in its proposals for the design and operation of the proposed Millar Mine. This includes for development of the pit head site and transport of coal and reject material therefrom as well as for the development of the mine itself.

Issues for particular attention relate to:

- . minimisation of water pollution, dust generation, and control of noise for the construction and operation of the pit head facilities as well as rehabilitation of the land affected thereby;
- . appropriate controls for transport of coal and reject material from the site with particular regard for noise generation and traffic safety with respect to local residents along the haulage routes, as well as dust emissions with respect to local residents and the local orchard industry; and
- . subsidence effects of mining within the coal lease area.

In addition, to ensuring the efficacy of pollution controls for the design of the development, environmental management will require provisions for monitoring, maintenance and control of the ongoing operation of the mine both at the pit head, along the transport routes and in the mine. For this purpose, the Company will appoint an officer with responsibilities for ensuring effective control of operations subsequent to the commissioning of the mine.

The location of the pit head facilities in the vicinity of Oakdale No. 3 shaft and the headwaters of Horse Creek is within the Warragamba Catchment area proclaimed under S55 of the Metropolitan Water Sewerage and Drainage Act, 1924. Accordingly, the potential effect of the mine's surface facilities on water quality within the catchment area is an important consideration requiring the maintenance of adequate safeguards for water discharges incorporated in the development and monitoring of the quality of receiving waters. Matters relevant to effective environmental management of the site in this regard relate to sewage treatment, including subsequent maturation and spray irrigation of effluent, direction and discharge of contaminated wastes from sedimentation ponds, and discharge of mine waters. An appropriate and regular monitoring programme of receiving waters will be established in

conjunction with the Water Board and State Pollution Control Commission for this purpose.

Likewise, appropriate inspection and monitoring programs for noise and dust generation from operations at the pit head facilities and from traffic generated by the mine will be established. Having regard for the increase in truck traffic particularly on Stevys Forest Road, every effort will be made to ensure strict adherence to permissible truck traffic times, speed limits and the covering of loads.

With regard to the underground coal mining operations, these are controlled by the provisions of the Coal Mines Regulation Act, 1982 which contains a comprehensive set of statutory controls to assist in achieving a safe working environment. The Act and associated regulations makes the mine manager ultimately responsible for the overall safety of the mine. The manager is assisted by the appointment of undermanagers, who have line responsibility for mine environmental and safety factors such as dust sampling, fire control and ventilation. A designated safety officer is proposed to be employed to assist production officials in achieving safe working conditions. A comprehensive training scheme will be undertaken as appropriate in accordance with order No. 34 of the Joint Coal Board. Statutory requirements for failsafe communications, gas monitoring systems, fire fighting and first aid stations will all be met. Gas monitoring, stone dusting and the provision of adequate support for strata control will all be employed.

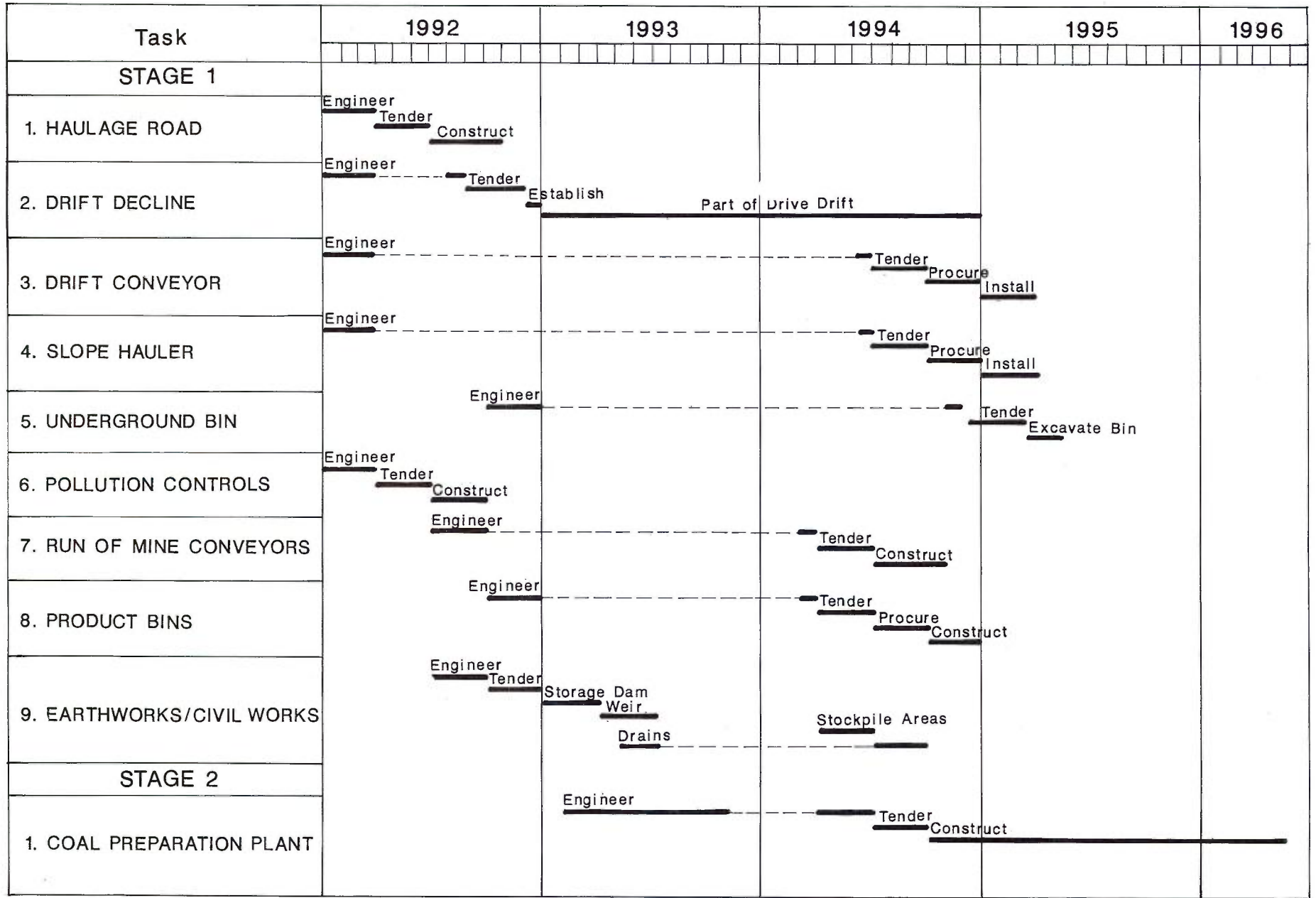
Subsidence monitoring will be included within the Company's operational program requirements as discussed in Section 4.10.

3.11 DEVELOPMENT PROGRAMME

Development of the mine will proceed as shown in Figure 3.3. The development program for the establishment of the pit head facilities is given in Figure 3.14. This is in accordance with the anticipated coal production schedule for the Company's Burragorang Valley mines contained

DEVELOPMENT PROGRAM

Figure 3.13



in Table 11 which indicates initial production from the Millar Mine commencing in 1992/93 at a rate of 500,000 tpa. The Company proposes to re-open the Oakdale No 3 facility for man access in July 1989 to reduce travel time to the work force.

It will be noted that development of the pit head facilities will take place in two stages. Stage 1 will consist of construction of access to the site via the proposed haul road, the materials decline drift, drift conveyor drive and transfer building, the slope haulage building, conveyors and coal handling facilities, stockpile areas for run of mine and product coal and product bins, etc as well as pollution control facilities as shown in Figure 3.4. Stage 2 will follow eighteen months later and include for construction and commissioning of the coal preparation plant and associated facilities.

Stage 1 will provide for transport by road of run of mine coal to the Wollondilly Washery for coal preparation and export. Stage 2 will provide for coal preparation on site, transport of rejects to Wollondilly, emplacement and the transport of product coal to Glenlee and Port Kembla.

3.12 ENERGY STATEMENT

3.12.1 Introduction

An energy statement for a coal mine consists of two main elements, an energy balance and an estimate of the efficiency of energy recovery.

An energy balance compares the energy content of the mine product with the energy input required to extract and process the coal. While energy balances are applicable to major energy consumers such as smelters, they are probably less relevant to a coal mine. This is because the energy output of a colliery is usually about two orders of magnitude higher than total energy input.

THAN

The efficiency of energy recovery compares the total energy recovered with total insitu energy reserves. It also indicates how much energy has been unavoidably lost through both the mine plan and the methods selected to extract the resource.

3.12.2 Energy Balance

. Energy Production

The total remaining recoverable reserves of Oakdale Colliery amount to 51.5 million tonnes of which about 70% or 36.1 million tonnes are located within the proposed Millar Mine.

Taking into account the two years required to commission the mine after development consent and achieve target raw coal production of 2.0 mtpa, this quantity of coal will be extracted over the 21 year period for which development consent is being sought. Over this period, total saleable coking coal production is estimated to be 23.4 million tonnes and total saleable steaming coal production is 5.1 million tonnes, a total of 28.5 million tonnes.

Assuming a specific energy of 31.0MJ/kg for coking coal and 28.5MJ/kg for coking coal, the total energy output from the first 21 years of coal production will be 8.71×10^{17} Joules.

. Energy Consumption

Production of coal will require the consumption of energy in the form of electricity, petroleum products and explosives.

Petroleum products consumed, shown in Table 3.6, will have an approximate energy equivalent of 7.41×10^{12} Joules per annum. Over 19 years of mining, total energy consumption from petroleum products will be 141×10^{12} Joules.

TABLE 3.6
ESTIMATED AVERAGE ANNUAL CONSUMPTION OF PETROLEUM PRODUCTS

User	Volume per annum (Kl)	Energy Equivalent *(Jx10 ¹²)
Distillate	96	3.72
Oil and Grease	90	3.69
Total	186	7.41

Key: * Specific energy for distillate is 38.7MJ/L and 41.0MJ/L for oils and greases

Electricity consumption is estimated to average 36 million kWh or 130×10^{12} Joules per annum. Over 19 years of mining, about 2470×10^{12} Joules of electricity will be used.

Energy used in explosives will mainly be limited to gaining entry to the underground workings through rock encountered in the initial entry and the inclined drifts to the coal seam. The amount used is difficult to calculate, but in any case will be small compared with petroleum and electricity consumption. It has therefore been excluded from the overall energy balance.

Likewise, energy will be used in the initial establishment of the mine site facilities and infrastructure. However, this will also be small compared with energy consumption in the continuing operation of the mine. Accordingly, it has therefore been excluded from the overall energy balance.

The total energy input for the development is therefore estimated to be about 2.61×10^{15} Joules. This covers the main energy requirements of the mine up to the point where coal leaves the site.

. **Nett Energy Balance**

Nett energy inputs and outputs are summarised in Table 3.7. This shows that total energy required to extract and process the coal represents about 0.30% of the total energy output of the mine.

TABLE 3.7
NETT ENERGY BALANCE
(J x 10¹⁵)

Energy Output	871
Primary energy inputs:	
. Petroleum products	0.14
. Electricity	2.47
Total Energy Input	2.61

3.12.3 Efficiency of Energy Recovery

. **Proposed Mine**

Over the nineteen years of mining relevant to the period for which development consent is being sought for the Millar Mine, in-situ reserves are estimated at 58.1 million tonnes, of which 36.1 million tonnes are recoverable and 28.5 million tonnes are saleable. The energy recovery for the mine for the period of development consent is summarised in Table 3.8. This shows that efficiency of energy recovery is 58.7% based on insitu reserves, and 94.6% on recoverable reserves.

In determining the mineable insitu reserves, a minimum seam working thickness of 1.5 metres was established and recoverable reserves were determined from the formulation of the mining plan and the accessibility it provides to the mineable working seam.

TABLE 3.8
ENERGY RECOVERY FROM MILLAR MINE

	Insitu	Reserves	Saleable		Total
		Recoverable	Steaming	Coking	
Tonnage (tonnes x 10 ⁶)	58.1	36.1	5.1	23.4	28.5
Specific Energy (MJ/kg)	25.5	25.5	28.5	31.0	
Total Energy (Joules x 10 ¹⁸)	14.81	9.20	1.45	7.25	8.70

Alternative Recovery Options

The number of alternative ways of recovering the coal reserves in the Millar Mine area is limited. Because of the depth of the deposit in the Bulli Seam, the coal deposit only lends itself to underground extraction. 36.1 million tonnes of recoverable reserves are available for extraction using short longwall mining technology and continuous mining methods as discussed in Section 3.4. This combination of mining methods is the best technique available to achieve an economically viable mine to maximise recovery of the resource.

Options for obtaining entry to the coal seam, appropriate sequencing of panel removal, and pattern of transport to and from the surface of the mine have been examined. The proposed mine development with entry location adjacent to Stevys Forest Road represents the optimal solution for such mining parameters.

4.1 TOPOGRAPHY

The proposed Millar Mine site is located near the eastern limit of the Burraborang Tableland. The mine entry and associated facilities, are located some 800 metres east of Stevy's Forest Road, within Hurricane Gully. The topography at this site is predominantly hilly with slopes generally between 10 and 20%. However, adjacent to this site, steeply sloping land (>30%) and gently sloping land (<5%) exists.

The topography of the proposed underground mine area is influenced by the general decrease in elevation which exists in an easterly direction. The surface gradients within this mine area vary between gently sloping along ridgelines and major creek beds to hilly and steeply sloping on sideslopes and within small gullies and streams. To the north, sideslopes and gully gradients tend to increase.

4.2 CLIMATE

4.2.1 Data Sources

The majority of climatic data used in this study was obtained from the Bureau of Meteorology station at Picton, approximately 16 kilometres south-east of the proposed Millar Mine site. There is also a climatic station at Camden. However, these data have not been used due to topographical differences.

Rainfall (1880-1986) and temperature (1976-1986) measurements were supplied from the Picton meteorological station. Percentage occurrence of wind speed versus direction, for the period 1965-1975 was also available from this station. Pan evaporation (1968-1983) values for the Oakdale area are assumed to be similar to Badgerys Creek, approximately 30 kilometres to the north-east.

4.2.2 Rainfall and Evaporation

(i) Rainfall

The monthly and annual rainfall totals, as well as the number of rain days for the period recorded at Picton, are shown in Table 4.1.

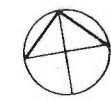
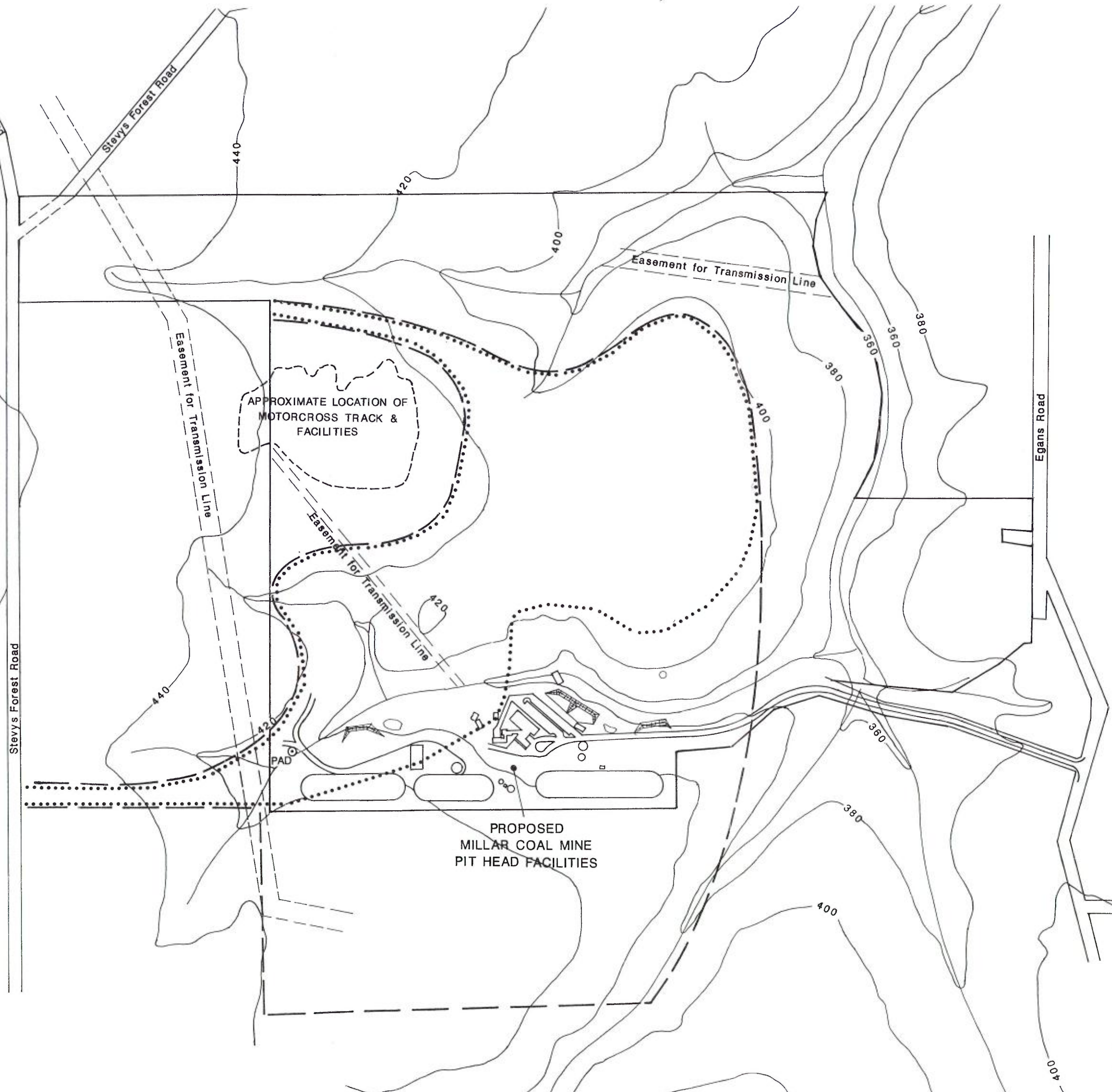
TABLE 4.1
MONTHLY RAINFALL MEASUREMENTS AND RAIN DAYS FOR PICTON
(1880-1986)

Median	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Rainfall													
(mm)	73	66	69	56	32	44	26	25	37	49	55	55	761
Mean													
Rainfall													
(mm)	90	87	88	72	59	67	51	45	45	64	72	73	813
Mean Rain													
Days No.	9	9	10	8	7	7	7	7	7	9	9	9	98

The above data show that there is clearly a seasonal factor in the distribution of annual rainfall, with a greater proportion occurring during the summer months and immediately preceding summer. The minimum totals are generally recorded in the winter months with intermediate values spread over the remaining months. The relatively larger differences between mean and median values from May through August reflect the less frequent rain episodes which occur during this time of the year.

MILLAR COAL MINE

- Flora & Fauna Survey Boundary
- Archaeological Survey Boundary



0 100 200 300m

Figure 4.1
PITHEAD SITE & TOPOGRAPHY
MITCHELL McCOTTER

(ii) Evaporation

Evaporation was measured using a US Class "A" pan above the ground at the Badgerys Creek Climatic Station. The monthly evaporation totals are presented in Table 4.2.

TABLE 4.2
MEAN MONTHLY EVAPORATION OF BADGERYS CREEK
(1968-1983)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean (mm)	183	151	139	105	68	51	65	93	123	152	171	205	1506
Median (mm)	177	150	144	105	67	51	62	88	118	149	159	200	1470

The evaporation figures measured at Badgerys Creek are approximately the values that would be expected at the proposed colliery. This is because these two locations have similar temperatures and available energy, which are major controls on evaporation.

These aforementioned rainfall and pan evaporation results are used in the mine water management programme, discussed in Section 3.8, and are also useful for determining appropriate rehabilitation procedures.

4.2.3 Temperature

The mean monthly values of daily maximum and minimum temperatures measured at Picton, are shown in Table 4.3.

TABLE 4.3
 MEAN MONTHLY TEMPERATURES FOR PICTON
 (1976-1986)
 (°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean													
Daily	28.1	27.8	26.5	23.7	19.9	17.2	16.9	17.8	20.6	23.1	24.9	27.3	22.8
Maximum													
Mean													
Daily	15.0	15.3	13.1	9.0	5.5	3.6	1.3	3.1	5.3	9.1	11.1	13.6	8.8
Minimum													

Hot conditions occur during the summer months with temperatures in excess of 34°C being recorded on occasions. The maximum recorded temperature is 46.7°C, with the highest temperature generally from mid January through to March. Minimum temperatures occur during the winter months with ground frost being quite frequent between May and September and sometimes severe during July and August.

Temperature measurements at Picton are taken at an elevation of RL171 metres, the approximate elevation at the proposed mine site is RL390 metres. Because temperatures generally decrease with elevation, at a rate of 5°C/km (Linacre E and Hobbs J., 1977), the estimated temperatures at the proposed site would be 1°C below the averages shown in Table 4.3.

4.2.4 Wind Regime

Information on wind patterns in the Oakdale area was obtained from the meteorological station at Picton. A seasonal breakdown of wind speed and direction was calculated from the meteorological data, and is

summarized in Table 4.4. Seasonal and annual wind roses are provided in Figure 4.2.

In general, annual wind directions tend to be predominantly south to southeasterly, at speeds of less than 20 km/hr. In winter, wind speeds tend to be south-southwesterly, with calms occurring 38% of the time. Summer winds are predominantly south-southeasterly, with calms occurring 26% of the time.

Northerly winds dominate in spring, but southerly and westerly winds also frequently occur. Spring wind speeds are the highest of the year, with calms occurring 25% of the time.

TABLE 4.4
SUMMARY OF WIND DATA FOR PICTON
WINTER (JUNE, JULY, AUGUST)

	1-5	6-10	11-20	21-30	31-40	41-50	>50	km/hr	ALL %
N	2	1							3
NE	1								1
E	1	1							2
SE	1	2	3	1	1				8
S	2	4	3	1					10
SW	1	3	5	3	1				13
W	3	4	6	3	1				17
NW	2	2	3	1					8
ALL	13	16	21	9	3				

Calm = 38

SPRING (SEPTEMBER, OCTOBER, NOVEMBER)

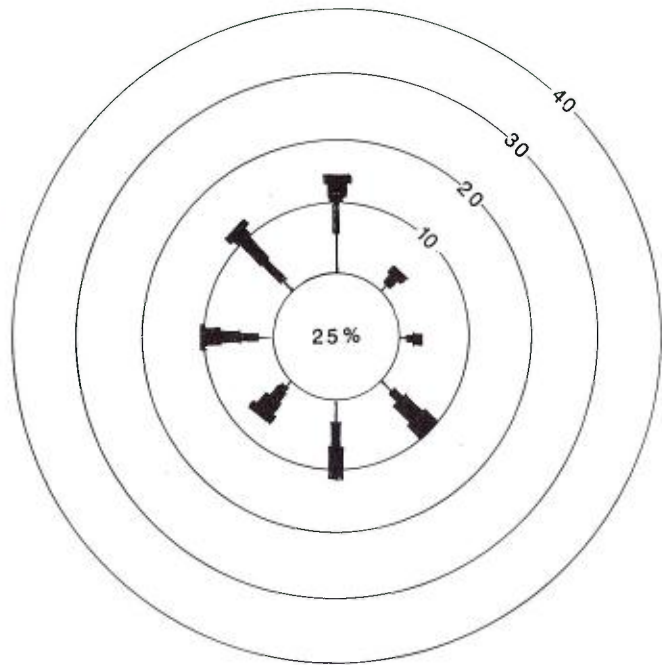
	1-5	6-10	11-20	21-30	31-40	41-50	>50	km/hr	ALL %
N	6	4	2	2	1				15
NE	1	2	1						4
E	1	1	1						3
SE	2	2	4	2					10
S	3	4	5						12
SW	1	1	2	2	1				7
W	2	3	3	2	1				11
NW	2	4	4	2	1				13
ALL	18	21	22	10	4				

Calm = 25

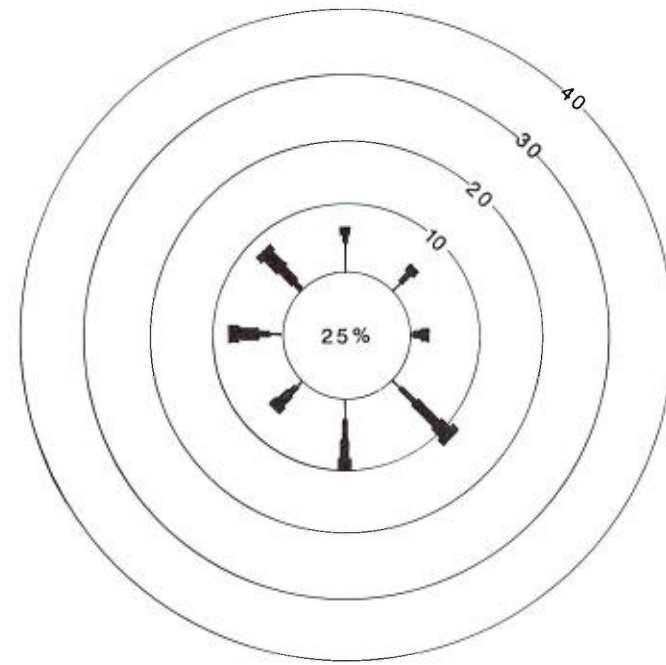
SUMMER (DECEMBER, JANUARY, FEBRUARY)

	1-5	6-10	11-20	21-30	31-40	41-50	>50	km/hr	ALL %
N	4	4	2	1					11
NE	2	3	3	1					9
E	2	1	1						4
SE	2	5	7	1	1				16
S	3	4	4	2	1				14
SW	1	1	1	1					4
W	1	1	1						3
NW	2	4	5	2					13
ALL	17	23	24	8	2				

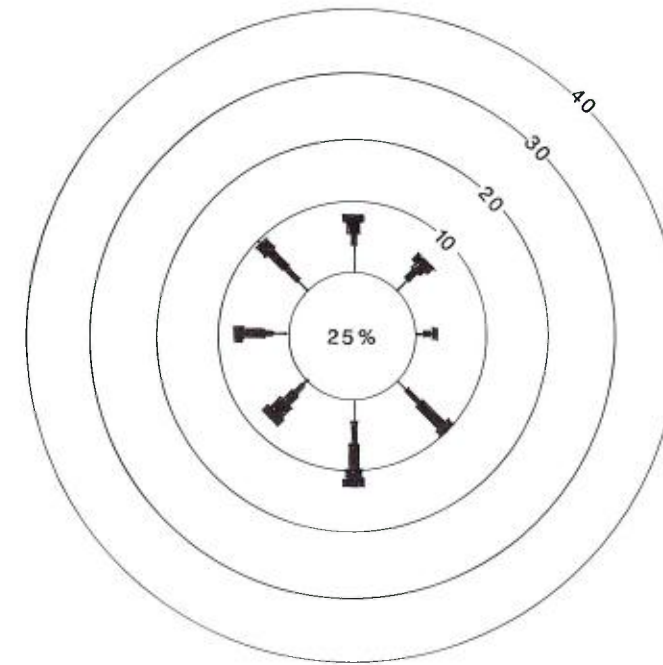
Calm = 25



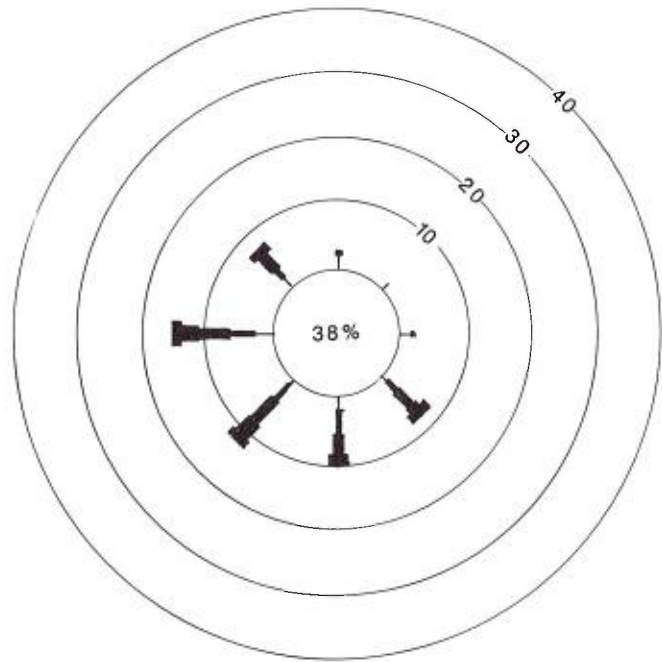
SUMMER
(Dec, Jan, Feb)



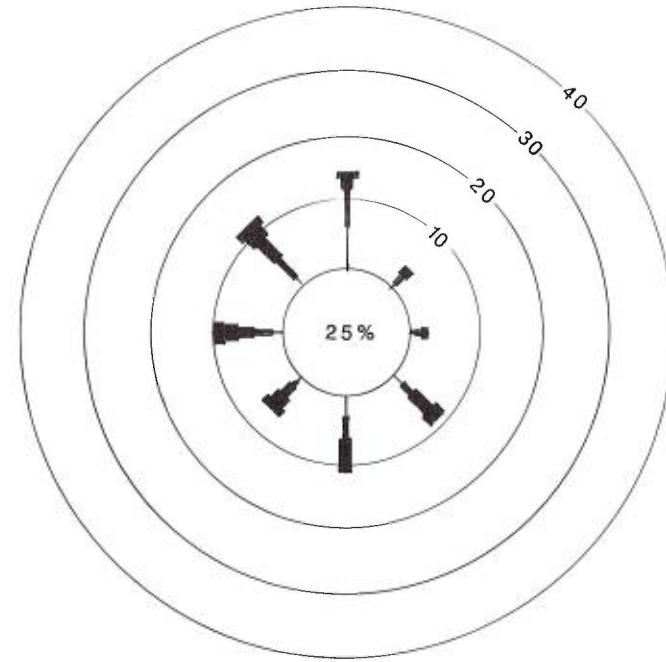
AUTUMN
(Mar, Apr, May)



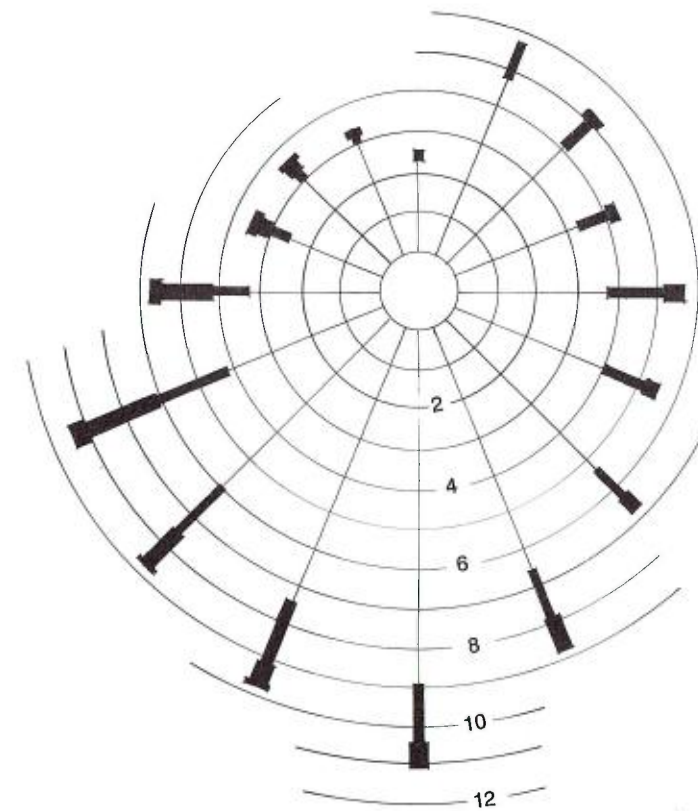
ANNUAL AVERAGE



WINTER
(Jun, Jul, Aug)



SPRING
(Sep, Oct, Nov)



1.5-3.4 5.4-8.5
<1.5 3.4-5.4 >8.5
WIND SPEED m/s

Represents a 1% frequency interval

BUREAU OF METEOROLOGY PICTON (1965-75)

% CALMS 1-5 6-10 11-20 21-30 >30
WIND SPEED KM/HR

10 Represents a 10% frequency interval

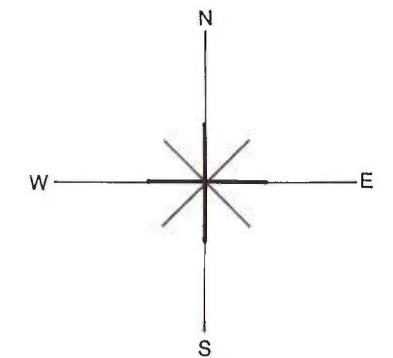


Figure 4.2

WIND ROSES

Note: Annual Wind Rose based on Continuous Wind Data at Camden from 1974 to 1976 (Macquarie University) Used for Dust Modelling Predictions Section 4.8

AUTUMN (MARCH, APRIL, MAY)

	1-5	6-10	11-20	21-30	31-40	41-50	>50	km/hr	ALL %
N	5	1	1						7
NE	2	2	1						5
E	1	1	1						3
SE	2	3	5	2	1				13
S	3	3	3	1	1				11
SW	1	2	2	1					7
W	2	2	3	1					8
NW	2	3	3	1					9
ALL	18	17	19	6	3				

Calm = 25

ANNUAL AVERAGE

	1-5	6-10	11-20	21-30	31-40	41-50	>50	km/hr	ALL %
N	4	2	2	1					9
NE	2	2	1		1				6
E	1	1	1						3
SE	2	3	5	1					11
S	3	4	4	1	1				13
SW	1	2	2	2	1				8
W	2	2	3	1					8
NW	2	3	3	2					10
ALL	17	19	21	8	3				

Calm = 25

4.3 SOILS

4.3.1 Introduction

The primary soil types in the study area shown in Figure 4.3 are derived from the Wianamatta Group and Hawkesbury Sandstone. Soils developed over the Wianamatta shale parent material are restricted to the mid and lower slopes and gradients <10%, while soils found over Hawkesbury Sandstone are confined to steeper slopes and gullied areas throughout the study area.

4.3.2 Survey Methodology

Field sampling was undertaken to determine, the distribution of soils within the study area. Information from the Soil Conservation Service (SCS) Soil Landscape Unit Maps was incorporated with this field data to distinguish representative soil types and their physical properties. These were classified by the Northcote Key into primary profile forms.

4.3.3 Soil Types









Soils formed over Wianamatta Shale are deep, with a friable loam to clay loam texture. They are dark to very dark brown in colour, with pH values ranging from 4.0 to 6.0. Clay is distributed throughout the profile, with content generally increasing with depth. This soil type corresponds to the Dr soils of Northcote, and is classed as a Blacktown Soil Landscape Unit by the SCS.

These soils are generally distributed along the margins of the study area. Their relatively high fertility and loamy texture renders them excellent for intensive cultivation. Because their distribution is in areas of low slope gradient, erosion hazard is minor, and limited only to sheet and gully erosion in isolated areas.

The soils formed over the Hawkesbury sandstone parent material are located along rugged rolling and very steep terrain, near the Nattai

MILLAR COAL MINE



-  Blacktown Soil Landscape
-  Lucas-Heights Soil Landscape
-  Hawkesbury Soil Landscape
-  Gynea Soil Landscape
-  Falconbridge Soil Landscape
-  Glenorie Soil Landscape
-  AB Soil Landscape
-  Proposed Millar Coal Mine Pithead Facilities



0 0.5 1km

Figure 4.3
SOILS

Colliery and extending north and south along Horse Creek. These soils are very shallow, discontinuous lithosols, with regular bedrock outcrops. They are composed of grey-brown loose, coarse, dry sand, with sand to sandy loam textures and single-grained, loose structure. The pH ranges from 4.0 to 5.5

In areas of gently sloping topography, soils are generally deeper, with clay content increasing to give subsoil textures ranging from light, sandy clay loams to medium clays. The predominance of clays indicates soil development over shale lenses that are present in the sandstone.

These soils have a very low fertility. They are generally covered by native bushland, and are not utilized for agricultural purposes. Erodibility is moderate to high, due to development along steep slopes. Vegetation removal results in severe sheet erosion in many instances, particularly of the sandy topsoils.

This soil type corresponds to the Uc soil of Northcote, and the Hawkesbury Soil Landscape Unit of the SCS.

The third major soil type present in the area is moderately deep, consisting of dark brown, loose, sandy loams, often over yellow pedal clay, or sandy apedal clay loam subsoils. These soils occur as an intermediate soil type between the shallow, sandy Hawkesbury Soil Unit and the deep, clay Blacktown Soil Unit. They are located to the west of the Hawkesbury Soils, in areas with undulating topography. Erosion hazard is moderate in most cases, although the sandy topsoils and sandy clay loams are highly erodible, due to easily detachable sand grains. These soils are generally covered by native bushland, although soils developed over occasional shale lenses present within this group may support intensive cultivation. This soils type is classified as Dy by Northcote, and the Lucas Heights Soil Landscape Unit by the SCS.

4.4 FLORA AND FAUNA

4.4.1 Introduction

A field survey of flora and fauna (Mills, 1988) was undertaken as part of the environmental studies for the proposed pit head, coal handling and washery facilities of the Millar Mine. The aim of the study was to:

- . describe the vegetation of the survey area and prepare a map of the vegetation communities;
- . prepare a list of the plants recorded in the survey area;
- . assess the fauna and fauna habitats found in the survey area;
- . identify any features of conservation importance in the survey area; and
- . make recommendations to lessen the impact of the proposed facilities on the flora and fauna.

4.4.2 Environmental Setting of Survey Area

The survey area is situated to the north and south of the existing Oakdale Colliery No. 3 Shaft as shown in Figure 4.1. It is located at an altitude of 420 metres in the catchment of Monkey Creek which drains north into Warragamba Dam.

The site is located on Hawkesbury Sandstone, in dissected country on the south-western edge of the Cumberland Plain. The finer grained Wianamatta Group sediments overly the sandstone and occur on the flatter topography surrounding the survey area. The vegetation which once grew on these soils has largely been cleared and the area is now used for orchards and other agricultural pursuits. Gullies to about 40 metres deep occur in the vicinity along Hurricane Creek, Horse Creek and the unnamed creek to the north of the site, the waters from which flow into

Monkey Creek which then flows into Lake Burragorang. These gullies are on the Hawkesbury Sandstone and contain some deeply entrenched, cliff-lined gorges. Most of the survey area consists of a relatively flat ridge top, composed mainly of Hawkesbury Sandstone with some Wianamatta Group soils in the extreme south-west.

4.4.3 Survey Methodology

Field investigations were undertaken late in 1988 within the survey area. Vegetation communities were identified in the field when a detailed plant species list was prepared. Features were identified for field investigation with the aid of aerial photographs and topographic maps.

Attention was paid to locating and then assessing plant species and vegetation communities of special conservation significance. Additional time was allocated to locations and communities likely to support rare or threatened plant species. Nearly all of the survey area was visited on foot.

4.4.4 Vegetation of the Survey Area

Plant Species

A list of the plant species recorded in the survey area was compiled during the course of the field study. This is provided in Appendix 1, which also indicates the family to which the species belong. The plant species list does not include all of the native grasses, because of difficulty with positive identification. Plant species names generally follow Jacobs and Pickard (1981), except for a few recent taxonomic changes; for ferns, Beadle et al. (1982), was used.

Many exotic (introduced) plant species occur in the vicinity of the survey area. As this study is primarily concerned with native vegetation, no detailed research for exotic species was undertaken. However, if these species were encountered and were readily

identifiable, their presence was recorded and they were included on the plant species list.

Vegetation Communities

Four vegetation communities were identified in the survey area. These are summarised in Table 4.5 and are described below in terms of their structural and floristic characteristics. They are classified using the terminology of Specht (1981) and the dominant tree species. This structural classification system is outlined in Appendix 2.

Each community in the survey area is described below according to the community name, structure, geology/soils, description and characteristic species. The distribution of the vegetation communities in the survey area is shown on the vegetation map in Figure 4.4.

Community 1: Eucalyptus piperita - Angophora costata Tall Open Forest/
Ceratopetalum apetalum Closed Forest (Rainforest)

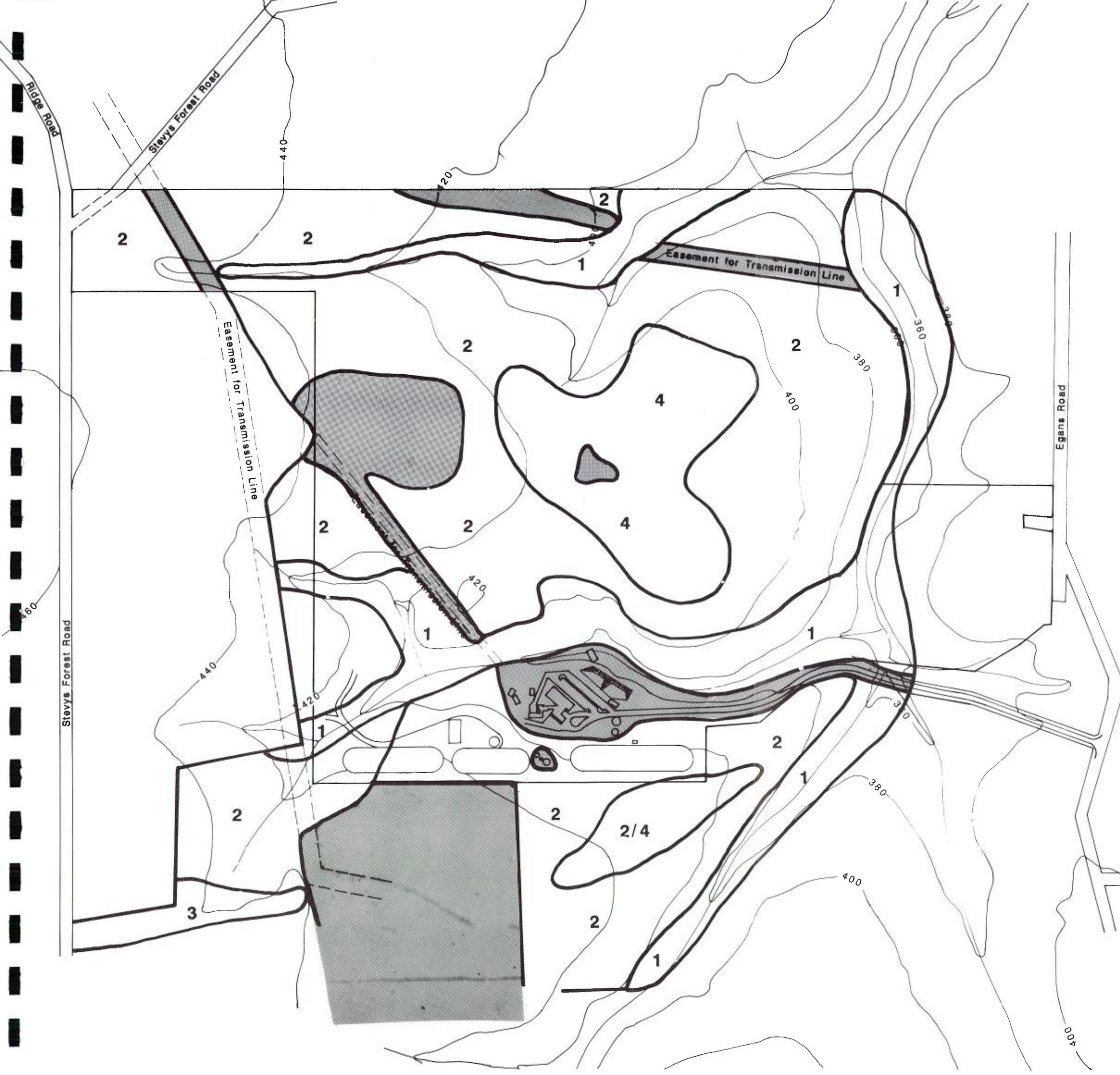
Structure: Tall open forest about 30 to 35 metres tall, with a closed to open forest understorey about 10 to 18 metres tall. Rainforest occurs along many of the gully bottoms in this community.

Geology/Soils: Deep gullies and gorges on the Hawkesbury Sandstone, on rather deep, moist soils.

Description: The upper canopy is dominated by Eucalyptus piperita and Angophora costata. The middle-canopy is quite dense and is composed of species such as Acacia elata, A. falciformis, Allocasuarina torulosa and rainforest tree species, particularly Ceratopetalum apetalum and Acmena smithii. Other common trees of the gullies include Syncarpia glomulifera, Callicoma serratifolia, Doryphora sassafras, Ceratopetalum gummiferum and Elaeocarpus reticulatus. The

MILLAR COAL MINE

- Community 1 Tall green forest / Closed forest (Rainforest)
 - Community 2 Open forest
 - Community 3 Open forest (Woodland)
 - Community 4 Woodland / Heathland
- For details see Table 4.5
-  Cleared Area



0 100 200 300m

Figure 4.4

VEGETATION DISTRIBUTION

understorey, which ranges from about 2 to 8 metres, is characterised by shrub species which prefer the moist conditions of these gullies. Characteristic species include *Astrotricha latifolia*, *Acrotriche serrulata*, *Logania albiflora*, *Zieria smithii* and some rainforest species. Many fern species occur in the ground cover, particularly in the rainforest patches. Common fern species are *Blechnum cartilagineum* and *Culcita dubia*.

Characteristic Species:	<i>Acacia elata</i>	<i>Culcita dubia</i>
	<i>Allocasuarina torulosa</i>	<i>Cyathea australis</i>
	<i>Acmena smithii</i>	<i>Doryphora sassafras</i>
	<i>Angophora costata</i>	<i>Elaeocarpus reticulatus</i>
	<i>Astrotricha latifolia</i>	<i>Eucalyptus piperita</i>
	<i>Blechnum cartilagineum</i>	<i>Logania albiflora</i>
	<i>Callicoma serratifolia</i>	<i>Syncarpia glomulifera</i>
	<i>Ceratopetalum apetalum</i>	<i>Todea barbara</i>
	<i>Ceratopetalum gummiferum</i>	<i>Zieria smithii</i>
	Community 2:	<i>Angophora costata</i> - <i>Eucalyptus piperita</i> Open Forest
Structure:	Open forest about 20 to 25 metres tall with a generally dense shrub or heath understorey and ground cover.	
Geology/soils:	Gentle to moderate slopes on the Hawkesbury Sandstone.	
Description:	Open forest dominated by <i>Angophora costata</i> and <i>Eucalyptus piperita</i> . Other canopy species occur less frequently in the community. These include <i>Eucalyptus agglomerata</i> , <i>Syncarpia glomulifera</i> and <i>E. eugenioides</i> . <i>Melaleuca linariifolia</i> was found on one moist site. Middle-canopy trees include <i>Exocarpos cupressiformis</i> , <i>Allocasuarina torulosa</i> and <i>A. littoralis</i> . Characteristic shrubs of the	

understorey include *Acacia linifolia*, *Daviesia corymbosa*, *Bossiaea lenticularis*, *Grevillea phyllicoides*, *Persoonia mollis*, *Leptospermum* spp. and *Banksia spinulosa*. Many other shrub species characteristic of the Hawkesbury Sandstone are also present.

Characteristic Species:	<i>Acacia linifolia</i> <i>Acacia myrtifolia</i> <i>Acacia terminalis</i> <i>Angophora costata</i> <i>Banksia spinulosa</i> <i>Bossiaea lenticularis</i> <i>Daviesia corymbosa</i> <i>Dodonaea triquetra</i>	<i>Eucalyptus piperita</i> <i>Grevillea phyllicoides</i> <i>Leptospermum</i> spp. <i>Lomandra longifolia</i> <i>Persoonia mollis</i> <i>Pteridium esculentum</i> <i>Pultenaea villosa</i>
Community 3:	<i>Eucalyptus paniculata</i> - <i>E. punctata</i> Open Forest/Woodland	
Structure:	Open forest or woodland with a rather dense middle-canopy and understorey.	
Geology/Soils:	On the Wianamatta Group soils. This community has largely been cleared from land in the vicinity of the survey area.	
Description:	This community is characterised by a group of species which occur only infrequently on the adjacent Hawkesbury Sandstone. Dominant trees are <i>Eucalyptus paniculata</i> and <i>E. punctata</i> . <i>Acacia mearnsii</i> is a common middle-canopy species. Shrubs are much less common than in the communities on the Hawkesbury Sandstone. Grasses are common in the ground cover of this community, particularly <i>Themeda australis</i> .	

Characteristic Species:	<i>Acacia mearnsii</i> <i>Adiantum aethiopicum</i> <i>Allocasuraina torulosa</i> <i>Bursaria spinosa</i> <i>Clematis aristata</i> <i>Dianella caerulea</i> <i>Eucalyptus eugenioides</i> <i>Eucalyptus paniculata</i>	<i>Eucalyptus punctata</i> <i>Helichrysum diosmifolium</i> <i>Hibbertia aspera</i> <i>Olearia viscidula</i> <i>Syncarpia glomulifera</i> <i>Themeda australis</i> <i>Tylophora barbata</i>
Community 4:	<i>Eucalyptus consideniana</i> - <i>E. gummifera</i> Woodland/Healthland	
Structure:	Woodland from 10 to 15 metres tall with a dense heathland understorey.	
Geology/soils:	On broad flat ridge tops on the Hawkesbury Sandstone where soils are rocky, sandy and rather dry.	
Description:	Dominated by <i>Eucalyptus consideniana</i> and <i>E. gummifera</i> . Compared with Community 2, it is more open, lower in height and lacks the canopy species <i>Angophora costata</i> and <i>E. piperita</i> . Communities 2 and 4 do overlap in the south of the survey area (see Figure 4.2) and the boundary between the two communities is not distinct. Other trees found in this community include <i>E. sieberi</i> , <i>E. sclerophylla</i> , <i>E. notabilis</i> , <i>Banksia serrata</i> and occasionally <i>E. eugenioides</i> . The understorey is similar to that of Community 2, but includes additional plant species associated with the dry sandstone soils. Common species in the heathy understorey include <i>Lambertia formosa</i> , <i>Phyllota phyllicoides</i> , <i>Kunzea ambigua</i> , <i>Acacia suaveolens</i> , <i>Leptospermum</i> spp., <i>Banksia spinulosa</i> and <i>Persoonia</i> spp.	

Characteristic Species:	<i>Acacia suaveolens</i>	<i>Grevillea phyllicoides</i>
	<i>Banksia serrata</i>	<i>Isopogon anemonifolius</i>
	<i>Banksia spinulosa</i>	<i>Lambertia formosa</i>
	<i>Eucalyptus consideniana</i>	<i>Leptospermum</i> spp.
	<i>Eucalyptus gummifera</i>	<i>Persoonia</i> spp.
	<i>Eucalyptus notabilis</i>	<i>Phyllota phyllicoides</i>
	<i>Eucalyptus sieberi</i>	<i>Stipa</i> sp.

TABLE 4.5
SUMMARY OF VEGETATION COMMUNITIES,
MILLER MINE SURVEY AREA AT OAKDALE

No.	Formation	Dominant Species	Occurrence
1	Tall Open Forest/ Closed Forest (Rainforest)	<i>Eucalyptus piperita</i> <i>Angophora costata</i> <i>Ceratopetalum apetalum</i> <i>Acmena smithii</i>	Hawkesbury Sandstone, in deeper valleys and gorges. On moister sites than Community 2, with which it is contiguous
2	Open Forest	<i>Angophora costata</i> <i>Eucalyptus piperita</i>	Hawkesbury Sandstone, on gentle to moderate slopes
3	Open Forest/ Woodland	<i>Eucalyptus paniculata</i> <i>Eucalyptus punctata</i>	Wianamatta Group. Fine-grained sediments, flat topography
4	Woodland/ Heathland	<i>Eucalyptus consideniana</i> <i>Eucalyptus gummifera</i>	Hawkesbury Sandstone, on broad ridge tops with flat topography

Source: Kevin Mills and Associates Pty Ltd: 1988

4.4.5 Fauna and Fauna Habitats of the Survey Area

It was not within the scope of the survey to carry out a detailed fauna study. Assessment of the fauna of the survey area concentrates on mammals, avifauna and those species listed as endangered fauna on Schedule 12 of the National Parks and Wildlife Act 1974. The fauna habitats of the survey area were surveyed in the field, and assessed using information provided by other studies and the consultant's experience in the region.

Detailed information on the other vertebrate fauna groups in the area is lacking, because so little research has yet been carried out. The presence of species can be predicted by the habitat types present and by the distribution maps provided by the standard reference for Australian reptiles and amphibians (Cogger, 1983). These fauna groups were not surveyed during this study.

Fauna Species

Appendix 3 lists the species of mammals known or expected to occur in the survey area. Although there is no detailed information available on the mammals occurring in the survey area, those species expected to occur there can be reasonably well predicted.

Appendix 4 lists the bird species observed in the survey area in November and December 1988. Many other species can be expected to occur there, and these can be obtained from standard works such as Blakers et al. (1984), or the regional work of Gibson (1977), which includes the survey area.

Fauna Habitats

Fauna habitats in the survey area fall into three main types: cleared land, which surrounds most of the survey area; dry ridge open forest and woodland; and moist gully forest, including rainforest. Because the subject study is concerned with native vegetation, cleared land has not been included in this discussion.

Drier open forest and woodland covers most of the survey area. This habitat is characterised by its dense heathy understorey and generally open canopy formed by moderately sized trees. Ground cover is often dense. Soils are dry and sandy, and there are some rock outcrops.

The moister forest habitat of the gullies contains the most diverse fauna community in the area. The trees are taller and larger, and the middle-canopy is well developed with a dense shrub understorey and a dense ground cover of ferns, shrubs, creepers and herbs. In some locations, patches of rainforest occur with many ferns; these are mainly in small, cliff-lined gorges. Cliff lines and rock outcrops are common and there is a stream along most gullies. Some fauna species which occur in the district are restricted to these moist gully habitats.

4.4.6 Conservation Importance of the Survey Area

Australian plant species which are either rare or threatened are listed in Leigh, Briggs and Hartley (1981) and Briggs & Leigh (1988); this publication is used to assess the conservation significance of plant species in New South Wales. None of these plant species was located in the survey area.

The vegetation of the survey area was not included as 'vegetation with significant vegetation values' in the report, Macarthur Regional Environmental Study - Regional Open Space and Recreational (DEP 1986). Vegetation similar to that found in the survey area also occurs to the west, on the extensive sandstone area within the eastern parts of the Warragamba Dam catchment. The vegetation of the survey area has no

particular conservation values over and above its values as local flora and fauna habitat and its scenic quality.

Fauna of particular conservation importance in New South Wales is listed on Schedule 12 of the National Parks and Wildlife Act 1974 (New South Wales 1974), as amended in 1984. The species from Schedule 12 which are known to occur in the survey area or could reasonably be expected to occur there are listed in Table 4.6. The survey area does not provide essential or specialised habitat for the species listed in Table 4.6, so that the destruction of some of the vegetation on the site, which will mainly be within Community 2, is not likely to affect these fauna species. As noted in Section 4.4.5, the most important fauna habitats in the survey area are the tall moist gully forests, including rainforest. These areas will largely remain unaffected by the proposed development.

TABLE 4.6

FAUNA LISTED ON SCHEDULE 12, NATIONAL PARKS & WILDLIFE ACT 1974
 KNOWN OR EXPECTED TO OCCUR IN OR NEAR THE SURVEY AREA AT OAKDALE

Part 1: Fauna of Special Concern

Mammals	<i>Cercartetus nanus</i>	Eastern Pygmy-possum
	<i>Acrobates pygmaeus</i>	Feathertail Glider
Reptiles	<i>Morelia spilota</i>	Carpet and Diamond Python
	<i>Hirundapus caudacutus</i>	White-throated Needletail
Birds	<i>Apus pacificus</i>	Fork-tailed Swift
	<i>Merops ornatus</i>	Rainbow Bee-eater
	<i>Coracina tenuirostris</i>	Cicadabird
	<i>Zoothera dauma</i>	White's Thrush
	<i>Falcunculus frontatus</i>	Crested Shrike-tit
	<i>Rhipidura rufifrons</i>	Rufous Fantail
	<i>Cinclosoma punctatum</i>	Spotted Quail-thrush

Part 2: Vulnerable and Rare Fauna

Birds	<i>Falco peregrinus</i>	Peregrine Falcon
	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo
	<i>Ninox strenua</i>	Powerful Owl (?)

Part 3: Threatened Fauna

Reptiles	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (?)
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Part 4: Fauna in Imminent Dange of Extinction

nil

4.4.7 Impact Assessment

Construction of the proposed pit head, coal handling and washery facilities of the Millar Mine will take place within Hurricane Gully as

shown on Figure 3.4. The drift portal and slope haulage buildings will be located on either side of the lower reaches of the Gully, the connecting conveyor crossing the creek bed by bridge. The coal handling facilities including the run of mine and product coal stockpiles and washery will be built on the upper banks of the southern side of the Gully for which benched earthworks in cut and fill will be required to provide appropriate foundations as shown in Figure 3.6. The haulage access road will traverse the flat ridge top before descending to cross the western upstream end of the Gully by culvert to enter the site on the northern side of the product coal stockpiles for access to the loading bins and washery.

Figure 4.4 indicates tall open forest (Community 2) within the gully with rainforest species (Community 1) present in the vicinity of the creek bed. The open forest extends to higher levels of the gully and hence over the area scheduled for the coal handling facilities on its southern side. Accordingly, the earthworks provided will have a substantial impact on this limited section of the forest community for which appropriate measures will be necessary to minimise the impact of the proposed development upon the flora and fauna of that area. The object of such safeguards will be to ensure that:

- . clearing of vegetation is kept to a minimum. The disposal of cleared vegetation is addressed in Section 3.5;
- . the deep gullies containing the moist forest community (Community 1) are not disturbed where they have not already been disturbed, as these contain the most diverse fauna communities and vegetation, such as rainforest, which is more restricted in the region than the drier woodland and forest of the ridges; and
- . erosion and pollution control measures are implemented to protect the downstream sections of streams running from the development site, particularly Hurricane Creek, and the flora and fauna occurring along these streams. Such measures are addressed in Section 3.8.

4.5 HYDROLOGY

4.5.1 Surface Waters

The proposed mine site is located on the south bank of Hurricane Creek which is within the Monkey Creek sub-catchment which forms part of the Warragamba catchment. Runoff enters Hurricane Creek and then flows to Horse Creek, Monkey Creek and ultimately to Lake Burragorang.

The Sydney Water Board has classified the catchment of Lake Burragorang into an inner and outer catchment. The inner catchment is subject to strict land controls. The outer catchment, in which the Millar Mine pit head is to be located, is less stringently controlled with requirements under Section 56A of the Metropolitan Water Sewerage and Drainage Act, 1924. The Board is able to comment on and under certain circumstances control developments.

The site is on a relatively small catchment of approximately 163 hectares and consists primarily of cultivated farmland and a smaller section of less permeable Wianamatta based soils to the north.

There is currently no information on surface water flows in the Horse Creek catchment. However, an estimate of average flow rates in Hurricane Gully adjacent to the proposed site and in Horse Creek at the northern boundary of the site has been made for dry, average and wet years of 320, 775 and 1415 mm as calculated in Section 3.8.5 and is given in Table 4.7.

TABLE 4.7
AVERAGE FLOWS m³ second

Location	Dry	Average	Wet
Hurricane Creek opposite pit head facilities	0.007	0.02	0.03
Horse Creek at northern site boundary	0.03	0.08	0.14

Rainfall intensity and duration data have been derived using the method prescribed in Australian Rainfall and Runoff (1988) and is presented in Figure 4.5. Based on this information, the design 2 year and 100 year peak flows are 3.8m³/second and 13.6m³/second respectively. The predicted 100 year flood height for the section of Hurricane Creek immediately adjacent to the site is approximately 1.5m which is well below the pit head facility and stockpile area.

4.5.2 Groundwaters

There are a number of bores in the vicinity of the site which are mostly consolidated between sandstone stratum at depths of 39 to 147 metres. Yield rates range from 1.18L/s to 6.82L/s and water is used for both irrigation and as a potable water supply.

Mine water originates from behind seals between the Oakdale and Nattai South Entry Collieries and is presently being pumped at a rate of 2.2ML/day to two small sedimentation ponds in Hurricane Gully before overflowing into Hurricane Creek.

4.6 WATER QUALITY

4.6.1 Surface Waters

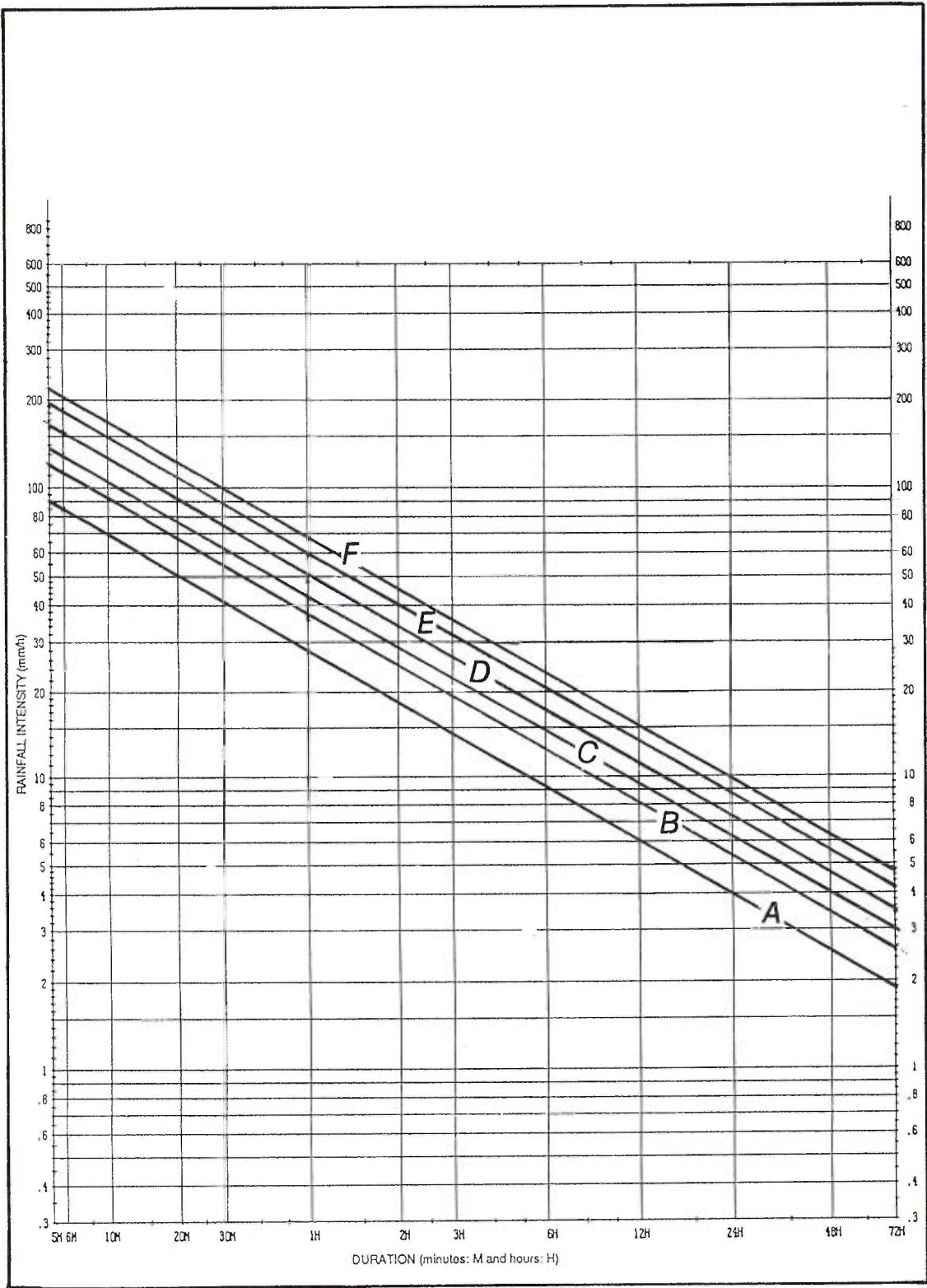
Monkey Creek has been classified as Class "P" - Protected Waters by the State Pollution Control Commission, discharges of effluents into which are limited to those with a quality similar to that required as a "raw" source of potable water (SPCC, 1980). Regulation 8 under the Clean Waters Act, 1970 prescribes details of constraints for discharges into such waters.

The Water Board is presently investigating the Monkey Creek sub-catchment as part of an overall review of water quality in the Warragamba Dam catchment.

Results of this study are not currently available and assessment of water quality is based on monitoring data from three stations located near the proposed site on Horse Creek (St. E547), further downstream on Horse Creek (St. E541) and on Monkey Creek near Fire Road (E531). These sites have not been regularly sampled and data may need to be verified once results from current investigations become available. Monitoring data was obtained from the Water Board and is presented in Appendix 5 and shows a gradual deterioration of water quality towards the lower reaches of the catchment. For dry weather flows near the Millar site, the total salt concentration is about 52mg/l, the pH is 5.3 and turbidity is low at 0.5 NTU. Further downstream on Monkey Creek, total salt concentration increases to a maximum of approximately 91mg/l water becomes less acidic as pH increases to around 7 and turbidity reaches 17.0 NTU.

4.6.2 Groundwaters

From data collected by the Water Resources Commission, the major chemical constituents are Ca, Mg, Na, HCO₃ and Cl with lesser amounts of K, CO₃ and SO₄. Water is of reasonable quality and is used for irrigation and in some cases as a stock and domestic supply. Salt



A = 2 years E = 50 years
 B = 5 years F = 100 years
 C = 10 years
 D = 20 years

* IFD= Intensity Frequency Duration

Figure 4.5

IFD RAINFALL DIAGRAM

concentrations are generally in the range of 300 to 400mg/l and pH ranges from 3.1 to 8 with an average of around 5.3.

Mine water quality is of similar standard. However, the alkalinity of waters associated with the Bulli coal seam offers substantial buffering against the formation of acidic mine waters so that pH values are substantially increased to around 7.3.

Monitoring data for both bore and mine waters is given in Appendices 6 and 7 respectively.

State Pollution Control Commission licencing conditions require that discharges of mine water to Hurricane Creek should not:

- . cause more than 20 milligrams per litre of biochemical oxygen demand;
- . contain more than 50 milligrams per litre of non-filterable residues;
- . have a pH value of less than 6.5 or more than 8.5; and
- . contain visible oil or grease and their concentration in the wastes not to exceed 10 milligrams per litre.

Recent monitoring data is presented in Table 4.8.

TABLE 4.8
MONITORING

Date	pH	Total Suspended Solids (mg/L)	Oil & Grease (mg/L)	BOD (mg/L)
25/8/87	8.4	<5	12	-
29/10/87	7.5	<5	13	-
15/12/87	8.4	5	6	-
23/2/88	8.5	<5	15	-
27/4/88	8.5	5	5.6	-
22/6/89	7.0	4	4	2

Reference to Table 4.8 shows that mine water is generally within quality standards stipulated by the State Pollution Control Commission for discharge into Hurricane Creek.

4.6.3 Impact Assessment

Specific controls have been incorporated in the design and layout of the mine to minimise or remove any potential pollution of receiving waters and are more fully discussed in Section 3.8.

Domestic and washdown wastes will be collected, treated and disposed of on-site via land irrigation and there will be no resultant drainage from the facility.

All rainfall potentially containing suspended solids will be passed through sedimentation ponds before being recycled or released. Settled runoff will be discharged to Hurricane Gully with little impact on receiving waters.

Mine water emanating from the Oakdale Colliery will be pumped to a settling and storage dam and used for pit head water demands. Excess mine water will overflow to Hurricane Gully.

The principal environmental concern will relate to the impact on receiving waters from any discharge of surplus water generated from the mine under all meteorological conditions. The water balance in Section 3.9.4 indicates that discharges into Hurricane Gully will be mainly from mine water and will be between 1.34ML/day and 2.2ML/day. Sedimentation ponds will cater for a 1 in 10 year, 1 hour duration storm before overflowing to Hurricane Gully. To maintain ponds as empty as possible, stored water will be used to supplement water demands prior to using water from the mine water storage dam.

The volume of mine water discharged to Hurricane Creek will remain constant or decrease by up to 40% as a result of the proposal. Water quality immediately downstream from the mine water discharge has not been adversely affected as shown by monitoring data described in Section 4.6.1. Water further down the catchment was found to contain increased salt concentrations which may be attributable to farming activities.

The proposed mine site is on a relatively small catchment, and at the discharge point, mine water forms a significant proportion of streamflow. However, at the northern site boundary on Horse Creek, the maximum proportion of mine water during average flows is estimated to significantly decrease to approximately 30%. At the confluence of Horse and Monkey Creeks, the proportion of mine water will become insignificant compared to total stream flow.

Sedimentation ponds will normally accept runoff from a 1 in 10 year, 1 hour duration storm. During greater intensity storms water will overflow to Hurricane Gully with minimal detention of sediments. However, the quantity of sediments compared to total sediment inputs from the Monkey Creek catchment would be comparatively small and have little impact. A further sedimentation control weir could be constructed across Hurricane Gully if required by the State Pollution

Control Commission. However, this would only be effective if the sedimentation ponds upstream are part full prior to the design storm. From water balance considerations given in Section 3.8.4, mine water demand would be in excess of contaminated runoff during a wet year so that overflows during storms less than the design intensity are unlikely.

From both a quality and quantitative perspective, there is expected to be minimal impact on the receiving waters.

4.7 NOISE

4.7.1 Introduction

This section examines the acoustic impact of the operation of the proposed colliery pit head facilities and transportation of coal and washery reject material by road from the pit head. This involves assessment of the existing acoustic environment in the area, as well as prediction of noise levels generated by the development. These predicted levels are then compared with established criteria, and measures to control noise emission are proposed where necessary.

4.7.2 Existing Acoustic Environment

The environment of the proposed mine shaft site is rural, with correspondingly low background noise levels determined by such sources as birds and wind in trees. There is a motorcross track to the north-west of the proposed development, but use of the track is infrequent, so its influence on the background noise level is negligible.

A substantial number of coal trucks, from Brimstone and Oakdale collieries, currently use Stevy's Forest Road during daytime, and ambient noise levels at residences along this road are strongly influenced by noise from this source.

Ambient noise levels in the area of the proposed development were recorded on December 21, 1988. Four locations were chosen for monitoring and these are shown in Figure 4.6. They represent the locations of the four nearest residences to the proposed development.

Because environmental noise levels vary with time, it is necessary to measure this noise in terms of statistical descriptors. For example, the L_{90} level is the noise level, in dB(A), which is exceeded for 90% of the time, and is approximately the average of the minimum noise levels recorded. This is often referred to as the "background" noise level. Similarly, the L_{10} level is the level exceeded for 10% of the time, and is approximately the average of the maximum noise levels. The L_{eq} level provides a measure of the average noise level during the measurement period.

A list of equipment used for noise measurements is provided in Table 4.9. Results of the noise survey are shown in summarised form in Table 4.10.

TABLE 4.9
LIST OF EQUIPMENT USED FOR NOISE SURVEY

Equipment	Type	Serial No.
Sound Level Meter*	B & K 2231	1178321
Microphone	B & K 4155	1214932
Calibrator	B & K 4230	1207370
Tape Recorder	SONY TC-D5M .	18755

* This statement complies with the requirements of Australian Standard AS1259 - "Sound Level Meters, Precision".

Calibration was checked for each reading, and no significant drift in calibration was detected.

Source: Renzo Tonin & Associates

TABLE 4.10
MEASURED DAYTIME AMBIENT NOISE LEVELS

Position Time	Weather	L ₉₀	L ₁₀ dB(A)	L _{eq}	Comment
1. 13:00-13:15pm	Overcast - intermittent rain	34	60	57	60m from road 37 vehicles 27 trucks
2. 13:38-13:53pm	"	<40	73	70	6m from road 42 vehicles 22 trucks
3. 14:10-14:25pm	"	35	47	51	No traffic
4. 14:40-14:55pm	"	35	49	53	5 cars

Source: Renzo Tonin & Associates

From Table 4.10, daytime L₉₀ noise levels in the same area around the proposed development are approximately 35 dB(A). This is typical of daytime background noise levels to be expected in a rural area. (At position 2, which was located within 6m of the road, it was not possible to accurately determine the L₉₀ level due to the very large range of noise levels at this site).

4.7.3 Noise Criteria

Criteria for Noise from Plant

When assessing the noise impact of a proposed development, it is usual to compare the noise levels to be generated by the new plant and equipment with the existing background noise levels in the area. The usual criterion is that the L₁₀ level from the proposed noise source should not exceed the L₉₀ level of the existing ambient noise by more than 5dB. This criterion is generally endorsed by the State Pollution Control Commission in its Environmental Noise Control Manual.

MILLAR COAL MINE

- △ Proposed Millar Coal Mine Pithead Facilities
- 3 Noise Monitoring Station



0 0.5 1km

Figure 4.6
NOISE MONITORING STATIONS
 MITCHELL MCCOTTER

However, in applying this criterion, other aspects of the development must be considered, such as the benefit of the project to the community and the number of people adversely affected.

From Table 4.10 above, it is clear that the daytime L_{90} background noise level in the area around the proposed development is approximately 35dB(A). This implies that daytime L_{10} noise levels due to plant and equipment should not exceed 40 dB(A) at the nearest residences.

It is considered that night-time L_{90} noise levels in an environment such as this would be approximately 30dB(A). Hence the criterion of 35dB(A) will be adopted for noise generated by plant and equipment at night.

These levels accord with acceptable limits for outdoor background noise levels in rural/residential areas defined in the State Pollution Control Commission's Environmental Noise Control Manual at 45 and 35dB(A) day and night respectively.

Criteria for Transportation Noise

The State Pollution Control Commission recommends that for a major road in a rural area, the L_{eq} noise level from road traffic at the facade of any affected residence should not exceed 55dB(A). Transportation of coal and rejects from the pit head facilities will be intermittent and will be carried out between 5am and 10pm, for which it is considered this criterion is appropriate.

Where the existing level of traffic noise already exceeds 55dB(A), it is considered that noise associated with the proposed development should not increase the existing L_{eq} traffic noise level by more than 2dB.

Summary of Noise Criteria

Table 4.11 summarises the noise criteria adopted for the Millar Mine.

TABLE 4.11
 CRITERIA ADOPTED FOR ASSESSMENT OF NOISE IMPACT

Noise Source	Criterion
Plant and equipment -	
Day	$L_{10} \leq 40 \text{ dB(A)}$
Night	$L_{10} \leq 35 \text{ dB(A)}$
Road traffic (daytime only) =	$L_{eq} \leq 55 \text{ dB(A)}$
	OR
	$L_{eq} \leq \text{existing } L_{eq} + 2 \text{ dB}$ if existing $L_{eq} > 55$

Source: Renzo Tonin & Associates

4.7.4 Noise Levels from Plant and Equipment at the Pit Head

Raw coal will be transported to the washery at Wollondilly for about eighteen months prior to the proposed new coal preparation plant at the pit head becoming operational. However, the noise assessment for the pit head includes noise from all proposed facilities at the site as shown in Figure 3.4 including the coal preparation plant and associated bins and conveyors. This represents the optimal situation for noise generation since lower noise levels will occur before these facilities are constructed when raw coal is processed off site.

When the coal preparation plant is operational, raw coal will be conveyed from the mine direct to the plant, or to an adjoining 50,000 tonnes run of mine (ROM) stockpile from which it will be reclaimed later by front end loader and fed into an inground hopper for conveying to the plant. Coal preparation will involve the use of dense media, froth flotation and spirals. Fine refuse will be mechanically dewatered and combined with coarse refuse for storage in a refuse bin from where it

will be road hauled to Wollondilly for disposal in the refuse emplacement adjoining the washery.

Product coal will be stored in above-ground bins with a total capacity of approximately 10,000 tonnes. A supplementary product coal stockpile will be provided adjacent to the bins for emergencies. From the product bins, coal will be road hauled either to the rail head at Glenlee or direct to the Port Kembla coal loader.

The major noise sources in the pit head area are listed in Table 4.12 together with their sound power levels which are based on measurements of noise from similar equipment.

TABLE 4.12
SOUND POWER LEVELS OF PLANT AND EQUIPMENT

Plant Item	Sound Power Level, dB(A)
2 Product bins	107 each
Rejects bin	107
Preparation plant	109
Ventilation fan	115
Compressor for mine equipment	103
Loading truck	110
15 Conveyor drive units	99 each
1710m Conveyors	83/metre
2 Cat 966 Front End Loaders*	110 each

* Operate during daytime only

Source: Renzo Tonin & Associates

Noise levels resulting from the above plant items were calculated at the locations of the four nearest residences, as indicated in Figure 4.6. Calculations were performed using the Environmental Noise Model (ENM) computer program. Ground cross sections between each source and receiver are used to calculate noise attenuation due to distance,

barriers, air absorption, and ground effects. The program has been shown to give consistently accurate predictions of actual noise levels.

Table 4.13 shows calculated noise levels at each of the four locations. As recommended by the State Pollution Control Commission, the calculated noise levels are for neutral wind conditions, with no allowance for increase or reduction in attenuation due to wind or temperature gradients.

TABLE 4.13
CALCULATED NOISE LEVELS AT RESIDENCES
FROM CONTINUOUSLY-OPERATING PLANT WITHOUT NOISE CONTROL

Noise Source	Noise Level [dB(A)] at				
	Loc. 1	Loc. 2	Loc. 3	Loc. 4	
Coal preparation plant	36	31	30	30	
* Front end loaders	35	23	26	23	
Conveyors	34	28	31	26	
Conveyor drive units	32	23	26	23	
Loading into bins	31	24	25	23	
Ventilation fan	30	23	26	22	
Loading into trucks	24	11	13	10	
Compressor	25	14	17	14	
	{Day	41	34	36	33
TOTAL:	{Night	40	34	35	33

* Operate during day time only

Source: Renzo Tonin & Associates

Table 4.13 indicates that with no noise control measures, the criterion noise level will be exceeded by 5dB at location 1, at night. Further, the major cause of this exceedence is noise from the conveyor drive

units, the coal preparation plant and the conveyors. At other residences, noise levels from the proposed plant will be acceptable.

In order to control noise levels at location 1, the following noise control measures are proposed:

- . the enclosed side of conveyors should face location 1 as far as possible. Wind shields should be designed to provide a noise attenuation of at least 9dB, compared with 4dB from a standard wind shield. This will be achieved by engineering noise control methods, including the use of heavier construction and extending the shield below the level of the conveyor itself;
- . the drive units for conveyors should be fully enclosed. The enclosure should provide a noise attenuation of at least 7dB. This will be achieved using standard sheet-metal enclosures; and
- . the coal preparation plant must be fully enclosed. The enclosure should provide a noise attenuation of at least 10dB. This may be achieved using a sheet-metal enclosure.

The Company may also install a tunnel reclaim system from the run of mine stockpile in the event of the need to maintain a run of mine washery feed at night from that source.

Adoption of the above measures assumes that all chutes associated with transfer towers will be fully lined with Linatex rubber lining or similar material and that front end loaders will generally not operate between 10pm and 7am.

Table 4.14 shows calculated noise levels with the incorporation of the above control measures. It will be noted that the predicted night-time noise levels at residence 1 exceed the criterion by only 1dB, a marginal excess which is considered acceptable.

TABLE 4.14
 CALCULATED NOISE LEVELS AT RESIDENCES
 FROM CONTINUOUSLY-OPERATING PLANT WITH RECOMMENDED NOISE CONTROL

Noise Source	Noise Level [dB(A)] at				
	Loc. 1	Loc. 2	Loc. 3	Loc. 4	
Compressor	25	14	17	14	
Conveyors	29	28	31	21	
Conveyor drive units	25	16	19	16	
Loading into bins	31	24	25	23	
Loading into trucks	24	11	13	10	
Ventilation fan	30	23	26	22	
Coal preparation plant	26	21	20	20	
* Front end loaders	35	23	26	23	
{Day		39	32	34	29
TOTAL:					
{Night		36	31	33	28
CRITERION:		Day	40dB(A)		
		Night	35dB(A)		

* Operates during day time only

Source: Renzo Tonin & Associates

4.7.5 Transportation Noise

An access road is to be built to transport coal and rejects from the new pit head facility to Stevys Forest Road. From here, raw coal will be transported to the washery at Wollondilly for about eighteen months prior to commissioning of the new coal preparation plant on site, where product coal will be transported by road directly to the rail head at Glenlee or to the Port Kembla coal loader. Rejects will be transported by road to the existing emplacement area at Wollondilly.

Truck movements on and off site will occur between 5am and 10pm.

L_{eq} noise levels were calculated using a traffic noise prediction model developed by the United States Federal Highway Administration. The model has been extensively validated, and takes account of the volume, speed and mix of traffic and the type of ground cover.

During the noise survey conducted on December 21, 1988, the average noise level from an individual coal truck on Stevys Forest Road was measured as 85dB(A) at 7.5m from the edge of the roadway. Details of measuring equipment used are given in Table 4.9. This measured level was used as the source noise level for calculations of L_{eq}.

The speed of trucks was assumed to be 90km/h, which is the speed at which trucks were observed to travel on sections of Stevys Forest Rd which are not covered by a 60km/h speed limit. L_{eq} noise levels were also calculated for that section of Stevys Forest Road covered by the 60km/hr speed limit in the residential zone as well as for a reduced speed of 40km/hr.

Current and projected truck haul tonnages and numbers of truck movements along roads in the area are given in Tables 5.11, 5.12 and 5.16. They include movements associated with the proposed development as well as those from other mines in the area. Calculations were performed for -

- . the current level of 25 tonne truck movements;
- . the period 1994/95, when it is expected that the new mine will be operating but the coal preparation plant will not; and
- . the period 1996/97, when the coal preparation plant will be operational, so that raw coal will not be transported by road to Wollondilly for processing.

Results of the calculations are shown in Table 4.15. The calculated L_{eq} noise level for the current volume of traffic along the unrestricted

section of Stevys Forest Rd is 66dB(A) at 10m or 69dB(A) at 6m. This accords with the measured level of 70dB(A) at 6m for position 2 in Table 4.10.

TABLE 4.15
CALCULATED NOISE LEVELS FROM TRUCKS
AT RESIDENCES CLOSEST TO ROAD

Roadway	Distance to Nearest Residence, m	Noise Level, L - dB(A)		
		Current	1994/95 ^{eq}	1996/97
Stevys Forest Rd -				
90km/hr	10	64	70	69
60km/hr	10	61	67	66
40km/hr	10	-	65	64
Burraborang Rd -	20	64	65	64
Oakdale to Wollondilly				
Burraborang Rd -	20	59	62	61
Oakdale to Glenlee				
Barkers Lodge Rd	15	62	62	62
to Picton				

It is clear from Table 4.15 that existing noise levels from coal trucks are considerably higher than the criterion of 55dB(A) along all the proposed road haulage routes. The recommended criterion is therefore that noise from the proposed development should not exceed the existing level by more than 2dB. However, it should be noted that the results are conservative as they are based on a five day working week whereas the Company now wishes to transport coal and rejects over a six day working week.

Table 4.15 indicates that along Stevys Forest Road, traffic noise levels at 90 and 60km/hr are predicted to increase by 5 to 6dB due to the development. Predicted noise levels exceed the recommended criterion for all residences within approximately 60m of the road; these number approximately 55. A reduction in speed to 40km/hr within the current speed limit would reduce noise levels by 2dB and the resulting increase over existing levels would be 3 to 4 dB at the most.

On other roads, the increase in noise levels will be within the criterion, with the exception that between Oakdale and Glenlee, the increase will exceed the criterion by 1dB for 1-2 years, a marginal increase which is considered acceptable.

In the longer term, 35 tonne trucks may be used for transporting coal and rejects from the Millar Mine. A change from 25 tonne to 35 tonne units would result in a decrease in L_{eq} noise levels of approximately 1dB due to the smaller number of units. However, this is likely to be offset by the slightly higher inherent noise level of the larger trucks.

The State Pollution Control Commission's Environmental Noise Control Manual nominates preferred times of movements of trucks having a gross vehicle mass of 2 tonnes or more to enter or leave scheduled premises. For Mondays to Saturdays, these are 7am to 6pm for normal frequencies, and 6am to 7am and 6pm to 10pm for significantly reduced frequencies, exceptions being subject to individual investigation. To meet the Company's requirements for truck transportation between 5am and 10pm and the recommended noise criteria, truck movements during early or late hours would need to be restricted to not more than 60% of existing movements during those periods.

Acceleration of trucks from stop positions could be expected to result in noise levels about 3dB higher than the average noise levels given in Table 4.15. At the junction of Stevys Forest Road and Burraborang Road, this increase will apply to existing traffic as well as that generated by the mine, and therefore the predicted increase in traffic noise over existing levels will be the same. Near the intersection of Stevys

Forest Road with the mine access road, truck acceleration will result in noise levels slightly higher than the values given in Table 4.15.

The installation of hush kits on trucks of the size under consideration, if properly designed and maintained, could be expected to reduce pass by noise levels by 3 to 5 dB(A). Such kits would involve fitting bushed hinges on and rubber seals around tailgates and additional mufflers.

4.7.6 Impact Assessment

(i) Pit Head Noise

Table 4.13 indicates that noise from continuously operating plant at the pit head without appropriate noise control measures will have adverse impacts only on the residence at location 1. However, the incorporation of enclosures to conveyors and the coal preparation plant, the lining of chutes associated with the transfer towers, and the restriction of operating times for front end loaders as nominated in Section 4.6.4 will result in the noise criteria being exceeded only at residence 1 at night and only by 1dB, an impact that is considerable acceptable.

(ii) Transportation Noise

Residences along all routes currently used by coal trucks in the Oakdale area are experiencing noise levels between 6 and 10dB(A) above the State Pollution Control Commission's criterion of 55dB(A). There are no economically viable alternative means of transporting coal from mines in the area to the nearest rail or port. Hence, continuation of such haulage must be accepted as the penalty to be paid for the future operation of the Burragorang Valley coal mines and their economic benefit to the local community.

Only in the case of Stevys Forest Road will operation of the new Millar Mine measurably increase transport noise levels on adjoining residences by more than the recommended criterion. The marginal increase over the criterion along the Burragorang Road between Oakdale and Glenlee is only transient over a relatively short period.

There are a number of measures that could be adopted to mitigate the adverse effects of noise from coal and reject traffic which will need to be the subject of consideration in the determination of the development application for the subject proposal. These include the following:

- . restriction of truck movements between 5am and 7am and between 6pm and 10pm to not more than 60% of existing movements during these periods;
- . extension of the existing 60km/hr speed limit along Stevy's Forest Road to the Millar Mine pit head entrance, and the possible reduction of the posted speed limit to 40km/hr on those sections of the road fronted by residential development;
- . strict adherence to speed limits which would require to be regularly policed to be effective;
- . installation of properly designed and maintained hush kits on all trucks associated with coal and reject haulage.

Having regard for the predicted noise levels along the nominated coal haul routes in Table 4.15, and the options available for mitigating such impacts as described above, it is considered practicable to contain traffic noise increases from the Millar Mine to within the permissible 2dB over current noise levels. A comprehensive analysis of all transport impacts generated by the Millar Mine is contained in Section 5.6.

4.8 AIR QUALITY

4.8.1 Introduction

This section provides the basis for assessing the effects of the proposed Millar coal mine and associated surface facilities on air quality.

Details of coal extraction by underground methods, conveying of coal to the coal preparation plant and its subsequent handling, washing and storage are described in Sections 3.4 to 3.6. Product coal and waste material from the washery will be hauled by road to destinations remote from the proposed mine site as described in Section 3.7.

This section describes the existing air quality in the vicinity of the mine site together with meteorological data and air quality criteria applicable to the project area. The proposed air quality safeguards and estimated emissions of atmospheric dust for the construction and operation phases of the development, including transportation of coal and rejects, then follow in Section 4.8.5.

Dispersion modelling techniques applied to obtain a quantitative assessment of effects on air quality are introduced, and the results presented and discussed with reference to the applicable air quality objectives and criteria as a measure of impact on the environment.

4.8.2 Existing Air Quality

Regional air quality is determined by a variety of emissions including emissions from industrial installations, mining and quarrying, road and rail traffic, farming activities and residential and commercial uses. The key pollutants found in industrial and urban areas are related to effects on public health and amenity. Those pollutants normally include oxides of sulphur and nitrogen, ozone, carbon monoxide as well as particulate matter and lead.

There are no air quality measurements available for the subregion containing the project area which would quantify the presence of key industrial pollutants in the ambient air. Owing to the absence of industrial installations which would emit large quantities of waste gases to the atmosphere, the existing levels of gaseous pollutants in the project area can be expected to be low.

Mining, handling and transport of coal and traffic on paved and unpaved roads result, together with scattered residential developments and agricultural activities, in generation of atmospheric dust. While raising local dust levels and possibly causing short term nuisance, especially during extended periods of dry weather, these activities do not normally impact on public health.

Deposition of dust on horizontal surfaces is often used as a measure of the existing levels of particulate matter in the air at a specific locality. For this purpose, a network of three dust gauges, located as shown in Figure 4.7, were established for a monitoring programme to determine the existing rate of dust deposition in the area containing the proposed Millar Mine. Monitoring sites Nos 1 and 2 were located 10.5 kilometres and 6 kilometres respectively to the west-northwest of the proposed Millar pit head and monitoring site. No. 3 was set up directly at the pit head. Site No. 1 was about 1 kilometre east of Wollondilly Washery.

Regular sampling commenced in March 1988. Equipment and sampling procedures were in accordance with Australian Standard AS 2724-1984; the gauges consisting of a stand, holder and deposit gauge in which dust was collected together with rain and any extraneous matter using a 150mm glass funnel. The deposit gauge was exposed to fallout over periods of time varying from 21 to 40 days. At the completion of sampling, the sample was collected and analysed in the laboratory. The mass of dried insoluble solids and combustible matter were determined for each sample.

The mean deposition rate of atmospheric particulates collected from March 3rd 1988 to March 3rd 1989 was $0.98\text{g/m}^2/\text{mth}$. The standard deviation of individual monthly values from the mean was $0.58\text{g/m}^2/\text{mth}$ indicating a reasonable consistency in the measurements.

The recorded dustfall is consistent with background dust levels existing in other regions of NSW. The background levels of atmospheric dust are the combination of contributions from subregional sources, both natural and manmade, and local dust sources. The monitoring results did not indicate any marked effect of local dust sources on the air quality of the project area.

4.8.3 Meteorological Data

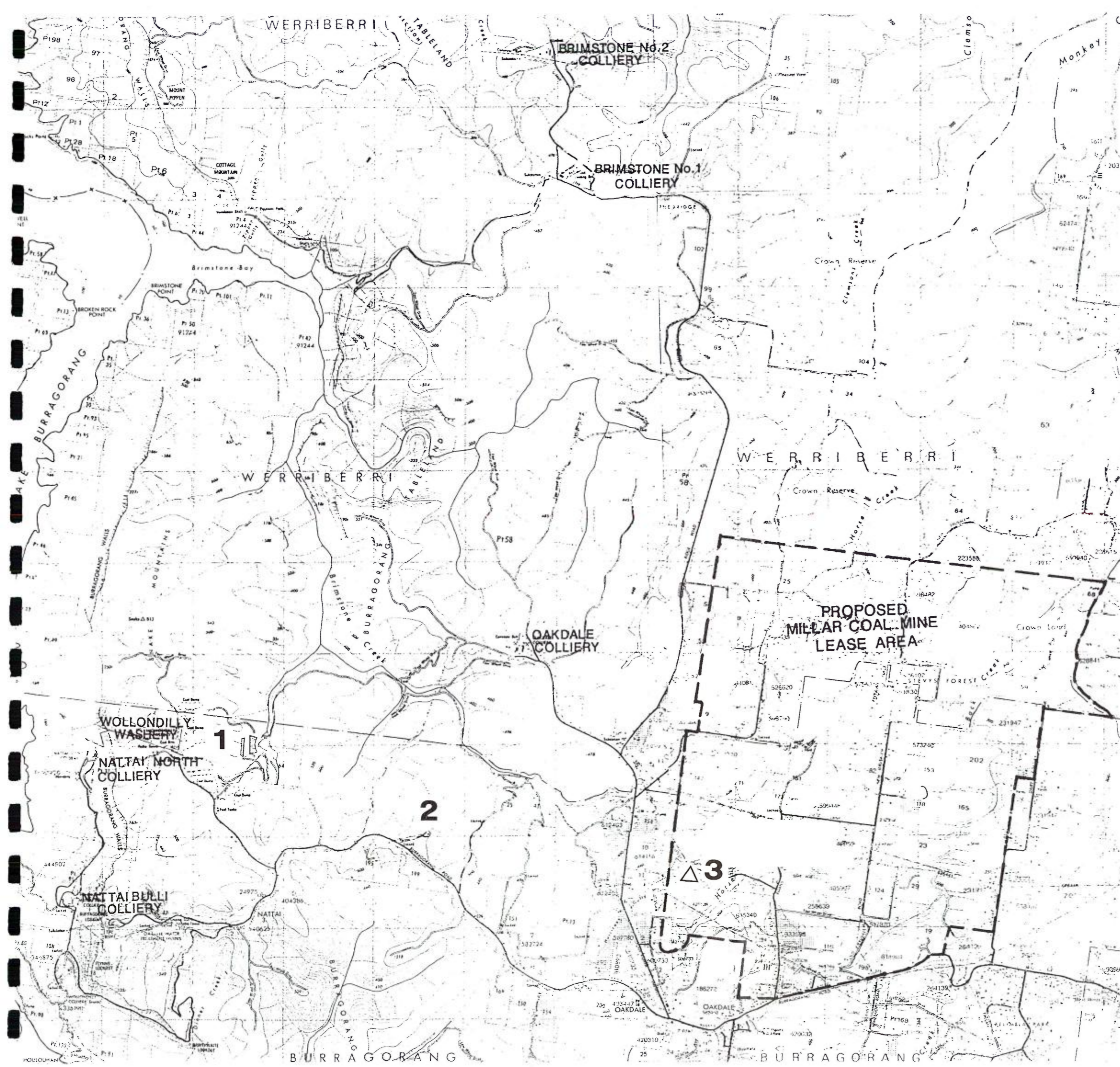
Climatic conditions in the area of the proposed mine are dominated by seasonal changes in the position of high pressure cells which migrate across the continent from west to east. In winter, the cells of high pressure move north resulting in prevailing westerly winds. In summer, the average path of high pressure systems lies to the south of the continent bringing easterly to northeasterly winds to the region. Occasional southeasterly to southwesterly winds can occur at any time of the year during frontal passages between successive high pressure cells.

Climatological information available from observations undertaken by the Bureau of Meteorology are contained in Section 4.2. However, while they provide general information on the climate of the area, they are not suitable for dispersion modelling which requires continuous records of the main meteorological parameters.

The Bureau of Meteorology has maintained records of observed wind directions and speeds at Camden Airport since 1943. Published climatological averages indicated that during the warmer part of the year (October to April), winds from the south were most common at 9am; but at 3pm they were most frequently observed from the east, and with full summer conditions, from the northeast. Southwesterly winds were shown to dominate the airflow during the rest of the year both in the

MILLAR COAL MINE

- △ Proposed Millar Coal Mine Pithead Facilities
- 2 Dust Monitoring Station



0 0.5 1 2km

Figure 4.7

DUST MONITORING STATIONS

MITCHELL McCOTTER

morning (9am) and in the afternoon (3pm); the frequencies of southwesterly winds are higher and the winds were stronger at 3pm than at 9am.

While providing a useful indication of long term trends in the prevailing winds at 9am and 3pm, the Bureau of Meteorology records do not refer to other times of the day such as the night and early morning. Continuous and instrument-based records are needed for that purpose.

Macquarie University used a recording anemometer to obtain continuous wind data at Camden for a period of about 2 years between July 1974 and August 1976. The recorder charts were analysed to determine hourly wind speeds and directions. The digitised hourly values were used to prepare joint frequencies of individual wind direction sectors and wind speed classes in the form of a wind rose shown in Figure 4.2. This confirmed the prevalence of southerly to southwesterly winds on a continuous, 24 hours/day basis which was indicated by the 9am and 3pm spot readings in the Bureau of Meteorology records. The wind rose also showed that most of the winds, irrespective of the direction, were only light with speeds below 3.4m/s (approximately 12 km/hr). The strongest winds with speeds in excess of 8.5m/s (approximately 30km/hr) originated in the westerly quadrant. Similar trends exist in the climatological records obtained by the Bureau of Meteorology.

The wind records obtained at Camden differ considerably from data collected by instrumental means in the Goulburn-Berrima region which is located further to the southeast. The records at Camden also differ from wind data obtained near Springwood further north. Winds in the Goulburn-Berrima region are much stronger and dominated by westerlies. Winds from NNE are also dominant particularly during the summer. By contrast, the wind speeds recorded at Springwood are comparable with those at Camden, but the main wind directions clearly display a pronounced NW-SE alignment. The magnitude of these variations in surface winds between neighbouring regions clearly demonstrates the need for using the best available data and this was the continuous data recorded at Camden, shown in Figure 4.2.

4.8.4 Dust Criteria

The main impact of the proposal on air quality will be from atmospheric dust generation. Acceptable dust criteria are based on potential for impact on amenity and impact on public health.

New amenity based criteria have been adopted recently by the State Pollution Control Commission (SPCC) to assess the effects of coal mining and processing on dustfall levels. When applied to the Millar Mine in an area where the Company's monitoring programme has indicated there is an existing dust deposition rate of $1.0\text{g/m}^2/\text{mth}$, the new criteria specify a mean annual increment of $2\text{g/m}^2/\text{mth}$ as the maximum acceptable increase over the background for all land uses surrounding the proposed pit top site.

The National Health and Medical Research Council of Australia (NHMRC) has recommended an annual concentration of 90ug/m^3 as the maximum permissible level of total suspended particulates in the air to protect public health in residential environments. Exposure periods shorter than one year are not covered by the NHMRC goals. In the United States, the USEPA uses a primary air quality standard of 260ug/m^3 to protect public health. This standard applies to peak concentrations over 24 hours and may not be exceeded more than once a year. A secondary standard of 150ug/m^3 over 24 hours is used by the USEPA to protect the public against nuisance dust.

4.8.5 Air Quality Safeguards and Dust Emissions

. Construction of Surface Facilities

Construction of the surface facilities will be carried out in the shortest possible time. Vegetation will be cleared and removed from the site where possible. Remaining vegetation will be burned on days with favourable dispersion conditions.

The extent of the cleared and disturbed surface areas will be kept to a minimum to reduce generation of dust by wind erosion. While some cross

fall in the stockpile areas will be accommodated, original ground contours will be retained where possible to minimise cut and fill operations.

A water cart will be used to maintain the area of exposed surfaces in a moist state. It will also be used during the short periods of topsoil stripping.

An emission factor of 2.69 tonnes of dust per hectare per month of heavy construction activity was adopted from USEPA (1972). It was assumed that the total surface area on which heavy construction will take place at a given time will not exceed a total of 2 hectares. In fact, construction activity is likely to be concentrated in a smaller area than 2 hectares in each month. For comparison, the base of the largest stockpile will cover less than 1 hectare when fully developed.

The total area of the loading pad including storage bins will also be less than 1 hectare. The areas of product coal stockpiles will be even smaller. Details of the spatial arrangements at the surface facility are shown in Figure 3.4.

. Operation of Surface Facilities

Standard controls will be applied to minimise emission of dust particles from coal handling operations at the pit head. Raw coal will be received from the underground mine by a conveyor system equipped with covers to prevent generation of atmospheric dust by wind. Adequate access and lifting facilities will be provided for maintenance.

Raw coal will be conveyed to a 50,000 tonne ROM stockpile adjoining the coal preparation plant. Stacking conveyors will be fitted with automatic trippers. Tripper travel will be activated on completion of the base pile, and free fall height of material will be limited by the length of predetermined steps. The tripper will be able to advance at any time.

Product coal will be stored in aboveground bins for loading out to trucks. Supplementary product stockpiles will be provided for both coking and steaming coal. Reclaiming from the supplementary stockpiles will be by front end loader.

Dust suppression in the stockpile area will be achieved by a spray system. Water pipes will be carried on the underside of the conveyor system and spray nozzles on either side of the discharge chute will be activated by the tripper. Control of nozzles will be zoned with spraying of selected zones being able to be activated from the control room.

Wash-down water pipes and hoses will be provided along all conveyors and at all transfers. Spillage plates will be fitted under all conveyors where elevated structures cross areas used for traffic.

Level differences at transfer points will be adequate to install and service suitable belt scrapers. Transfer chutes will be of ample proportion, with steep angled sliding surfaces and will be arranged to direct the scraping into the main material flow.

Receival chutes will be fully covered and fitted with skirting. Spillage will be minimised by configuring transfers with directional chute sections and limited (max 10 degrees) conveyor slopes at points of receival.

Conveyor capacities will be selected to allow a minimum of 10 percent additional volumetric capacity against recommended data and standard edge distances will be increased to minimise spillage.

The access road to the mine facilities from Stevys Forest Road and between the underground mine and the coal preparation plant will be sealed. The existing Egans Road access and parking facilities for employees' cars are already sealed. Sealed surfaces will be maintained free of spillages to minimise generation of dust by passing vehicles.

Annual emission rates of atmospheric dust from coal receipt, handling, washing, storage and loading at the Millar Mine were estimated as shown in Table 4.16. Emission rates were determined for a production rate of 1.8 mtpa of ROM coal. Fifty percent of the ROM production was assumed to pass through the stockpile of maximum capacity of 50,000 tonnes. The other half was assumed to be conveyed directly to the coal preparation plant.

In this regard, it should be noted that the Company increased its proposed maximum production rate from 1.8 to 2.0 mtpa of ROM coal after completion of the dust studies. However, it is not considered that the 11% increase in production rate, even if translated in direct proportion to dust emissions, will affect the conclusions of the study given on page 4.56.

USEPA (1981) experimentally-based emission factors were used to calculate dust emission rates for uncontrolled operations. Minimum efficiencies were then applied to account for the controls proposed for the loading onto ROM stockpile (75 percent), storage (watering at 50 percent) and reclaiming (80 percent) as derived from USEPA (1981).

The same methodology was followed for the determination of dust emissions from the two product stockpiles. The emission rates in Table 4.16 include all handling, maintenance and traffic at the stockpiles. Wind erosion of the stockpile surfaces was determined separately. The contribution of wind erosion to total dust emission remained relatively small.

TABLE 4.16
ESTIMATED ANNUAL EMISSIONS OF DUST FROM MILLAR MINE
SURFACE FACILITIES

Source	Emission Rate (tonnes/year)	Reference
ROM stockpile (active)	35.2	USEPA
(wind erosion)	6.3	USEPA
Coking coal stockpile (active)	11.7	USEPA
(wind erosion)	1.9	USEPA
Steaming coal stockpile (active)	15.6	USEPA
(wind erosion)	2.6	USEPA
Total	73.3	

. Transport of Coal and Rejects

Product coal will be loaded from aboveground bins or supplementary stockpiles to coal trucks and taken either directly to Port Kembla or to the rail head facility at Glenlee. Waste material from the coal preparation plant will be transported by a conveyor to a rejects bin and then hauled by truck to the emplacement area at Wollondilly Washery.

Residual dust emissions during loading from bins and from truck movements on the loading pad were included in the assessment. An annual emission of 10.0 tonnes of atmospheric dust was calculated using an emission factor developed by the USEPA (1981) for loading to trucks from bins. It was assumed that all rejects and one half of product coal will be loaded from bins.

Option "A" for the coal haul route as shown in Figure 3.5 passes the eastern and northern boundaries of a commercial orchard and its length is estimated at about 1400 metres. Option "B" through the western corridor is about 500 metres long and passes between two commercial orchards located adjacent to Stevys Forest Road. Option "C" utilises an existing right of way between Options "A" and "B" and is about 1400 metres long.

Private coal haul roads can be a potential source of significant dust generation, and depending on circumstances may be sealed or unsealed. Such dust generation depends on a number of parameters including vehicle speed, weight, number of wheels, and weather conditions, as well as the type of surface and its silt content.

Extensive experimental data has been collected in the United States and Australia on dust generation from traffic on unpaved roads, and emission

factors have been developed to enable the amount of dust generated to be estimated with an acceptable degree of accuracy.

When applied to the Millar Mine, assuming regular watering and maintenance and an emission factor of 2.0kg of dust per kilometre travelled per truck (SPCC, 1983), it is estimated that the total length of Route "A" will generate 360,000kg of dust per year if unpaved, and Route "B" will generate 144,000kg per year in a similar condition. Such emissions will be subject to normal dilution processes in the ambient air. However, they are not appropriate for indicating the amount of particle settlement on neighbouring properties which would require detailed dispersion modelling analysis.

Accordingly, having regard for the proximity of local commercial orchards to the project and public concern about the potential for dust settling on fruit during the growing season, the Company proposes to seal the entire haul road between the coal storage area and Stevys Forest Road. All internal roads at the pithead facilities will also be sealed.

Generation of dust from a paved road is dependent on the amount of particulates present on its surface. Those particulates may be present as the result of:

- . deposition of mud and dirt from the tyres and bodies of trucks;
- . spillage from trucks;
- . road surface wear;
- . runoff or erosion of adjacent land strips;
- . wear from tyres and brake linings;
- . exhaust emission; and
- . atmospheric fallout.

The average emission rate determined from field test data on paved roads is approximately 3.5g of dust per vehicle kilometre (USEPA, 1972). This represents an estimated reduction by a factor of about 570 in the annual dust emission from haulage.

The following safeguards will be implemented at the Millar Mine to minimise vehicle dust emissions to within the USEPA average emission rate:

- . the construction period will be kept to a minimum and watering of surfaces by water carts will be used to suppress excessive generation of dust. As an additional measure, it may be possible to schedule the construction work near the orchards during the time when there is no fruit on the trees;
- . truck loads will be covered to minimise spillage and to prevent entrainment of particles by wind during transport;
- . trucks will pass through a truck washing station at Wollondilly and Glenlee to clean the undercarriage and tyres; and
- . regular cleaning and maintenance of all paved surfaces will be undertaken.

The provision and maintenance of sealed roads together with the above dust controls will eliminate traffic as the major source of atmospheric dust from the proposed development particularly in relation to neighbouring properties.

4.8.6 Modelling Results and Impact Assessment

The estimated rates of dust emissions were applied together with the meteorological data in a computer model of dust dispersion. Both the construction and operational stages of the proposal were modelled using the technique described in Appendix 8.

. Construction Stage

Increases in the annual deposition rate of dust (dustfall) and the annual concentration of total suspended particulates in the area for the construction period are predicted in Figures 4.8 and 4.9. Inherent in the predictions is the conservative assumption that the construction period will extend over 12 months or longer and that a total area of two hectares will be active throughout the year. In reality, large segments of the construction work will be able to be completed in much shorter times and so minimise the annual dust emission from not only the construction activity but also from wind erosion of the disturbed surfaces. As a result, the actual annual dust deposition and concentration levels are expected to be far less than those estimated in Figures 4.8 and 4.9. By using the levels indicated in these figures for impact analysis, an additional margin of safety has been incorporated in the assessment.

Figure 4.8 shows that despite the conservative assumptions made for these predictions, the mean annual increase in dust deposition will be limited to between 0.2 and 0.3 g/m²/mth at the nearest residences located along Stevys Forest Road. The maximum increment in dust deposition at the nearest orchard will be 0.5 g/m²/mth or less. Predicted increases in the mean annual concentrations of total suspended particulates will be limited to 10 ug/m³ for the nearest orchards and residences.

These predicted increases in dust deposition and total suspended particulates are well within the acceptable criteria defined in Section 4.8.4.

. Operational Stage

Increases in the annual deposition rate of dust (dustfall) and the annual concentration of total suspended particulates in the air are predicted for the operational stage in Figures 4.10 and 4.11. The

predictions took into account emissions listed in Table 4.1.6 as well as dust from the loading area.

Contours of mean annual dust deposition in Figure 4.10 show the centre of the coal storage and handling area to be associated with the highest expected dust fallout. The contour lines, expressed in $\text{grams/m}^2/\text{mth}$ (annual average), also reflect the effect of the strongest winds blowing from the west and west-southwest on the generation of atmospheric dust and the main direction of its dispersal.

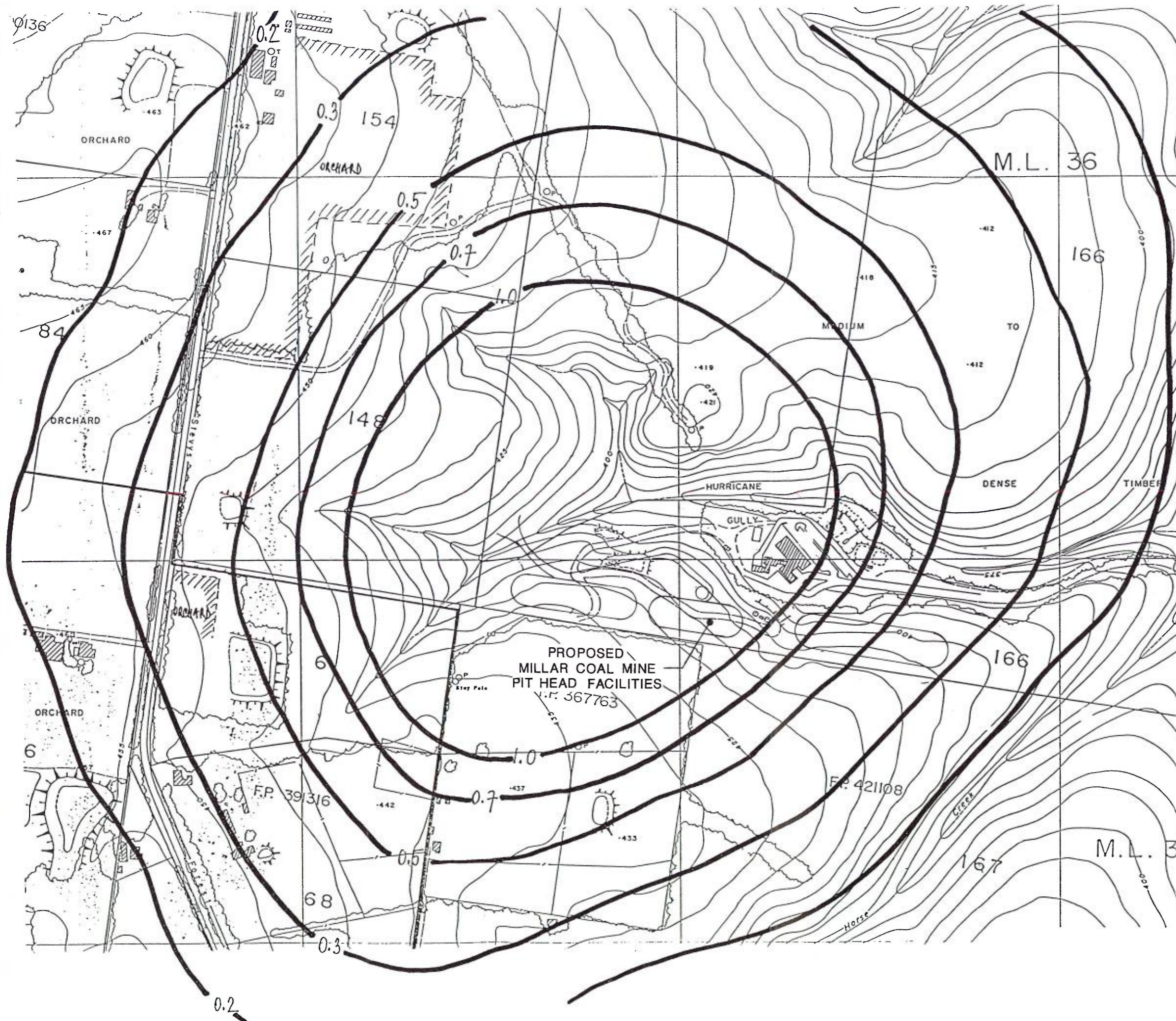
Dust levels will decrease more rapidly with increasing distance from the surface facilities in all remaining directions. An increase of approximately 0.2 to 0.25 $\text{g/m}^2/\text{mth}$ in the mean annual deposition rate is predicted for the nearest residences located along Stevys Forest Road to the northwest and west-southwest from the operation.

This predicted increase remains safely below the amenity based criterion of 2.0 $\text{g/m}^2/\text{mth}$ defined in Section 4.8.4 as the maximum acceptable mean annual increase over background for all land uses surrounding the proposed pit top site.

The area contains a number of commercial orchards, and one of the main aims of the detailed air quality study carried out for the Millar Mine was to examine the likely increases in dust deposition in those locations. Indeed, advice received from the SPCC indicated that no significant air pollution problems were anticipated to result from the propose development safeguarded by the implementation of standard controls.

The mean annual increase in dust deposition predicted in Figure 4.10 confirms this advice. The predictions also indicate mean annual increases in dustfall at the nearest distances to existing orchards to be limited to about 0.30 $\text{g/m}^2/\text{mth}$ at the small orchard on the eastern side of Stevys Forest Road to the WSW of the Millar Mine, and about 0.35 $\text{g/m}^2/\text{mth}$ at the eastern limit of the orchard located to the northwest. Those increases represent about 15 percent of the SPCC criteria and will

MILLAR COAL MINE



Predicted Increased in Mean Annual
Dust Deposition Rates
(g m²/month)

NOTE: All altitudes in meters above
Australian Height Datum

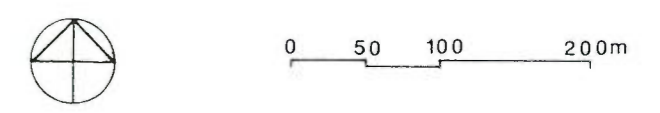
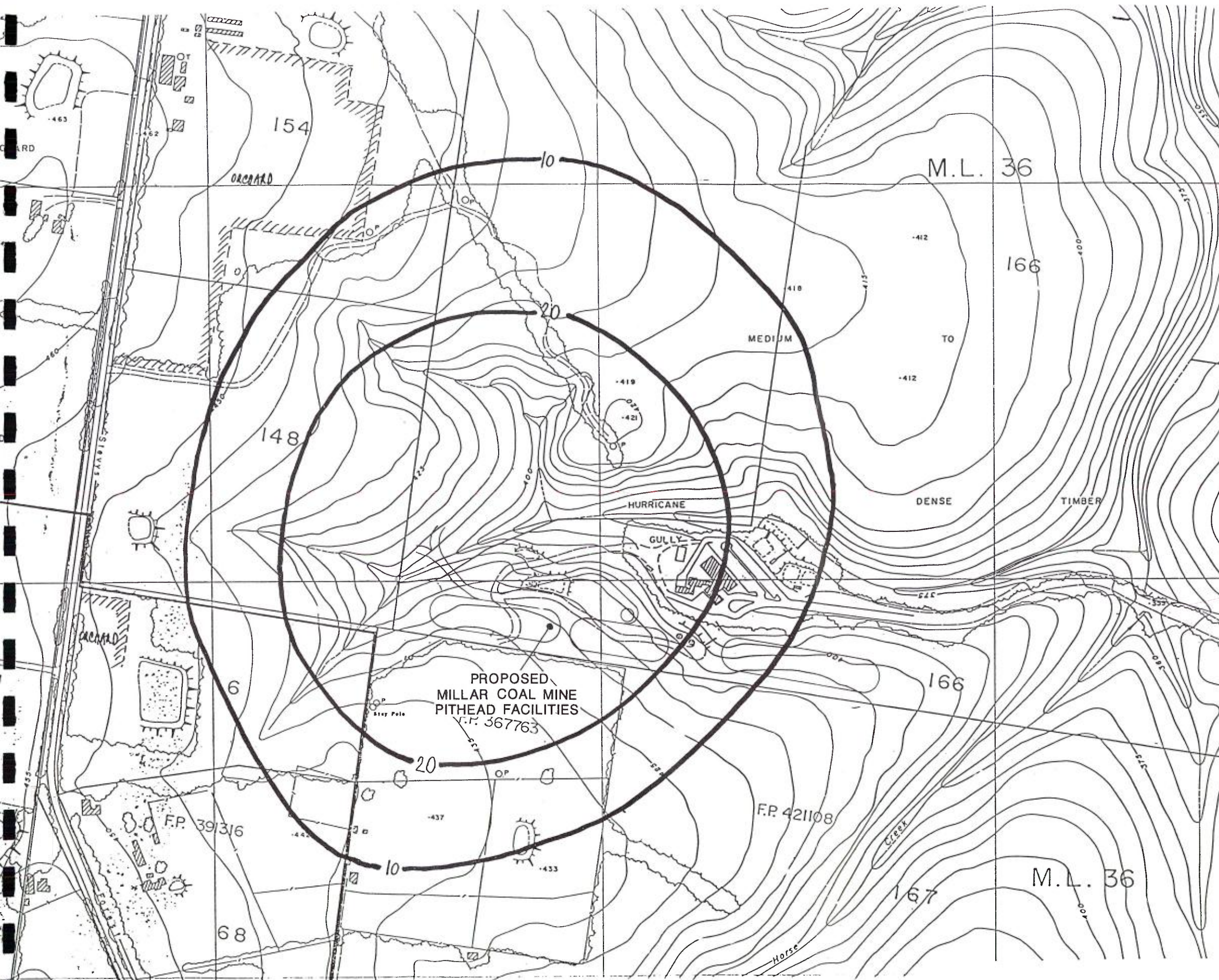


Figure 4.8
**INCREASES IN DUST DEPOSITION
PIT TOP CONSTRUCTION**
Source : P ZIB ASSOCIATES

MILLAR COAL MINE



20

Predicted Increase in Mean Annual Concentrations of Total Suspended Particulates (micrograms/m³)

NOTE: All altitudes in meters above Australian Height Datum

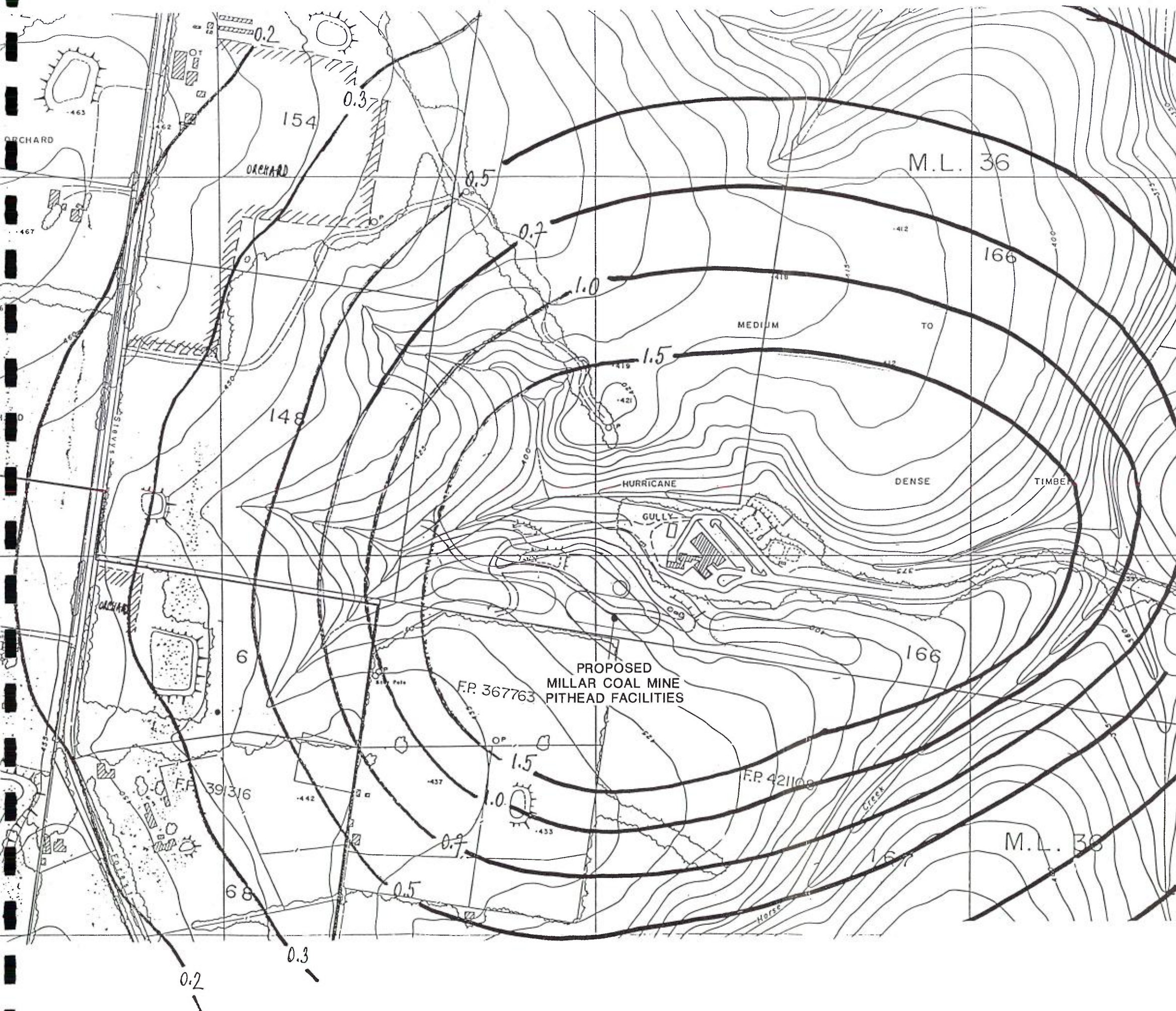


0 50 100 200m

Figure 4.9
INCREASES IN TOTAL SUSPENDED PARTICULATES
PIT TOP CONSTRUCTION

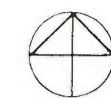
Source: P ZIB & ASSOCIATES

MILLAR COAL MINE



Predicted Increased in Mean Annual
Dust Deposition Rates
(g/m²/month)

NOTE: All altitudes in meters above
Australian Height Datum

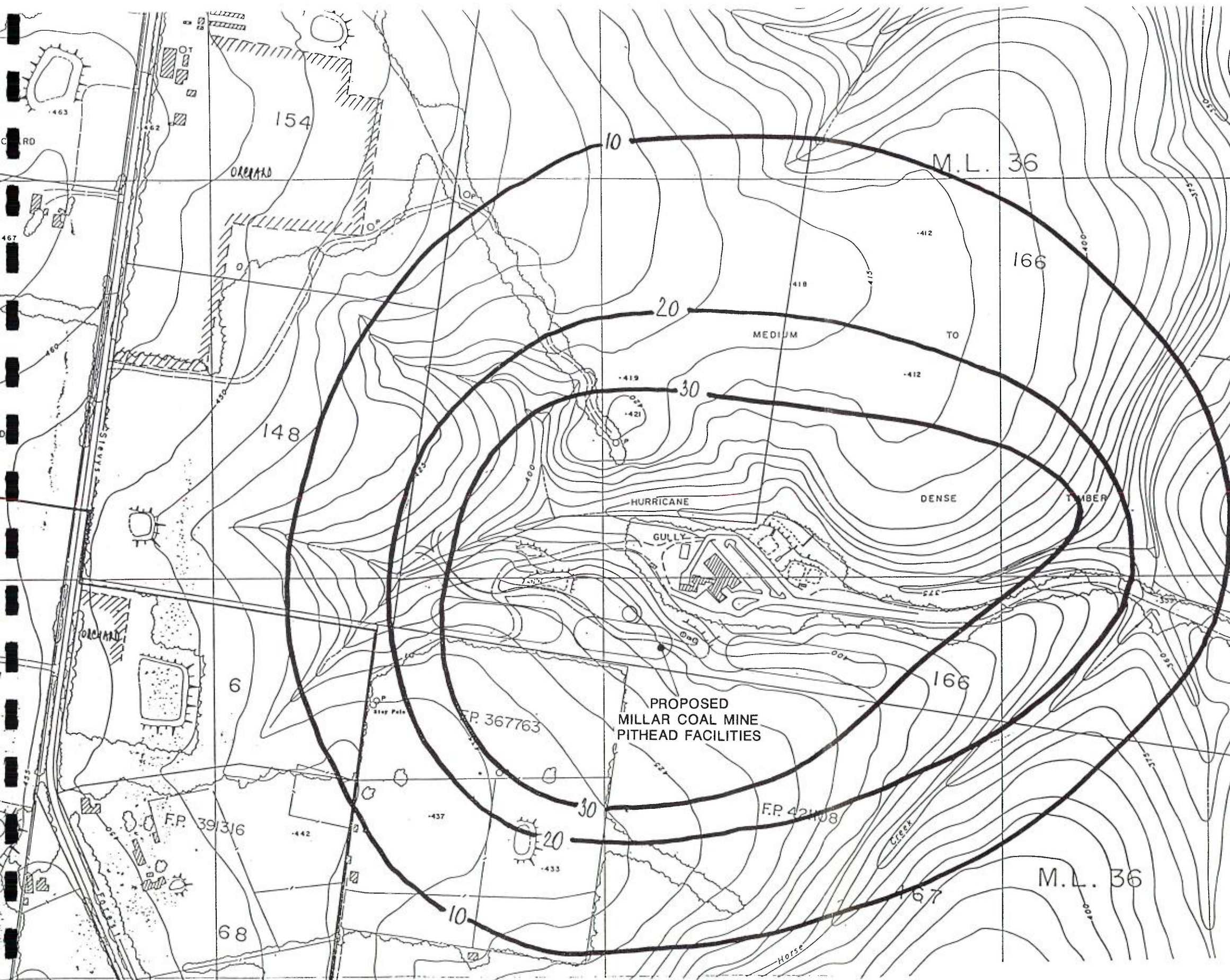


0 50 100 200m

Figure 4.10
INCREASES IN DUST DEPOSITION
MINE OPERATION

Source: P ZIB & ASSOCIATES

MILLAR COAL MINE



20

Predicted Increase in Mean Annual Concentrations of Total Suspended Particulates (micrograms/m³)

NOTE: All altitudes in meters above Australian Height Datum



0 50 100 200m

Figure 4.11
INCREASES IN TOTAL SUSPENDED PARTICULATES - MINE OPERATION

Source: P ZIB & ASSOCIATES

not result in any adverse affects on the operation of the orchards and the quality of the produce.

The large majority of orchards in the area are located further away from the proposed Millar Mine. The increase in dustfall at those orchards as a result of the operation of the surface facility will be even lower than the above predictions due to a better dispersal in the air over longer distances.

Predicted increases in the mean annual concentrations of total suspended particulates in the ambient air, shown in Figure 4.11 indicate the increase at the nearest residence will be less than 10 micrograms of particulate matter in a cubic metre of air.

The current concentrations of total suspended particulates found in the air near the proposed Millar Mine are not known. It may, however, be estimated from measurements obtained in similar locations throughout NSW that the mean annual values are likely to be between 20 and 30 $\mu\text{g}/\text{m}^3$. This range would also be consistent with the mean annual deposition rate of 1.0 g/m^2 measured at the proposed site and the typical relationship which exists between concentration and deposition levels in most environments. It is evident therefore that an increase in concentration of less than 10 $\mu\text{g}/\text{m}^3$ predicted at the nearest residences as a consequence of the present air quality and the resulting air quality will be well within the public health criteria defined in Section 4.8.4.

Estimates of short-term increases of the order of hours to a day in the concentration of total suspended particulates were made for conditions of moderate to strong winds blowing over the coal stockpile and loading areas. An analysis of the wind data for Camden included in Figure 4.2 shows that the strongest and most persistent winds are associated with westerly to southwesterly directions.

The nearest residences and orchards located to the east of the proposed mine and hence downwind of the surface facilities in strong westerly winds are about 1000 metres away. Sample calculations, including for coal loading at a rate of 10 trucks per hour and wind erosion of

surfaces in the stockpile area, indicate that the estimated increase in hourly peak concentrations could reach 75 ug/m^3 at the residences during strong westerly winds coinciding with coal loading by front end loader to trucks in the product stockpile area.

The average concentration period of 24 hours would be considerably less than the hourly peak of 75 ug/m^3 depending on the duration of coal loading and the continuing presence of strong winds. It is therefore evident that the maximum 24 hour concentration of total suspended particulates from coal operations at the Millar Mine will reach only a fraction of the primary USEPA standard of 260 ug/m^3 to protect public health.

. Conclusion

The results of the modelling study show that neither residential amenity nor public health will be adversely affected by the proposal. A range of air pollution safeguards will be implemented at the proposed mine to minimise generation of atmospheric dust, the main feature of which will be the provision of a sealed road for coal haulage to Stevys Forest Road, as well as the sealing and regular maintenance of internal roads at the site.

The decision by the Company to seal all roads will effectively eliminate coal haulage as a major source of atmospheric dust and will, together with the use of standard controls for coal handling at the site, ensure there will be no adverse effects of the operation on the orchards located in the area.

4.9 VISUAL CHARACTERISTICS AND SCENIC QUALITY

4.9.1 Method of Assessment

The objective of the landscape assessment has been to identify areas with different visual characteristics and scenic quality and to establish the level of tolerance of these different areas to

disturbance. The method that has been used is the "National Forest Landscape Management" system, developed in the USA by the Forests Service of the Department of Agriculture (USDA, 1974). This system aims to minimise subjectivity in the assessment of scenic quality. It is conducted by the following sequential process:

- . identification of areas with similar visual characteristics, known as landscape character types, and assessment of their inherent visual quality; the latter part of this step is somewhat subjective but it can be minimised by an analysis of the attractiveness of the main visual characteristics of a particular area, such as topographic, vegetation and land usage patterns;
- . determination of sensitivity levels by establishing how frequently an area is viewed and by what kinds of viewers, as well as the proximity of a point in the landscape to a viewing location; and
- . a synthesis of the two key factors, inherent visual quality and sensitivity levels, to determine areas with differing levels of tolerance to disturbance.

Details of specific aspects of the assessment methodology are given in the sections that follow.

4.9.2 Visual Context of the Study Area

The Millar Mine lease area is located within the Macarthur Region which has been defined by the Department of Planning in a regional environmental study (1986) as a mix of urban and rural land uses.

The site is situated in the Oaks Valley on the western elevated sections of the Monkey Creek Catchment. This landscape unit is within an attractive rural and natural setting consisting of farmland areas, rolling terrain, strongly defined patterns of contrasting vegetation and rugged gorge country.

4.9.3 Landscape Character Types

An area that has a common appearance or character due to the peculiarities of the terrain, vegetation cover, land use and presence of water bodies within it, is referred to as a landscape character type. Character types are used as the basic reference point in the determination of the varying degree of scenic quality that applies to an area.

The lease area is dissected by two prominent south-north orientated gorges, formed by Horse and Back Creeks which flow north towards Monkey Creek. The resulting landscape character may be described by the two following visual units which are shown in Figure 4.12: -

Rural

This unit consists of rolling terrain which has been mostly cleared for apple orchards and pastures. It occupies a significant proportion of the site and has a moderate scenic quality.

Natural

In contrast, the natural landscape unit consists of distinctive natural features within a natural setting. Typical of this unit are steep sided gorges, rocky outcrops and densely vegetated plateau areas. The landscape unit can be clarified as being of high scenic quality.

A summary of these visual units is given in Table 4.17.

MILLAR COAL MINE

- Concern for Visual Resources
- Natural
 - Rural
 - Lease Boundary
 - Proposed Millar Coal Mine Pithead Facilities



0 0.5 1km

Figure 4.12
VISUAL UNITS

TABLE 4.17
SCENIC QUALITY CLASSES

Visual Unit	Scenic Quality Class
Rural	Moderate
Natural	High

4.9.4 Sensitivity Levels

Sensitivity levels are a measure of people's concern for the scenic quality of an area. They are based on a combination of distance from a viewing point and the type of viewer. Concern will vary significantly according to the motivations of the viewer: a resident who views an area every day will be affected more by changes to the landscape than will a non-recreational traveller passing a site. Greater concern for the aesthetics of the landscape will also be expressed by travellers who are sightseeing than those who are travelling for work.

Around the study area, a tiered hierarchy of travel routes and viewing points was identified according to the number and motivations of travellers or viewers using them, taking into account the following factors:

- . the viewshed from primary dwellings is of the highest importance or sensitivity;
- . the viewshed from roads with the greatest volumes of traffic or leading to important recreational sites will have generally higher sensitivity because of the large number of travellers they carry, a significant number of whom will be sightseers; and
- . the viewshed from local roads will be less significant, as they will carry lower volumes of traffic.

The sites and travel routes making up the levels of viewing significance are given in Table 4.18.

TABLE 4.18
RANKING OF VIEWING POSITIONS ACCORDING TO SENSITIVITY

Level 1: Highest Sensitivity	Level 2: Moderate Sensitivity	Level 3: Lowest Sensitivity
Primary dwellings	Burraborang Road Oakdale Village	Stevys Forest Road Egans Road Dairy Road Unsealed roads

Note: extensive sections of level 3 roads have a level 1 classification due to primary dwellings.

The second component in the determination of sensitivity levels is the distance from viewing point factor. In this regard, three categories are normally used, that is foreground, middleground and background. These have the following characteristics:

- . the foreground allows the detail of the landscape to be observed and is within 0 to 400 metres of the observer;
- . the middleground is that area where visual features and patterns are apparent and is located between 400 and 3500 metres of the observer; and
- . the background is that part in which distinction of general colouration and form is all that is possible and it is beyond 3500 metres of the viewer.

The sensitivity level rating of an area is determined by combining the sensitivity rating of the viewing point and the distance factor. In this study, difficulties sometimes arose because some areas could be

viewed from more than one distance zone or from places with a different sensitivity value. When such a situation arose the more restrictive sensitivity level was adopted, as is illustrated by the following chart.

<u>fg1</u>	<u>mg1</u>	<u>bg1</u>	<u>fg2</u>	<u>mg2</u>	<u>bg2</u>		
bg2	fg1	mg1	bg1	fg2	mg2	bg2	<p>The most restrictive sensitivity level can be easily determined by use of this chart. If an area has been identified as both mg2, fg2, these can be compared (mg2 in the left column versus fg2 in the top row) to determine that fg2 is the proper (or more restrictive) designation for that area.</p>
mg2	fg1	mg1	mg2	fg2	mg2		
fg2	fg1	mg1	fg2	fg2			
bg1	fg1	mg1	bg1				
mg1	fg1	mg1					
fg1	fg1						

Note: Sensitivity Level: 1-High, 2-Moderate, 3-Low

Distinctive Zones: fg-foreground, mg-middleground, bg-background

The sensitivity levels for the study area are shown in Figure 4.13. These incorporate, to the fullest extent possible, the screening provided by landform only, although some interpretation is used. They indicate the two Main Creek gorges including the pit head site and some adjacent plateau areas are unseen from all viewing points. The remaining lease area has a high landscape sensitivity level.

4.9.5 Landscape Management Zones

The proposed mine site is within an important element of the Millar Colliery landscape so that the overriding visual quality objective should be to preserve the existing level of visual amenity in the area. This can be achieved by determining management zones which indicate the tolerance of different areas to disturbance.

Landscape management zones are achieved by combining the scenic quality data with the sensitivity levels. The method of combination gives three levels of ranking, namely:

- . Zone A: High Concern for Visual Resource
- . Zone B: Moderate Concern for Visual Resource
- . Zone C: Low Concern for Visual Resource

The greatest landscape value has been given to those visual units that are in the foreground and have high inherent scenic quality. The full range of possible rankings is shown in Table 4.19. Management zones within the study area are shown in Figure 4.14.

TABLE 4.19
DEFINITION OF LANDSCAPE MANAGEMENT ZONES

Scenic Quality Class (see Figure 2.6)	Distance Zone - Sensitivity Level*						
	fg1	mg1	fg2	mg2	fg3	mg3	Unseen
High	A	A	A	A	B	B	B
Moderate	A	A	B	B	C	C	C
Low	B	B	B	C	C	C	C




* Sensitivity Levels: 1-High, 2-Moderate, 3-Low

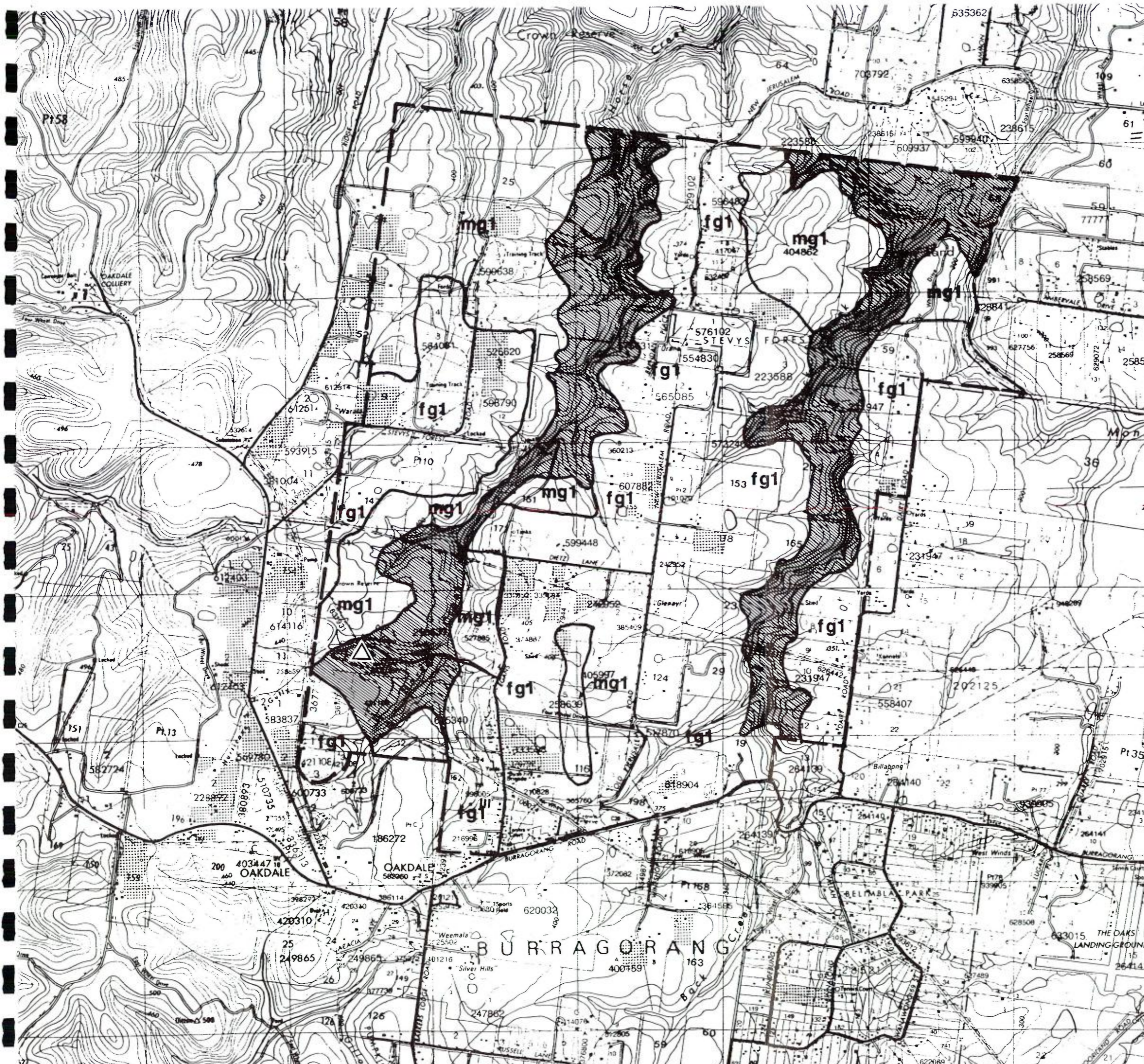
Distance Zones: fg-foreground, mg-middleground, bg-background

Zone A: High Concern for Visual Resource

This zone forms the major part of the study area and is a consequence of a large number of high sensitivity viewing positions obtained from the many primary dwellings scattered throughout the site. Within this zone are found both rural and natural visual units which can be viewed in the foreground and middleground levels.

MILLAR COAL MINE

- fg1 fg1
- mg1 mg1
-  Unseen
-  Lease Boundary
-  Proposed Millar Coal Mine Pithead Facilities







0 0.5 1km

Figure 4.13

MILLAR COAL MINE



-  Zone A High
-  Zone B Moderate
-  Lease Boundary
-  Proposed Millar Coal Mine Pithead Facilities



0 0.5 1km

Figure 4.14

LANDSCAPE MANAGEMENT ZONES

MITCHELL MCCOTTER

Alterations or disturbances in this zone should be minimal and should be minimal and should be sensitive to the form, line, colour and texture in the host landscape and no contrasting elements should be apparent.

These management principles imply that substantial development, such as the proposed pithead development, would not be appropriate in this zone. However, construction of the haul route would be acceptable if environmental constraints are considered.

Zone B: Moderate Concern for Visual Resource

This zone includes the unseen sections of the site in which the pit head facilities are to be located and consists of densely vegetated plateau and gorge areas. It is mostly in the middleground from level 1 viewing points, which are mostly primary dwellings.

Alterations to this zone may occur and should subordinate to established landscape characteristics. Modifications to this zone should not be visually dominant for more than two years. Activities may introduce form, line, colour and texture which are found infrequently or not at all in the characteristic landscape, but they should remain subordinate to the visual strength of the characteristic landscape.

The implications of these management practices for pit head development are that it would be acceptable if appropriate controls on the appearance and siting of structures and suitable landscaping are adopted.

4.9.6 Visual Safeguards and Impact Assessment

The pit head site is currently unseen from all nominated viewing positions and will remain so even when all necessary vegetation has been cleared to allow construction to begin. However, the site is in an area of high scenic quality and it has been classified as having a moderate concern for visual resource (Zone B). Sections of the proposal will be locally visible from surrounding private property. It therefore

warrants appropriate visual safeguards to be incorporated in the various facilities and these are addressed in Section 3.9.

Sections of the haul routes from the pit head to Stevys Forest Road will be seen from some viewing points and are in an area of moderate scenic quality. Accordingly, they are classified as having a high concern for visual resource (Zone A), truck movements thereon will be visible from viewing points along Stevys Forest Road including a local house in the vicinity of haul route option A.

4.10 MINE SUBSIDENCE

4.10.1 Introduction

When sufficient coal is removed by underground mining, the immediate roof caves leading to the lowering of the natural ground surface level. Given local geological conditions and the proposed mining methods, which employ a longwall and to lesser extent continuous miner extraction techniques, this subsidence is expected over much of the underground mine area. If ground subsidence is sufficiently extensive, damage can be caused to surface improvements and to natural geographic features.

Rather than sterilize significant coal reserves, it is often more economically sound to relocate surface improvements or repair them. Damage to surface improvements caused by mining can be compensated under the Mine Subsidence Compensation Act 1961. Under the Act, the Mine Subsidence Board can undertake works that minimise damage and can compensate land owners by monetary payments, the repair of damage assets or the purchase of land. The Board's activities are funded by a levy on all coal producers.

In addition to its provisions for payment of compensation for damage to land and/or improvements caused by mine subsidence following the extraction of shale or coal, the Act also provides for controlling development within proclaimed Mine Subsidence districts. However, none

of the mines operated in the Burraborang Valley by Clutha Coal Pty Ltd are in a prescribed subsidence district.

The proposed mine plan extracts as much coal resource as is possible subject to safety and economic feasibility, and is consistent with Government policy for conservation and proper utilisation of the State's natural resources.

Section 138 of the Coal Mines Regulation Act provides that only the Minister can authorise mining methods other than first workings by the bord and pillar method. It follows that the State Government and not the Company has the right to authorise coal extraction which would lead to subsidence.

The Company, in the normal operation of the Oakdale Mine, consults with the Mine Subsidence Board and the Department of Minerals and Energy.

4.10.2 Previous Subsidence Experience

Owing to the fact that the Company's coal reserves are not in a prescribed subsidence district and that most of its leases lie beneath inaccessible Water Board land, there has been little opportunity or need for subsidence monitoring apart from the cliff face above the now closed Nattai North Colliery.

Pillar removal is practised in both the Oakdale and Brimstone Mines and in part of the Nattai South Mine.

Limited measurements of subsidence have taken place over Brimstone Colliery indicating maximum subsidence of between 700 and 900 mm related to a depth of coal seam between 350 and 380m. Measurements at another Southern District Colliery have revealed subsidence in the order of 700 mm from mining of the Bulli Seam of thickness 2.1 metres at a depth of cover of 450 m.

Previous complaints relating to subsidence damage in the last five years have only concerned small surface cracks in a private dirt road off the

Burraborang Valley Road at Oakdale. They were caused by mining at Nattai Bulli Colliery, now known as the Nattai South Colliery, and were easily repaired.

4.10.3 Magnitude of Predicted Subsidence

X The Millar Mine will be extracting the Bulli Seam at an average thickness of 2 metres with a depth of cover ranging from 350 to 500 metres. Notwithstanding use of the longwall mining system extracting 300 mm wide slices from a 100 m wide face, the amount of subsidence to be experienced is estimated to be in the range of 600 to 700 mm only. WH-1/3

4.10.4 Effects on Natural Features and Improvements

A description of existing land uses over the Millar Mine lease area is contained in Section 5.4 and shown in Figure 5.3. The lease area extends essentially from the Burraborang Road in the south for 4 km to the north, and from Dairy Road in the east to Stevys Forest Road in the west. It is traversed north/south by two major waterways feeding into the Burraborang Dam catchment, Horse Creek near the proposed pit head facilities and Back Creek some 2km to the east. The lease area is essentially rural in character and with the exception of dense bushland in the vicinity of creeks and gullies, the major agricultural activities are grazing and orchard production. A large number of man made dams exist in the area in support of same. Residential properties are associated with the village of Oakdale along Stevys Forest Road and the Burraborang Road as well as Egans Road and Dairy Road. Such properties are essentially along the edge of the lease area, those in the south eastern quadrant being associated with continuous miner extraction, and the remainder with longwall extraction.

Section 3.1 indicates that most of the land in the proposed Millar Mine lease area is privately owned except for small areas of Crown Land in the north and north eastern sections. No comprehensive inventory of property owners has been carried out for purposes of this environmental impact statement because of the provisions of the Mines Subsidence

Compensation Act described in Section 4.10.1, and the limited potential for subsidence predicted in Section 4.10.3.

Some damage may occur to buildings and surface improvements within the zone affected by subsidence. Prior to any mining, a detailed property examination may be required to find a proper basis for compensation claims.

Experience with other underground mines has shown that farming and mines can co-exist successfully especially if the mining company and property owners exchange information on detailed mine plans and farming practices that may be affected by same.

Mining beneath Horse Creek and Back Creek will cause limited subsidence of the Creek beds which may affect low flows in those watercourses and potential for flooding. However, these are not expected to cause any significant impacts.

Subsidence may also affect roads crossing the lease area to a minor degree, but it is considered subsidence induced pavement deterioration will be minimal. Certainly, this will be the case for the main roads on the boundaries of the lease area. The Company will liaise with the Roads and Traffic Authority and Council as appropriate in this regard.

Utility services that could be affected by subsidence will be power and Telecom lines and water supply facilities. Discussions will be held with the appropriate authorities responsible for these installations to seek ways to minimise any damage to these services. The cost of such preventative work is met by the Mine Subsidence Board under its legislation.

4.11 BUSHFIRE HAZARD

The proposed Millar Mine pit head is located close to extensive bushland associated with the Water Board's catchment area to the east of Warragamba Dam and therefore is in area where bushfire hazard is of

potential concern. This assessment draws upon information contained in a recent report (Mitchell McCotter, 1989) which addresses bushfire hazard in Wollondilly Shire which determines areas of high, medium and low bushfire potential, formulates planning guidelines for applications in such areas, and provides the basis for an effective fire management program.

4.11.1 Bushfire History

Figure 4.15 shows the extent of the Shire burnt out by major bushfires since 1964. In addition to these outbreaks, many others have occurred in the Shire but are not shown due to their relatively small size. It will be noted that the proposed Millar Mine pit head site is close to the areas affected in the 1964/65 season. Further, in the 1980/81 season, bushfires occurred to the west of Oakdale, adjacent to the Burragorang Tower (approximately 1800 hectares), as well as in small areas near Stevys Forest Road (less than 400 hectares).

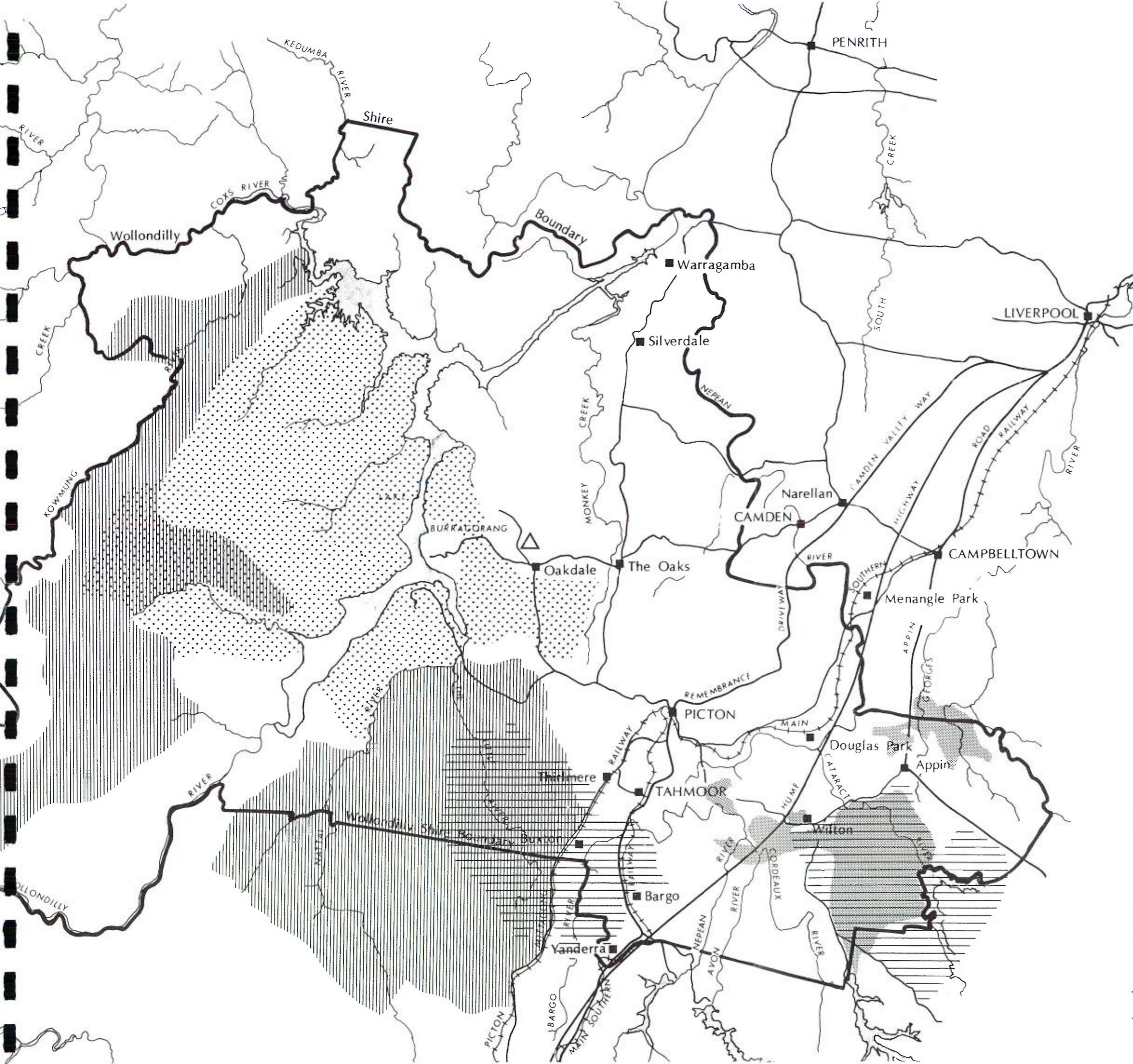
The bushfire season for Wollondilly Shire extends from October to April. Major bushfires in the past have had the tendency, once ignited, to move in an easterly direction. This is a consequence of the warm westerly summer winds which occur in this area.

4.11.2 Bushfire Potential





DoP has developed a method of fire hazard assessment (DoP Circular No. 74, "Planning in Fire Prone Areas") consisting of the following three stage process:

- (i) the subject area is placed within one of three fire zones;
- (ii) vegetation and slope maps are prepared for the study area, with the vegetation description being based on the capacity to produce fuel and flammability of different plant communities and the slope categories being those normally used for land capability assessment; and

MILLAR COAL MINE



AREAS BURNT OUT

-  1964/65 Season
-  1968/69 Season
-  1977/78 Season
-  1984/85 Season

 Proposed Millar Coal Mine Pithead Facilities



0 5 10km

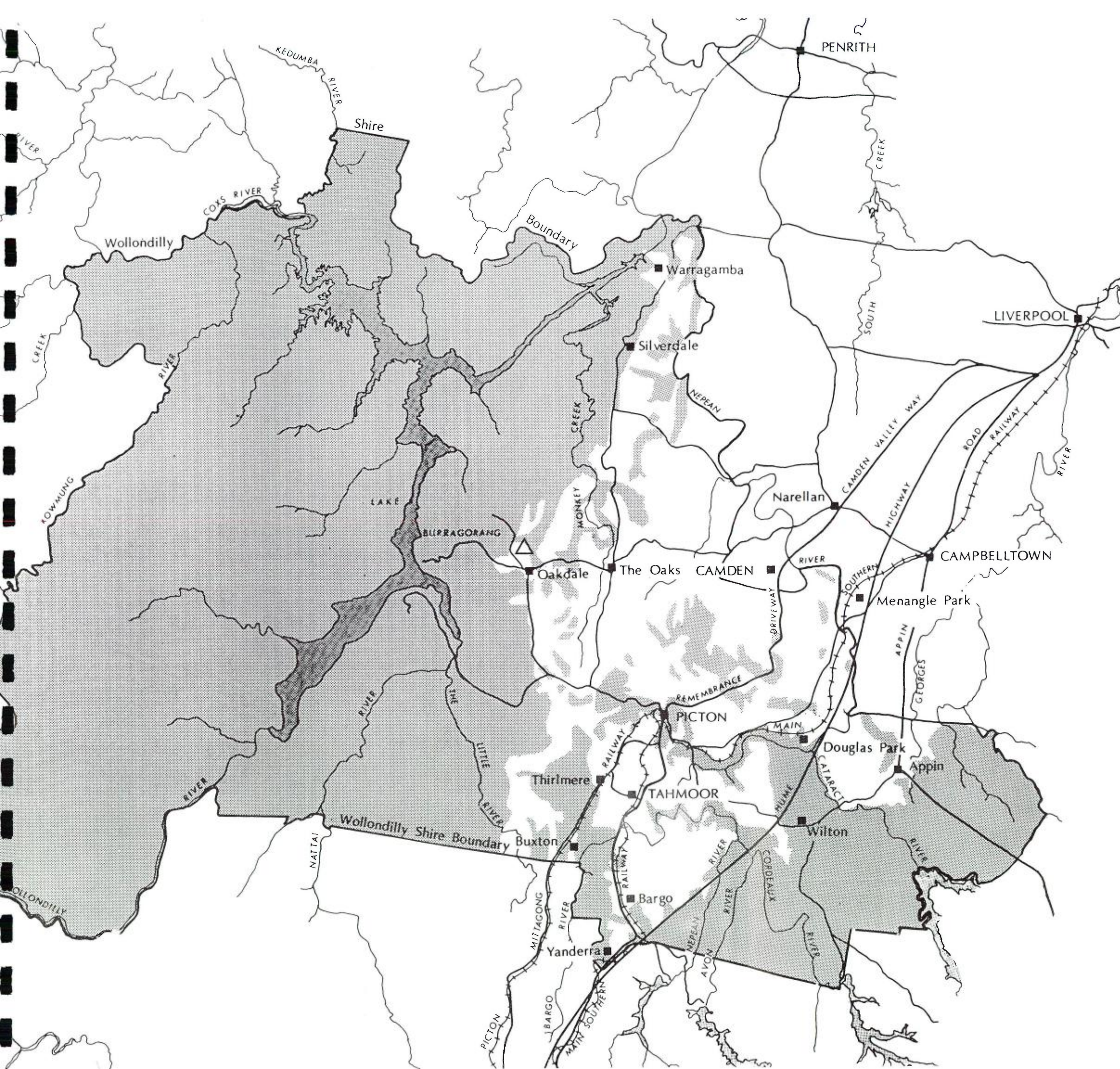
Figure 4.15

BUSHFIRE HISTORY

MILLAR COAL MINE

-  High - Moderate
-  Low
-  Proposed Millar Coal Mine Pithead Facilities

NOTE: For planning purpose the 1:50 000 D.O.P. Hazard Maps should to used



0 5 10km

Figure 4.16

BUSHFIRE HAZARD

(iii) the hazard is determined by allocating a score to each vegetation community, according to the likely intensity of a fire from the fuel produced, and a score is given for each slope category, according to the inferred rate of spread of a fire over the slope in question. The degree of hazard is determined by multiplying the two scores together.

This method has been used in the Macarthur Regional Environmental Study (DoP, 1986) from which the Shire has been mapped as shown in Figure 4.16. The area is part of the Warragamba Dam catchment area, which is densely vegetated bushland with relatively few natural or man-made fire breaks. It is, therefore, assumed that the bushfire hazard in this part of the Shire is high.

The Millar Mine pit head site is located on the banks of Hurricane Gully a tributary of Horse Creek, within the catchment of Monkey Creek which drains north into Warragamba Dam. The system of incised gullies which comprise the dissected country within the catchment are densely forested, the high country between having been cleared for agricultural purposes. The environmental setting of the specific pit head locality is described in Section 4.4.2 with local vegetation distribution as shown in Figure 4.4. The site, which is within 1 kilometre of residential development on Stevys Forest and Egans Roads, is surrounded by substantial areas of sclerophyll forest associated with the gully system, any conflagration of which would spread rapidly up the valley slopes. Accordingly, the pit head site must be given a high hazard rating.

The nature of the facilities to be provided, particularly the coal stockpiles and coal handling facilities and their associated activities, are potential sources of fire outbreak for which adequate fire controls and management will be necessary.

Safeguards to be provided for fire control are addressed in Section 3.5. They include for emergency water supply tanks fed by the minewater rising main and fire reticulation mains and hydrants. Trafficable

access will be provided around the stockpiles and relevant sections of the perimeter of the site to implement bushfire protection measures required for surrounding vegetation. Consideration will also be given to the provision of appropriate firebreak trails external to the site for clearance on a 6 to 7 year basis.

Fire outbreaks will be treated as emergencies for prompt attention using facilities on site with the support of the local fire brigade for more serious outbreaks.

5.0 DESCRIPTION OF SOCIO ECONOMIC ENVIRONMENT AND IMPACT ANALYSIS

5.1 PLANNING FRAMEWORK

5.1.1 State and Regional Planning Policies

There is no State Environmental Planning Policy nor Regional Environmental Plan directly relevant to the proposal. However, the Draft Sydney Regional Environmental Plan - Macarthur Rural Lands (DoP, 1989) has recently been placed on exhibition for public comment.

As a first step in formulating the draft plan, the Department of Planning investigated the region's resources and assessed planning issues and policy implications for various matters related to future development. These are contained in a Regional Environmental Study (DoP, 1986) which includes the following references applicable to coal mining in the area:

"In planning for possible future urban development in the southern part of Macarthur, it will be necessary to resolve the issue of access to coal, including identification of locations for pit heads and ventilation shafts.

The Glenlee site could be rehabilitated. Camden and Campbelltown Councils should review its continued use for coal mining purposes (eg. coal washing, mining and road/rail interchange)".

"To ameliorate adverse transportation and environmental effects, it may be necessary to limit the number of operational mines at any one time, with priority being given to those which would be associated with industrial development, eg. Glenlee and Nepean (Maldon). Preferred locations for road/rail interchanges are at Glenlee (to the Balmain Coal Loader) and Abbotsford Bridge (Picton) or Nepean (Maldon to Port Kembla Coal Loader via the Maldon-Dombarton-Port Kembla rail line now under construction).

Within Macarthur, there are no obviously suitable sites for coal washery reject disposal. If sites are to be identified, given the adverse environmental effects associated with such sites, further studies will be required to avoid possible land use conflicts. Use of alternative disposal methods, eg. ocean and underground disposal and fluidised bed combustion, should be viewed in combination with those methods used in Illawarra".

The 1986 Regional Environmental Study also identified the following regional aims and objectives relevant to coal mining:

"To protect currently worked mineral resources and preserve them for future exploitation and ensure that areas with resource potential remain available for future evaluation.

To ensure that sufficient extractive resources are available to meet foreseeable future demands".

5.1.2 Draft Regional Environmental Plan

The 1989 Draft Sydney Regional Environmental Plan - Macarthur Rural Lands includes a planning report describing the issues covered by the draft plan and, inter alia, provides an outline of policies relating to the extraction of coal, its transport and coal washing facilities. These are reproduced in Appendix 9.

The draft legal instrument lists the following objectives relating to coal resource development:

- (a) to manage coal resources in the region in an coordinated manner so as to meet community needs while ensuring that adverse impact on the environment and the community is minimal;
- (b) to ensure that proposed development is assessed in relation to its potential to render coal resources unavailable; and

- (c) to minimise haulage of coal on public roads in order to overcome conflict with other road users and the adverse environmental impact of such haulage.

The draft legal instrument also identifies the following policy and principle relating to coal resource development:

- (a) the consent authority shall only consent to a development application for a new coal mine or the extension of an existing coal mine where it has consulted with the Secretary, Department of Housing, or his nominee beforehand; and
- (b) before granting consent to a new coal mine, the expansion of an existing coal mine or other major coal industry work, the consent authority should be satisfied that there is a proposed environmentally acceptable mode of transport associated with the development which is, or is capable of being, integrated into a comprehensive system for handling all coal movements within the region. If public road haulage is the only feasible mode of transport, it should be restricted to the most environmentally acceptable route.

No future urban areas or rural residential areas (subdivisions of 2 to 40 hectares) are identified in the vicinity of Oakdale and the new Millar Mine. However, extensive areas for urban growth are identified between Picton and Wilton either side of the Picton Road which have implications for coal transport along that route as discussed in Section 5.6.8. Further, the Plan also identifies rural residential boundaries between The Oaks and Picton extending east to Douglas Park.

The Macarthur Regional Study identified areas of high conservation value because of their sensitive environmental qualities. The planning report of the Draft Plan identifies the area generally between Oakdale and Camden and between Picton and the Warragamba Dam as an area of scenic protection which therefore applies to the Millar Mine.

The draft legal instrument identifies the following objective, policy and principle with respect to environmentally sensitive lands:

- . to protect the scenic quality of the region while allowing orderly and economic development which is compatible with the natural landscape;
- . vegetation clearance, whether or not it is ancillary to a use that requires development consent, shall only be carried out with the consent of the consent authority;
- . a Council when considering development applications for land within such areas should have regard to the impact of that proposed development on prominent ridgetops or slopes, excessively steep land or river gorges and should only grant consent to vegetation clearance where it is satisfied that:
 - . appropriate measures will be taken to control soil erosion and preserve water quality of water courses, based on advice from the Soil Conservation Service;
 - . the removal of vegetation will not jeopardise the extent or functioning of important wildlife habitats or corridors;
 - . any rare or endangered species of vegetation will be conserved where practicable; and
 - . removal of vegetation will not jeopardise the cultural or scenic significance of the land.

The Draft Plan identifies items of environmental heritage. Those aspects relevant to the Millar Mine are addressed in Section 5.3. The Draft Plan also recognises a number of cultural landscapes which includes Oaks Valley/Monkey Creek to the east of the Mine. The Draft Plan contains guidelines for areas of heritage significance and includes

advice that a Council when considering development applications for land identified as a cultural landscape in the planning report should have regard to advice in those guidelines.

5.1.3 Local Planning Requirements

Statutory planning controls relevant to the proposal are contained within Interim Development Order No. 17 - Shire of Wollondilly.

A special uses 5(2) water catchment zoning affects land within and immediately adjacent to the proposed mine site.

Under this zoning, the proposal is permissible with the approval of Wollondilly Shire Council and the concurrence of the Director of Planning. As the proposal is 'designated' by the Environmental Planning and Assessment Regulation, the development application must be accompanied by an environmental impact statement, and processed in accordance with the procedures described in Section 2.6.

5.2 ARCHAEOLOGY

5.2.1 Introduction

An archaeological survey of the site (Rich, 1988) was undertaken as part of the environmental studies for the proposed pit head, coal handling and washery facilities of the Millar Mine. The aim of the study was to:

- . undertake an archaeological survey of the area of the proposed development in order to locate and assess any Aboriginal sites present;
- . provide a general description of archaeological resources in the immediate locality outside the area of the proposed development;
- . prepare a brief draft report on the archaeological significance of the area; and

- . assess the potential impact of the proposed development on the archaeological significance of the area.

5.2.2 Environmental Setting of the Survey Area

This is described in general in Section 4.4 which addresses the flora and fauna survey. The spur to the north of the existing Oakdale Colliery No. 3 shaft is bounded by Hurricane Gully to the south, Horse Creek to the east and a tributary of Horse Creek to the north. It is a small off-shoot of a ridge which extends from Mittagong and the Southern Highlands continuing north past the survey area to overlook Lake Burragorang.

The top of the spur consists of open woodland dominated by regenerating stringybarks with a few mature trees and thick understorey in places. The spur has probably been logged or cleared in the past. The land has been cleared in the vicinity of the motorcross track and a graded track crosses the top of the spur. Two transmission lines cross the western side of the survey area and a track has been graded along the western end of the southern access option. The upper slopes of the northern gully consist of open forest with fairly open understorey. Along Hurricane Gully, the vegetation is generally open woodland, heath species occur around the upper contours and coachwood and ferns populate the lower contours. Such vegetation is described in detail in Section 4.4.4.

5.2.3 Survey Methodology

Prior to the archaeological survey, the Register of Aboriginal sites maintained by the National Parks and Wildlife Service was checked to determine whether sites were known to occur in or adjacent to the survey area. Two sites had been recorded 3 kilometres to the north-west.

The archaeological survey was carried out in November 1988. A member of the Tharawal Local Aboriginal Land Council was also present who has

verbally agreed to the archaeologist's recommendations and who will report to the Land Council on the survey.

The route of the north road option was followed. The tracks on top of the spur and the cleared area in the survey area were inspected for open sites. Slashed survey lines were also followed. As visibility was low, the eastern section of the motocross circuit was also inspected. In all, about 20 percent of the top of the spur was inspected with about 5 percent of the area having reasonable ground visibility.

The valley of Hurricane Gully was inspected by walking parallel transects along contour lines. Sandstone ledges were inspected for shelters. Sandstone platforms along the gullies and on the side of the valley were inspected for engravings and axe grinding grooves.

The route of the southern road option was then followed up the spur to Stevys Forest Road.

5.2.4 Survey Findings

Two platforms were noted on top of the spur which were considered unsuitable for engravings or axe grounding grooves, both having been damaged by previous construction works.

Occasional sandstone boulders up to 2 metres in size were noted along the western end of the northern gully and the upper northern slopes of the spur but these were too small to have formed shelters.

Discontinuous sandstone lodges up to 5 metres high and some large boulders were noted along the sides of the valley above Hurricane Gully. Four habitable shelters were found along this section of the survey area, one of which had an earth floor with a potential archaeological deposit (PAD). Only this shelter had a wall suitable for art. An upturned boulder had also weathered to form a shelter but without a floor; the wall and ceiling of this boulder had niches suitable for art but none were found.

Horizontal sandstone platforms were exposed along the west end of Hurricane Gully and the tributary gully. In places, these were smooth and associated with rock holes; but no axe grinding grooves were evident. A platform also occurred on the valley slopes above the gully which flows into Hurricane Gully. This had a smooth surface suitable for engravings and axe grinding grooves; but none were found.

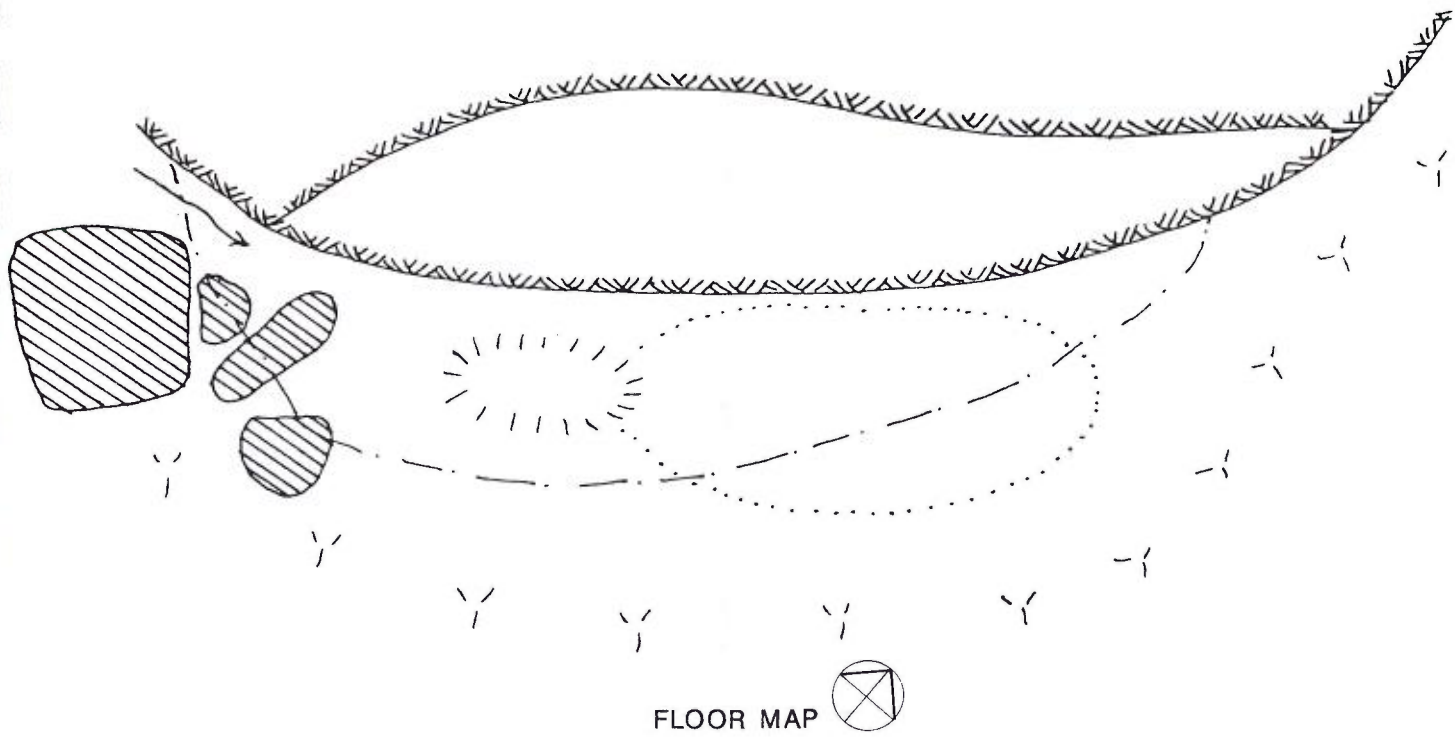
In places, the sandstone contained small quartz pebbles, but these were not of artefact quality.

5.2.5 Shelter with Potential Archaeological Interest (PAD)

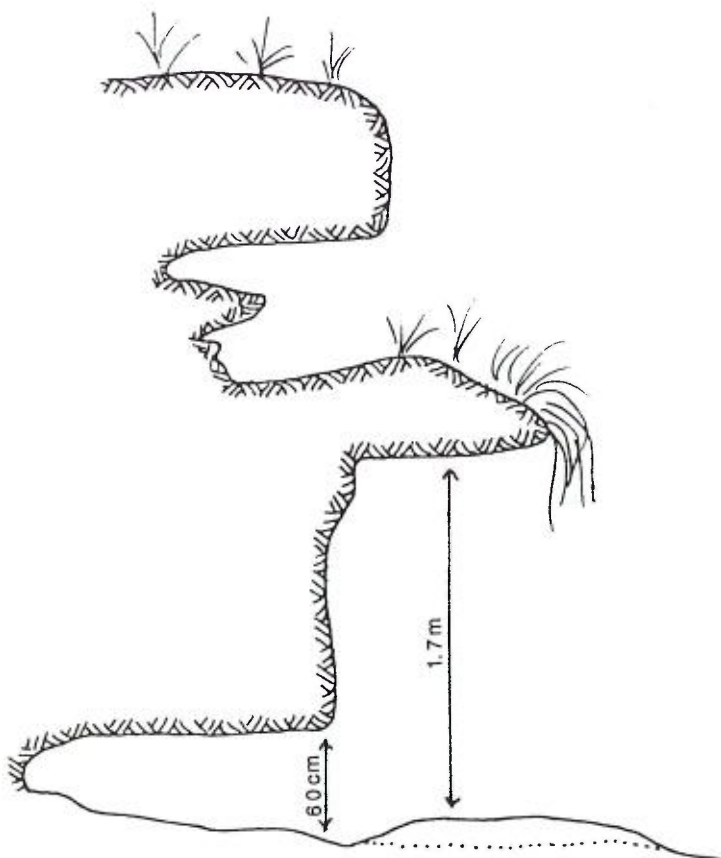
The one potential archaeological deposit recorded during the survey was located on the northern side of Hurricane Gully about 5 metres from the Gully and 2 metres above it. The vegetation consisted of coachwood and bracken. The shelter was 20 metres from and about 10 metres below the proposed route of the southern road option. The approximate position of the shelter is shown in Figure 4.1.

The shelter has formed under a ledge which outcrops discontinuously above Hurricane Gully and is shown in Figure 5.1. The shelter is 6.5 metres long with about 5 metres of usable floor space. It is 1 to 1.5 metres wide and about 1.7 metres high. It has a low overhang which extends under the back wall. It faces the south-east with an aspect of 140°. The back wall of the shelter is smooth enough for art, but is weathered and is almost covered with white and red accretions. Further, a large wombat hole has been dug into its floor and an uprooted tree lies in front of it.

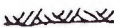





While the shelter is quite likely to be a site, the disturbance caused by the wombat would substantially reduce its potential for archaeological research and therefore, its archaeological significance.



FLOOR MAP



CROSS SECTION

-  Bedrock
-  Roof Fall
-  Drip Line
-  Wombat Hole
-  Edge of Clay Soil
-  Edge of Slope to Gully

Location Shown on Figure 4.1

Figure 5.1

NOT TO SCALE

POTENTIAL ARCHAEOLOGICAL DEPOSIT

Source: ELIZABETH RICH November 1988



Photo 1: Shelter with Potential Archaeological Deposit.
Take from the south end of the shelter.

5.2.6 Local Archaeological Context

Archaeological and ethnohistorical information for the ranges around Lake Burraborang and the Nattai River is very poorly documented. There have been very few archaeological surveys in this area and there are few known sites. Some of the ethnohistorical information has been collated by Martin (1986) and Rich (1988), but there has been no detailed research or analysis of sources.

Relatively few Aboriginal sites are known for the Oakdale-Nattai area. Only two sites have previously been recorded within a 3 kilometre radius of the survey area. These are both shelters with art and were recorded by a ranger from the National Parks and Wildlife Service.

A systematic archaeological survey of three small gullies at Nattai 4 kilometres west of the survey area was carried out in 1984. This survey

and subsequent test excavations resulted in the identification of six sites. These sites are shelters with art and/or occupation deposit, and axe grinding grooves are associated with a rock well. The axe grinding grooves are located on the edge of a ridge top, while three of the shelters occur mid-way down the valley sides. Two other shelters occur just above the valley floor (Haglund et al, 1984).

An archeological survey has recently been carried out south of Camden (Smith and Crew, personal communication). This area covered a ridge top and upper slopes. Eight shelters with art (one with more than 70 figures) were recorded.

These two surveys and the present survey indicate that:

- . high densities of Aboriginal sites can be identified in this area through systematic archaeological survey, but only where the sandstone has weathered to form suitable shelters; and
- . sites can have high densities of stone tools or art motifs, or they may have scant remains with few stone artefacts and art figures.

Ethnohistorical sources indicate that the Burragorang Valley and the Cowpastures (around Camden) were favoured camping locations. There was a variety and abundance of food supplies, including kangaroos, possums, lizards, lizards' and birds' eggs, wombat, eels, fish and shellfish, and honey (Rich 1988:28). There would also have been a variety of vegetable foods.

On some occasions, people moved from the south coast and southern highlands (around Bong Bong) to the Lower Nattai, Burragorang and the Cowpastures. People from Burragorang also went further north to Prospect Hill and Parramatta (Rich, 1988:25).

The low open country of the Burragorang Valley and the Cowpastures were important camping places and people moved between here and the south coast and southern highlands. However, the extent to which the ranges

around these central locations were used is not clear at this time. Continuous ridge lines in otherwise rugged country may have provided important access routes between areas. Some shelters along these ridges may have provided temporary camp sites while travelling between areas.

The present survey area is located near a ridge system which leads from the Southern Highlands to Lake Burragorang. The survey area may have provided some food resources. If the PAD shelter is a site, then it may have provided shelter for temporary use during travel between these two areas.

Archaeological surveys to date indicate that shelter sites may have either dense occupation deposit and/or extensive art, or occupation evidence and art may be sparse. The sites with high densities of occupation evidence and art may represent much more than casual stop-over sites.

The PAD shelter recorded during the present archaeological survey may provide some information on past Aboriginal landuse, but because of its disturbed deposit, it would probably provide only restricted information.

5.2.7 Conclusions

The archaeological report recommends:

1. A surveyor should determine the precise location of the shelter with potential archaeological deposit in relation to the proposed development.

2. If a road is constructed along the route of the southern road option, then care should be taken not to inadvertently damage the shelter. Debris and overburden from the road construction should not be dumped down the slope towards the PAD shelter.
3. If the proposed development is re-designed, then facilities should be located away from the PAD shelter.
4. If it is not possible to avoid the PAD shelter, then the deposit should be test excavated to determine whether it is a site, and if so the likely nature of its deposit. If the shelter is found to be a site and it is not highly significant, then consent to destroy it should be sought from the National Parks and Wildlife Service. The opinion of the Tharawal Local Aboriginal Land Council to the destruction of the site should be sought if this circumstance arises. If the shelter is found to be highly significant, then it should not be destroyed.
5. Apart from the above constraints, the proposed development should be allowed to proceed.

5.3 EUROPEAN HERITAGE

5.3.1 Historical Background of the Region

The proposed mine site is located on the eastern margin of the Burragorang Valley. The Burragorang Valley region was first visited by Europeans in 1788. However, it was not until 1802 that the area became known through the journals of Francis Barrallier. It was officially discovered in the early 19th century by the explorer William Howell, after which it was used as a stock run by the first land holders. Settlement extended rapidly and development for agricultural and grazing purpose began.

A rich deposit of silver ore was discovered at Yerranderie in 1871 but was not developed until 1898. Up to 1950, nearly 11 million ounces of silver and over 27,000 tons of lead were won on the Yerranderie field. Coal was first discovered in the Warragamba Gorge in the early 19th century and coal outcrops were observed in the Upper Marine formations near the mouth of the Nattai River in the 1860s. Coal seams were opened up in the 1890s and prospecting followed through to the 1920s, but development was not considered worthwhile due to transport difficulties. In the early 1930s, the Nattai Bulli Coal Company commenced simple mining operations, hauling coal to Camden by truck. A degree of mechanisation followed up to, during, and after the War.

Development of Wollondilly Colliery to the north followed similar lines commencing in 1930, mechanisation resulting in the installation of belt conveyors in the 1950s. The Valley Collieries in the southern most part of the coalfields, commenced operations in 1957 via the No. 1 Colliery. In 1960, the Valley No. 2 Colliery was opened and subsequently amalgamated with Valley No. 1 Colliery in 1966. During 1970/71, a new road was built to develop Valley No. 3 Colliery to the south.

Construction of Warragamba Dam, to provide a major water resource for Sydney, commenced after the War and was completed in 1960. Flooding of the Burratorang Valley resulted in property relocation to the Oakdale area. A great detail of river gorge and tableland country was proclaimed for water catchment purposes and as a result, further development in the Valley after 1960 was severely limited.

5.3.2 Items of Heritage Significance

The Australian Heritage Commission, the Heritage Council of NSW, the National Trust registers have been searched to determine if any sites of heritage significance exist within the proposed mine study area and along coal haulage routes. The Macarthur Region Heritage Study (DoP, 1986) has also been used to identify items which represent evidence of the historical themes of the area.

Within the proposed mine site and lease area no items of heritage significance exist. However, the following items are located adjacent to the proposed coal haulage route from Oakdale to Glenlee:

- . Oakdale Winery Group (Cottage);
- . The Oaks Airfield;
- . Noak's Store;
- . St. Luke's Anglican Group (Church, trees);
- . St. Aloysius Roman Catholic Group (Church, Convent, Old Presloytery, Schoolhouse);
- . The Oaks Schoolhouse;
- . The Oaks Mill Site;
- . Millar Manager's House Site;
- . Glenmore Group (2 houses, 1 barn);
- . Glenmore Uniting Church Group (Cemetery, Church, Silky Oaks);
- . Mt. Hunter Cemetery;
- . Buxton Cottage;
- . Shepherds' Hut Site;
- . Camden Nursing Home; and
- . Bridge Farm.

The majority of the abovementioned items shown in Figure 5.2, were constructed between the 1840s and early 1900s, and provide good examples of developments associated with early agricultural production. Although these items were adjacent to the proposed coal haulage route, they are sufficiently distant not to be affected by the proposal.

5.4 EXISTING LAND USE

The proposed pit head facilities and access roads are located within dense native bushland which has been cleared in part as described in Section 4.4. A motorcross track exists to the north of the pit head facilities and adjacent to the northern access option.

Grazing and orchard production are the major agricultural activities within the mining lease area and its environs. Dense native bushland covers the major creeks and gullies where grazing is not suitable or profitable. Areas classified as grazing land may include beef cattle grazing and minor horse and dairy grazing. A large number of man-made dams exist in this area and are mainly used for irrigating orchards and providing drinking water for grazing animals. Poultry sheds, and a produce store are located to the southeast of the pit head site, on Egars Road.

Medium-sized rural properties surround the proposed pit head facilities with the closest resident approximately 0.5 km to the southwest of the site. However, the majority of nearby residents are between 0.75 and 1.0 km distant from the site. Most of these residents live along Stevys Forest Road and Egans Road. Residential size allotments exist approximately 1.0 km to the southwest and southeast of the site. These residential areas are located along Stevys Forest and Egans Roads and parts of Burraborang Road within and adjacent to Oakdale township. Commercial interests are confined to the township of Oakdale.

The distribution of these existing land uses is shown in Figure 5.3.

5.5 SOCIO ECONOMIC IMPACTS

5.5.1 Existing Environment

Introduction

This section investigates the socio-economic impacts of the proposal. It is presented in two sections, the first is a description of the existing social and economic characteristics including the results of a survey carried out to determine the attitude of those residents likely to be most affected. The second section identifies the impacts that may be expected should the proposal be given approval.

. Study Area

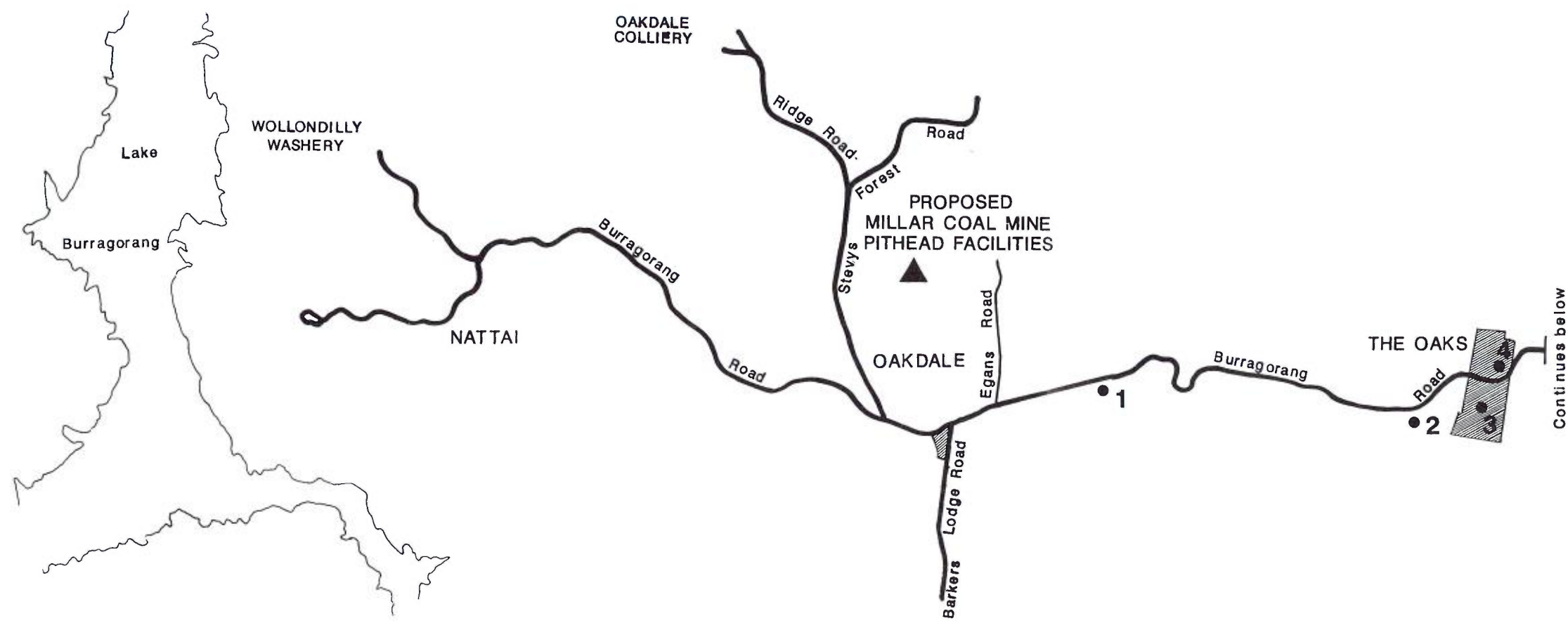
The site of the proposed Millar Mine is located within the Shire of Wollondilly, on the south western fringe of the Sydney metropolitan area. The major town in the Shire is Picton which is approximately 17 km from the site. The only population centres in the vicinity of the site are Oakdale, about 1.5 km away, and The Oaks which is about 9 km from the site. Other centres in the area include Camden, which is 19 km away, Campbelltown 21 km, and Liverpool 48 km. A locality diagram is shown as Figure 2.1.

For the purposes of this study, the affected residential population has been defined as persons resident in the two nearest villages, Oakdale and The Oaks. The local economy has been assumed to comprise the Shire of Wollondilly, while the regional economy has not been defined because of the integration of the local economy with the economies of both the Sydney and Illawarra regions.

. Population

The population of Oakdale and The Oaks totalled 1695 at the 1986 census. The area had grown considerably over the previous five year period, as

MILLAR COAL MINE



- 7 Items of Heritage Significance
1. Oakdale Winery Group (cottage)
 2. The Oaks Airfield
 3. Noaks Store
 4. (i) St Lukes Anglican Group (church, trees)
(ii) St Aloysius Roman Catholic Group (church, convent, old presbytery, schoolhouse)
(iii) The Oaks Schoolhouse
 5. The Oaks Mill Site
 6. Mill Mangers House site
 7. Glenmore Group (2 house, 1 barn)
 8. Glenmore Uniting Church Group (cemetery, church, silky oaks, trees)
 9. Mt Hunter Creamery
 10. Buxton Cottage
 11. Shepherds Hut Site
 12. Camden Nursing Home
 13. Bridge Farm

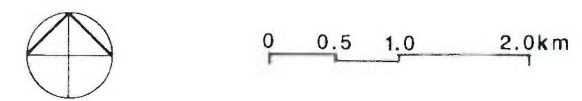
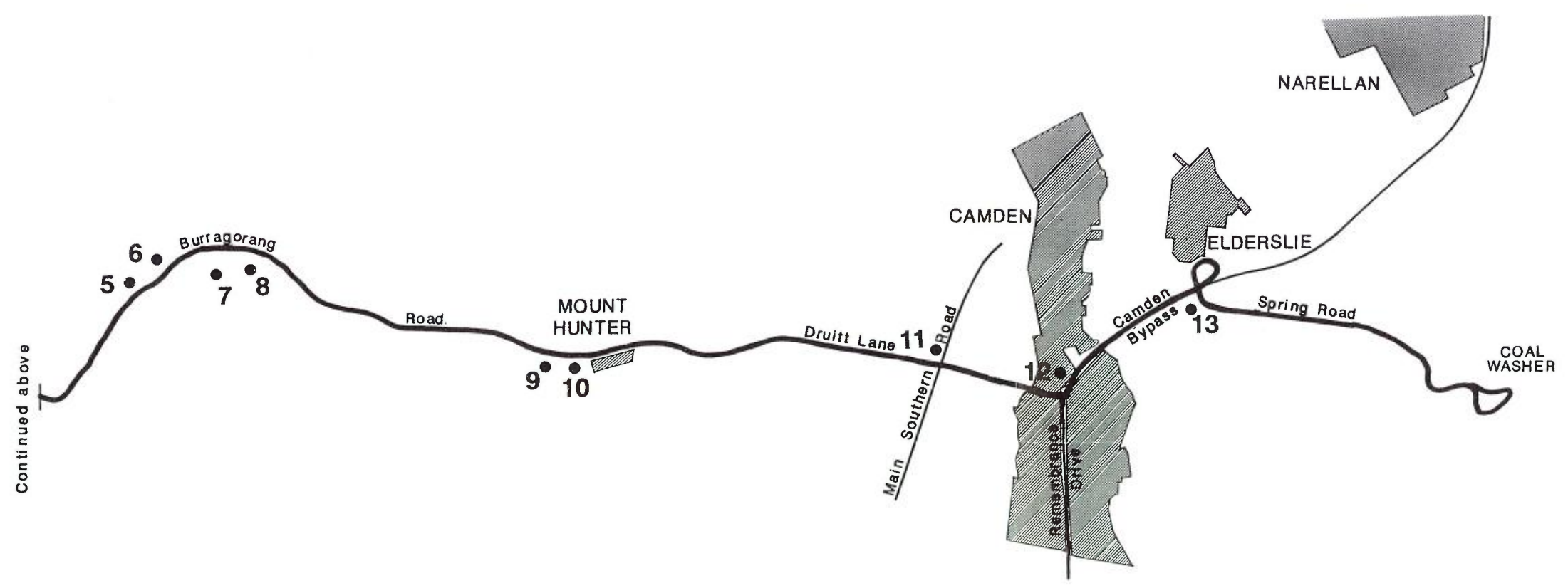
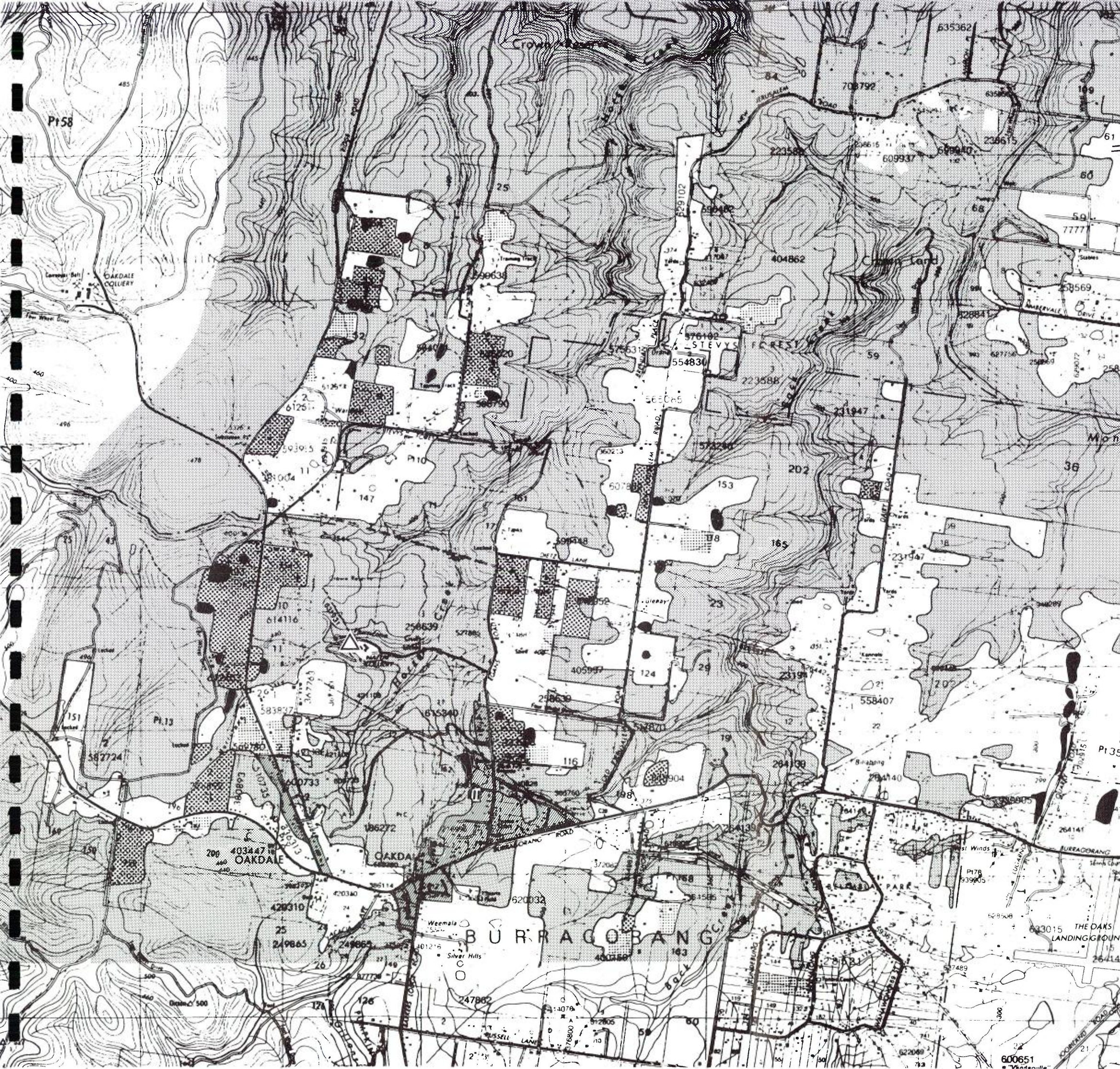







Figure 5.2
HERITAGE ITEMS

MILLAR COAL MINE



-  Dense Bushland
-  Orchards
-  Dams
-  Predominantly Residential Dwellings
-  Proposed Millar Coal Mine Pithead Facilities



0 0.5 1km

Figure 5.3
LAND USE

had the population of the Wollondilly Shire, where the rate of population growth was almost five times that of NSW.

Population projections for the Shire anticipate that high rates of growth will continue, as indicated in Table 5.1.

It is considered that the population growth in the area is the result of in migration caused by a number of factors including; cheaper land and housing prices than the Sydney area; growth of employment opportunities in the Macarthur region; and the increased popularity of rural residential lifestyles.

TABLE 5.1
POPULATION

	1981	1986	1981-86 % Change	1987 ¹	1991 ²	1986-91 % Change
Oakdale	398	530	+33.1	544	615	+16.0
The Oaks	931	1095	+17.6	1181	1335	+21.9
Wollondilly	19830	24928	+25.7	26550	30000	+20.3
NSW	5126217	5401881	+ 5.4	5605300	5902600	+ 5.3

1 ABS Estimated Residential Population 30 June 1987

2 DEP Medium Projection

3 Projections for The Oaks and Oakdale estimated using a simple regional share technique

Source: ABS Census Data 1981 and 1986

ABS Regional Statistics 1988 (1304.1)

DEP, 1987

Demographic Characteristics

An age profile of the study area is shown in Table 5.2. It indicates that the villages of Oakdale and The Oaks have an age profile which is considerably younger than that for NSW. This is consistent with the

in-migration discussed in the previous section, and indicates that much of the in-migration is young families. The low proportion of elderly in the area is probably partly the result of its isolation and lack of services.

TABLE 5.2
AGE PROFILE
PROPORTION OF POPULATION (%)

Age (Years)	Oakdale		
	and The Oaks	Wollondilly	NSW
0-4	14.0	10.0	7.6
5-19	27.1	27.9	23.4
20-49	48.7	44.6	43.6
50-64	7.4	10.4	14.3
65+	2.8	7.2	11.0
	100.0	100.0	

Source: ABS, Census 1986

Employment Characteristics

Unemployment

At the 1986 Census, some 66 persons in Oakdale and The Oaks were counted as unemployed. While this corresponded to 9.8% of the labourforce, 17 of these (2.5% of the labourforce) were looking for part time work.

This unemployment rate was higher than the average for Wollondilly, yet slightly below that for NSW. According to estimates of unemployment maintained by the NSW State Statistical Coordination Unit, unemployment rates both in NSW and the Wollondilly Shire fell in the year following the census. However, it is not possible to relate these trends to a small area. Table 5.3 provides details of unemployment.

TABLE 5.3
UNEMPLOYMENT
PROPORTION OF LABOURFORCE
(%)

	Oakdale and The Oaks	Wollondilly Shire	NSW
Unemployed at Census 1986	9.8	8.8	10.1
Estimated Unemployed June 1987	-	7.6	9.6

Source: ABS Census 1986

NSW State Statistical Coordination Unit

Employed

Table 5.4 provides information on the industry of employment. It indicates that mining is an important local employer, accounting for approximately 15% of the workforce. This is higher than the proportion of employment in for New South Wales. Other industries which employ larger than average proportions of the workforce include construction, transport and storage, and community services. Industries under represented are manufacturing, business services, and public administration. It is interesting to note that relatively few of the study area labour force are employed in agriculture, less in fact than the average for the Wollondilly Shire.

TABLE 5.4
INDUSTRY OF EMPLOYMENT

	Oakdale and The Oaks	Wollondilly Shire	NSW
Agriculture	5.0	7.7	4.7
Mining	14.8	7.2	1.3
Manufacturing	11.4	15.6	15.4
Utilities	2.2	4.2	2.1
Construction	10.1	7.9	6.7
Wholesale/Retail	18.1	15.3	18.9
Transport	8.4	5.4	5.7
Communication	1.0	1.5	2.2
Business Services	5.7	7.1	11.7
Public Administration	3.2	3.6	5.5
Community Services	17.1	16.7	16.4
Recreation, Personal	2.0	4.1	6.3
Not classified	1.0	1.2	0.1
Total	100.0	100.0	100.0
(including not stated)			

Source: ABS Census 1986

The occupational status of the labour force is shown in Table 5.5. This indicates that the local area has a larger than average proportion of tradespersons, plant and machine operations and labourers. The management and professional occupations are under represented.

TABLE 5.5
OCCUPATIONAL STATUS

	Oakdale and The Oaks	Wollondilly	NSW
Managers and Administrators	7.3	11.6	11.2
Professionals	7.8	9.6	12.2
Para-professionals	5.9	6.6	6.2
Tradespersons	17.6	17.5	15.0
Clerks	10.4	13.6	18.0
Sales & Personal Service	10.0	9.8	12.2
Plant and Machine	19.6	11.7	8.2
Labourers and related	18.6	16.8	14.2
Inadequately described	1.0	1.3	1.5
Total (including not Stated)	100.0	100.0	100.0

Source: ABS 1986

These indicators describe an area which is fairly representative of a growing fringe urban area. While agriculture still plays a part, there is considerable development in the area with an active construction industry. The labour force is comprised of workers with skills and trades which are not city linked, allowing them to take the opportunity of living a rural village lifestyle.

The area is dominated by single family households, the majority of which comprise a couple or couple with children. Approximately 80% of households own or are purchasing their homes, compared with about 68% for NSW.

. Local Economy

Wollondilly Shire is situated on the fringe of the Metropolitan area. It has good transport and communication links with both the Sydney metropolitan area and the Illawarra basin. Agricultural produce is sold on city markets, and coal is transported to coal loaders at Balmain or Port Kembla. In addition, many of the specialised goods and services required in the area are sourced from these centres.

It is considered that the economy of the Shire has strong linkages with the wider regional economy. Therefore this section is confined to a description of the economy of the Wollondilly Shire. The following section will discuss the contributions that the Clutha Company makes to this local economy, as well as the wider region.

One indicator of the composition of the local economy is the industry of occupation of the resident workforce. While in city areas this may not be valid, because of commuting to different areas it will provide an indication for rural areas. In the case of Wollondilly, there will be employment leakage to the outer areas of Sydney, including Campbelltown and Camden, and the mines of the Illawarra escarpment. This should be noted in assessing the following data.

Table 5.6 shows the industry of employment for the labour force of Wollondilly at the 1981 and 1986 census counts.

TABLE 5.6
INDUSTRY OF EMPLOYMENT

	Wollondilly Proportion of Labourforce		NSW
	1981	1986	1986
Agriculture	9.3	7.7	4.7
Mining	12.9	7.2	1.3
Manufacturing	14.4	15.6	15.4
Utilities	5.2	4.2	2.1
Construction	7.3	7.9	6.7
Wholesale/Retail	11.1	15.3	18.9
Transport	4.9	5.4	5.7
Communication	1.3	1.5	2.2
Business Services	4.8	7.1	11.7
Public Administration	3.1	3.6	5.5
Community Services	13.0	16.7	16.4
Recreation, Personal	3.7	4.1	6.3
Not classified	9.0	1.2	0.1
Total	100.0	100.0	100.0
(including not stated)			

Source: ABS Census 1986

Table 5.6 indicates that the economy of Wollondilly is moving away from a traditional dependence on primary industries, and the proportion of employment occupied in the mining and agriculture industries is declining. However, this decline in the mining industry was worldwide and reflected steel recession and reduction in energy growth. The global situation is now showing some signs of reversing this trend.

Table 5.6 also indicates that secondary industry has increased slightly while major gains have occurred in the tertiary sector, with the wholesale/retail trade, business services and community services industries all growing considerably. To some extent, these represent a

trend in Wollondilly away from a traditional "rural" based economy towards a "city" based economy.

More detailed information on the current status of some sectors of the local economy is available from statistical data. This is summarized in the following sections.

Agriculture

Agricultural activities in Wollondilly Shire tend to be those which need to be sited close to markets and do not require large land areas. Consequently, for the year 1986-7 the Shire had a population of over 2.6 million meat fowls, 35,500 pigs, 350,000 turkeys, 700 stud horses and 8,000 dairy cattle. In addition vegetables occupied 230 ha, and orchards 218 ha.

A proportion of the labour force employed in agriculture in the Shire has declined, however in real terms it increased marginally, employing 735 persons in 1981 and 749 persons in 1986.

Mining

Until 1985-6, the Joint Coal Board maintained separate statistics for the coal mines of the Burragorang Valley. After this time the Burragorang Valley and South Coast coal producing areas were merged to form the Southern Region.

Table 5.7 provides details of coal production in the area over the last six years.

TABLE 5.7
 RAW COAL PRODUCTION ('000 TONNES)
 BY COAL PRODUCING DISTRICT

	Burraborang Valley	South Coast	South Region	Southern Region Production as a proportion of NSW production %
1982-3	3264	12641	15905	23.6
1983-4	3223	11285	14508	21.8
1984-5	3093	11418	14511	20.1
1985-6	3014	12329	15343	19.8
1986-7			16537	18.7
1987-8			15229	20.0

Source:

Between 1982 and 1986, the Burraborang Valley maintained its share of NSW production, at around 4.5%. However it can be seen that the proportion of NSW coal produced in the Southern Region has been declining.

Mining employed 705 persons in Wollondilly at the 1986 census, a decrease from 1,017 in 1981. The Joint Coal Board figures show that coal mining in the Burraborang Valley employed 913 persons in June 1986 with the Southern Region employing 4,959 in June 1987 and 4,577 in June 1988, a drop of 7.7%.

Manufacturing

Information on manufacturing in the area is scant. However, it has increased employment in both real and proportional terms, in the 1981-1986 period. By 1986, Wollondilly Shire had more employment in manufacturing than the NSW average.

A 1985 survey of manufacturing establishments showed that the Shire supported 43 enterprises, of which 17 employed fewer than four persons.

Fringe urban areas often support manufacturing establishments which require cheap land. Small enterprises follow providing local support services, and the economy gradually diversifies, building an economic base which is less reliant on primary industry.

Survey

A door to door survey was carried out along Stevys Forest Road to assess impacts resulting from the proposal. The survey included all residences from the intersection of Burraborang Road to the access to the proposed mine. After completion of a questionnaire, the respondent was given a brochure outlining the proposal. Where residents were absent, a questionnaire, brochure and self addressed envelope were left.

A total of 54 residences were identified along Stevys Forest Road. Of these, 44 are on suburban sized blocks (1/4 to 1/3 acre) and are 10 - 25 meters from the road. Three new houses are presently being built on suburban sized lots. The remainder are on lots greater than 0.5ha and are located around the northern section of Stevys Forest road near the proposed mine entrance. These houses are over 50 meters from the road and many are surrounded by orchards.

Sixteen questionnaires were completed on site and to date ten have been received giving a completion rate of 48%. The houses surveyed contain 80 residents including 15 school aged children.

Results of Survey

. Employment

Employment is mostly within the Picton/Camden locality. 28% of the respondents are employed by Clutha mines, however the majority of people are employed the service industries, in occupations such as shop assistants, diesel mechanic, storeman, roof tiler and boilermaker. Also represented are housewives and a number of retired people.

. Demography

40% of those surveyed have moved into the area within the previous two years while 29% have remained in the one house for more than ten years. For many of the residents the reason for moving to the area has been associated with employment (28%), a rural lifestyle (50%) or both. Nearly all those interviewed (80%) intend to remain permanently. Eighteen houses are owner occupied and five are rented of which two are owned by Clutha.

. Problems and Perceived Impacts

Almost half the number of respondents (48%) cite coal dust and truck noise as a serious or very serious problem. In most cases the coal dust problem is attributed to the Wollondilly Washery in combination with strong westerly winds. There is a perceived fear that the proposed washery at the Miller site will accentuate this problem.

Noise is a major problem however most people have accepted this inconvenience without undue criticism, provided trucks operate within the specified hours. Truck movements at night are regarded as a serious and unnecessary intrusion on the amenity and rural atmosphere of the area. Many of the residents are against the proposed increase in the number of truck movements. Truck speed and safety aspects were viewed by some (16%) as serious problems, in particular the potential danger to young children.

Other problems which were identified by less than three residents were:

- severe damage to apple produce by coal dust.
- water pollution.
- depressed land prices.
- coal spillage from trucks.

. **Comments on the Proposal**

42% of those surveyed believe that the proposed mine will have a beneficial effect on the community by increasing employment opportunities both with the mine and in service industries. However the resulting increases in noise, dust and safety aspects are deemed to be serious and unwelcome impacts requiring strict operational control.

. **Conclusion**

The socio-economic characteristics of the study area indicate a growing rural/urban fringe district. It has an expanding population, who tend to be young and have skills which allow them to live outside the city. The economy is moving closer to that of a city area, with less emphasis on traditional rural pursuits.

Within this context, coal mining is a major industry. It employs a large proportion of the workforce and produces about 4% of NSW Coal output. When indirect and induced effects are included, it would have to be one of the most important industries in the local economy. The Burratorang coal mining district is also almost exclusively export orientated and therefore a foreign exchange earner.

5.5.2 Impact Assessment

The socio-economic impacts of the proposal will primarily stem from workforce changes, and effects on the economy. Consequently impacts will be considered under three headings; construction workforce, operational workforce, and economic impacts.

. **Construction Workforce**

Construction for the project will be carried out in two stages. The first would commence in 1993 and continue for 34 months, while the second would be carried out concurrently with production, commencing in 1994 and continuing for 20 months.

Construction will be carried out by contractors who will be awarded principal contracts for the major construction items.

It is estimated that construction workforce numbers during Stage 1 will not exceed 60 people/day, with 95 people/day in Stage 2. A great deal of the project items will be prefabricated away from the site.

Sources of Workforce

To some extent the source of the construction workforce will be dependent upon which contractors are employed to carry out the work, and the size of their permanent workforces.

In this instance it is likely that the contractors will be employed from the wider Sydney-Illawarra region. All managerial staff and most senior tradesmen are likely to be permanent employees, whereas there may be a requirement to recruit additional tradesmen, semi-skilled and unskilled workers.

The Wollondilly Shire has an unemployment rate lower than the State average is therefore unlikely to be able to supply a large number of appropriately skilled persons from the ranks of the unemployed. However, considering the relatively small size of the construction workforce, and the age and skill profiles of the Shire discussed previously, it is estimated that the resident population would be able to supply approximately 20% of the construction workforce requirement. This is in line with experience at other coal mines in New South Wales.

The nearest major urban areas, the Macarthur and Illawarra regions tend to have populations suitable for construction work. Both have suffered high unemployment rates, and have young populations and a large proportion with trades and technical skills.

Consequently, it is likely that these areas will supply some of the construction workforce for the project.

On this basis, it is likely that during Stage 1, approximately 48 workers/day from outside the region will be required, rising to 76 for Stage 2.

Because of the proximity of the metropolitan fringe areas and the temporary nature of the work, it is likely that a considerable proportion of construction workers will commute from homes in the Sydney or Illawarra areas. Construction workers are required to work on a variety of projects, and consequently they are used to extended commuting distances. Experience in the Hunter Valley has confirmed this.

Therefore it is estimated that an additional 30 percent of the construction workforce will commute to the area daily. The implication is that during Stage 1, some 30 workers may be temporary residents of the Shire, while in Stage 2 this may increase to 45.

Because of the transitory nature of construction work, most workers move to a construction site without their families. A survey of temporary residents in Muswellbrook (Graham and Collins, 1981) showed that only 15 percent of workers intended to bring their families. On this basis and assuming 2.5 persons per family, the construction period could generate a total population increase of 38 persons in Stage 1 and 55 in Stage 2. This would represent a maximum figure because of the proximity of the site to the Metropolitan area.

No on site construction camp will be provided for the Millar Mine. Construction workers who require accommodation will reside in caravan parks, hotels, motels or rented accommodation in Camden or Narellan.

The social impacts generated by the construction phase will not be significant because of the small workforce required.

. Operational Workforce

It is anticipated that the proposal will not involve any recruitment or retrenchment of operational workforce.

In January 1989, Clutha employed 690 employees in the Burragorang Valley, a workforce highly skilled in all facets of coalmining, transport and administrative operations. While the proposed longwall represents new technology to Clutha, the Company intends to train its existing workforce in its operations.

Consequently there will be no impact associated with the operational workforce, and the status quo will be maintained.

. Economic Effects

In general terms, the economic impacts of the proposal will be to maintain the existing situation. Coal production in the Burragorang and its associated economic impacts will continue. The major components of these impacts are discussed below:

Construction Period

The construction period will generate substantial benefits for both the local and wider economies. The local and regional economy will receive a direct injection of funds in the form of wages, salaries and payments for goods and services. Additional indirect and induced expenditure will increase the total amount of money entering the local and regional economies.

The capital cost of the construction and mine development will be about \$80 million of which \$20 million will be applicable to surface works and buildings, the subject of the development application.

Approximately 80% of this will be expended on goods and services produced in Australia, maximising indirect benefits.

Production

Overall saleable coal production from the Burraborang Valley may increase from the existing 2.2 mtpa up to 3.6 mtpa. Approximately 98% of the Company's product is exported, so the current proposal will allow the export earnings generated by the Burraborang Valley to be maintained, and possibly increased by 60 percent.

The operating costs of the mine are shown in Table 5.8.

TABLE 5.8
ANTICIPATED OPERATING COSTS

<u>\$/tonne</u>	<u>ROM</u>
Labour	8.00
Materials/Supplies	3.00
Royalties	1.36
Depreciation	2.00
Other	<u>4.64</u>
Total	<u>19.00</u>

Employment

The new facility will be manned by 223 personnel. All will be relocated from existing mines in the Burraborang Valley, and consequently no retrenchment or recruitment is anticipated. The annual wages bill will be approximately \$14,000,000, and the impact of this proposal will be the continued employment of these personnel and injection of this money into the local and regional economies.

Payments to Government

The operation of a coal mine involves substantial payments to government at all levels. Table 5.9 indicates some of the main payments that will be made as a result of this proposal.

TABLE 5.9
ESTIMATED ANNUAL PAYMENTS TO GOVERNMENT

Federal	
PAYE Tax, FBT, Excise and Fuel Tax	\$ 6,125,000
Income Tax	39% of profit*

*In the financial year ending June 1988
the Company made an operating loss after
tax of £ 1.9 million

State

Payroll, Subsidence Levy, Mine Rescue Levy,
Rail Charges, Port Loader Charges, Wharfage,
Harbour dues, Pension, Workers Compensation,
Lease Charges, Electricity, Financial Transactions
etc.

Royalties: \$1.21/tonne	\$17,680,000
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Local

Water	\$ 17,000
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SHIRE COUNCIL

Indirect and Induced Effects

A major development project of this nature can generate additional benefits for the local regional economies through flow on effects. These are indirect impacts generated as direct expenditure or employment on the project circulates through the economy

Measurement of these indirect effects can be carried out using input-output analysis to generate multipliers.

However, definition of the region is crucial to the accurate estimation of economic effects and multipliers. These multipliers are affected by the complexity, size and comprehensiveness of the regional economy and

linkages between firms, which determines the extent to which expenditure remains within the region in question. Secondly, multipliers will vary according to the industry being studied, due to different levels of labour and capital and imported goods and equipment in different industries.

Because of the difficulties discussed previously, multipliers are not readily available for the Wollondilly Shire. The high level of escape expenditure would make any multiplier for this level of economy highly speculative.

However the indirect effects of the project, such as employment for local contractors and service firms and second round expenditure of wages in the area can have a substantial beneficial impact on the economy. In some instance indirect effects have doubled the impact of a project on the economy.

5.5.3 Conclusion

The economic and employment impacts of the proposal are, in general terms, the maintenance of the status quo. In the short term, additional income and employment will be generated during the construction phases.

The consequences to the local economy of not proceeding with the project are discussed in Section 7.2.

5.6 TRANSPORT

5.6.1 Introduction

This section deals with the major coal haulage routes, both existing and proposed for the new Millar Mine. Clutha has a commitment to haul at least one million tonnes of saleable coal by rail from Glenlee. It proposes to increase this amount so that the quantity of coal road hauled by existing routes to Port Kembla, along Barkers Lodge Road through Picton, Picton Road to Mt Ousley and Wollongong is limited to

the current tonnage of 1.2 mtpa. There will be a continuation of existing impacts along this route at approximately current levels. A number of studies over the last ten years have examined the haulage of coal in the Illawarra Region, and successive governments have balanced the socio-economic benefits of the industry in the region against the impacts of such road haulage. Accordingly, it is not considered appropriate that the environmental impact statement for the new Millar Mine should comprehensively re-examine such issues if existing transport levels are not to be increased except for any implications arising from poor road conditions or new regional planning proposals that may be relevant.

A layout of regional coal haulage routes is shown in Figure 2.5. The objectives of this section will be to present changes in road haulage tonnages from 1988 to peak levels anticipated in 1994, as well as a description of the existing road network and coal transport operations, changes generated by the proposal, and an assessment of their impacts.

This investigation will essentially be confined to the immediate road network affected by the Clutha Collieries of Nattai South, Brimstone No.1, Oakdale and the proposed Millar Mine. The principal roads considered are Stevys Forest Road and the Burragorong Road route to Glenlee and these are shown in Figure 5.4.

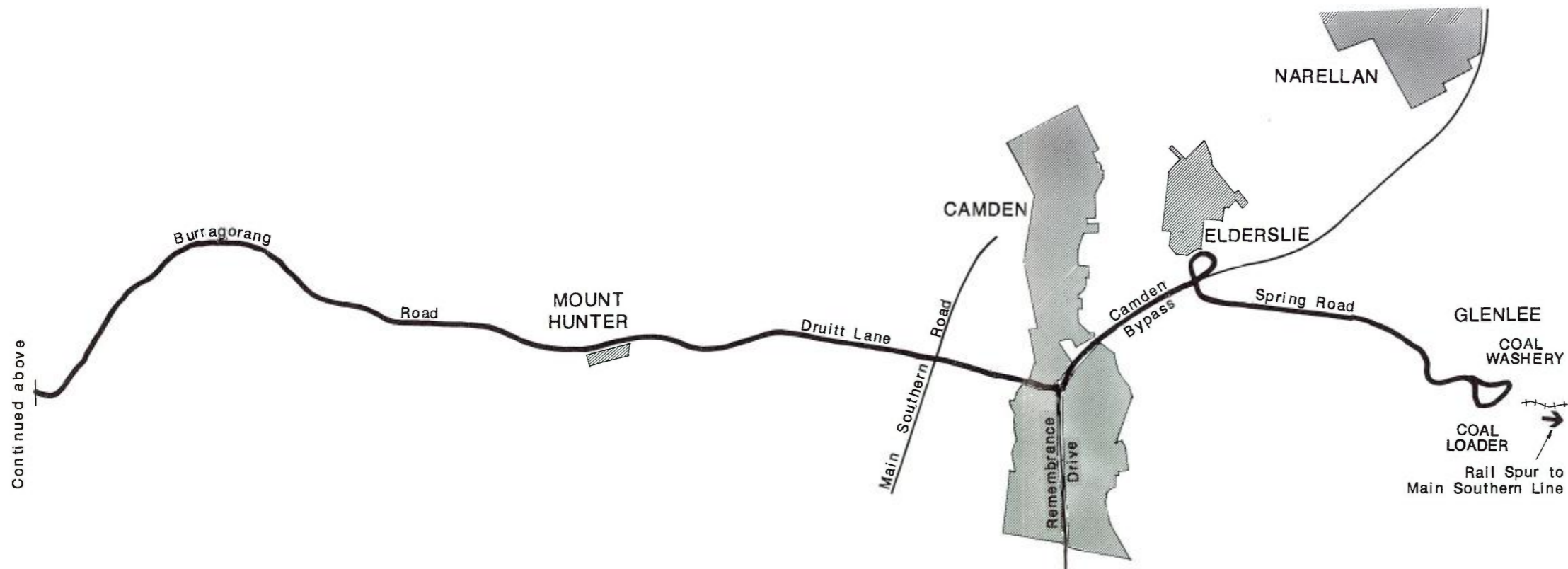
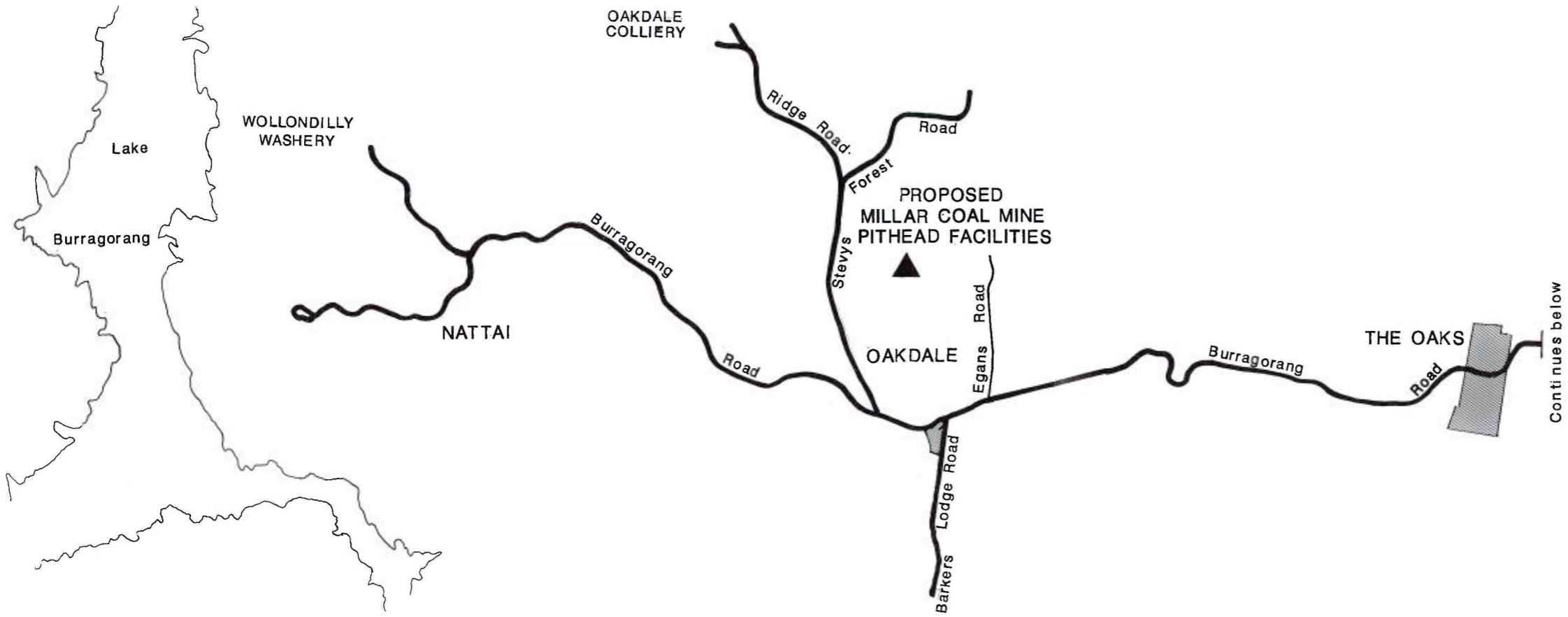
The infrastructure and capacity of the roads are investigated together with an engineering assessment of such factors as visibility, pavement width, alignment, pavement condition and provision of turning movements. Existing traffic flows and truck haulage movements are assessed and the proposal discussed with respect to increased truck movements, alternative routes, access from the mine, arrangement of transport, time of haulage, traffic management controls, roadwork requirements and environmental impact with particular emphasis on noise emissions.

5.6.2 Regional Transport Infrastructure

An examination of truck traffic in the Illawarra Region is contained in a report by the NRMA (1985). This contains an overview of the coal industry ^{AI} that that time, an evaluation of the standard of the regional road network, operational aspects of coal haulage, and a review of coal transport options other than the use of road haulage. Its conclusions and recommendations include for the Association's support for the transport of coal other than by road wherever practicable, improvements to the road system, the fitting of tachographs on all coal trucks in addition to regulation of overloading and reasonable cost recovery from all vehicles for road maintenance. The report makes reference as appropriate to the findings of the 1984 National Road Freight Industry Inquiry. The scope of haul routes examined includes the two basic components of the regional road system proposed for the Millar Mine shown on Figure 2.5, namely the Burragorang Road MR259 between the Burragorang Valley and Glenlee, and the Picton Road (TR95) between Oakdale and Port Kembla. The amount of product coal to be hauled over the former will be about double the current tonnage, while haulage over the latter will be maintained at existing levels.

A recent update of traffic issues in the Region is contained in a further report by the NRMA (1988). This identifies transport deficiencies in the Illawarra with a view to providing advice to Government on spending priorities for transport infrastructure. However, its scope is more restricted than the 1985 report as it does not extend to the Burragorang Road, concentrating more on access to the Illawarra Escarpment and traffic distribution into Wollongong. The report concludes that overtaking opportunities have decreased on most roads since the 1985 survey, pavement conditions are generally fair or to the minimum acceptable standard, alignment standards between the Escarpment and the coastal plain are poor, and while the regional road network has excess capacity bulk transport demands hamper the level of service and overall safety provided. The report reiterates the Association's contention that wherever economically and operationally

MILLAR COAL MINE



0 0.5 1.0 2.0km

Figure 5.4
COAL TRANSPORT ROUTES
MITCHELL McCOTTER

possible, bulk commodity haulage should be undertaken by means other than by public road.

The 1985 report identifies the Burragorang Road as a major route for coal trucks to the Burragorang Mines and for tourist and recreational activities to parklands and lookouts around Nattai. It states that traffic volumes have decreased since the peak period of the late 70s, but that several aspects of its road characteristics are substandard. It recommends improvements particularly in pavement width and realignment. Recent extensive upgrading has in fact taken place as reported in Section 5.6.5 such that the Burragorang Road should not be greatly affected by traffic generated by the proposed Millar Mine except for a few specific items described in Section 5.6.8.

The NRMA's 1985 assessment of the Picton Road noted it was basically an undivided two lane road with limited overtaking opportunities. It identified the need for improved alignment and frequently spaced overtaking lanes. The section between Picton and Mt. Ousley Road has subsequently been the subject of major improvements. The NRMA's 1988 assessment contains a level of service survey of the operational characteristics of the Illawarra's present transport routes which are described in Section 5.6.5. Results indicate substandard pavement conditions over a small section of the road between Oakdale and Picton, otherwise operational characteristics appear reasonable except for continued restrictions on overtaking for much of the entire route.

The other important coal haul route in the Illawarra Region is the Appin Road (MR177) which links Campbelltown to the F6 Freeway at Bulli Pass. It serves as an important access route from the western areas of Sydney to Wollongong and beyond. It previously served coal truck traffic from the Burragorang Valley coal mines and the Glenlee Coal Washery which joined the road south of Campbelltown. However, its only relevance now to such coal traffic is to serve as an emergency route only in the event that the railways are unable to cope with shipping demand. It will continue that role with the Millar Mine. Between Appin and the Southern Freeway, it serves the Appin and Westcliff Coal Mines and is used by

a substantial volume of coal traffic. It has been subject to recent upgrading.

Figure 2.1 shows the State Rail Authority railways available to service the export coal loading facilities at Balmain and Port Kembla from the Southern Coalfields. They consist of the Main Southern Line from Goulburn to Sydney, the Illawarra Line from Sydney to Port Kembla and the Moss Vale to Unanderra Line which connects Port Kembla, with the Main Southern Line near Mittagong, but which is not used for coal trains except in emergencies. Figure 2.1 also shows the partially completed Maldon-Dombarton Link. State Rail are investigating the running of limited size trains to Port Kembla via Moss Vale and a southern turnout is under construction at Glenlee.

The electrified Illawarra Line is the only railway on which coal is regularly transported to Port Kembla from both the Western and South Coalfields. However, it is not available to freight trains for six hours of the day during morning and afternoon passenger train peak times. Coal train service is dependent on demand for export coal at the Port Kembla Coal Loader at any one time. Coal trains do not therefore run to a time table and daily train movements vary according to demand and the resources available.

Burraborang Valley coal transferred to rail at Glenlee will either be exported from Balmain or Port Kembla. Coal for shipment will be carried along the Main Southern Line to Sydney and Port Kembla coal will join the Illawarra Line within the Metropolitan railway system for transport down the coast. The impact of future Burraborang Valley coal on the railway system is addressed in Section 5.6.8.

5.6.3 Coal Production and Haulage Estimates

With the establishment of the new mine, increased production from Brimstone Colliery and progressive depletion of Nattai South, output from the Burraborang Valley will be maintained. Depending on the phasing of these transitions, output from the Valley could increase for a period from the current 2.2 mtpa to between 3.0 and 3.6 mtpa. The

Company has already made a public commitment to haul one million tonnes of coal from its Burragorang Valley mines by rail from Glenlee. It now proposes to increase this amount so that the quantity of coal road hauled direct to Port Kembla via Picton is limited to the existing 1.2 mtpa.

The present and expected coal production for each of the mines is given in Table 5.10.

TABLE 5.10
CLUTHA MINES - ROM COAL PRODUCTION (tonnes x 1000)

	Historical											
	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97
Nattai Nth.	747	1100	256	278	-	-	-	-	-	-	-	-
Nattai Sth.	140	222	296	454	500	250	-	-	-	-	-	-
Brimstone	286	630	693	1159	1500	2000	2000	2000	1500	1500	500	-
Oakdale	228	419	454	686	750	750	750	750	750	750	750	750
Oak (Millar)	-	-	-	-	-	-	-	500	1500	1800	2000	2000
Total	1401	2371	2299	2577	2750	3000	2750	3250	3750	4050	3250	2750

The figures assume a six day working week at the Brimstone and Millar Mines and a five day working week at Oakdale and Nattai South.

A new man riding access will be necessary in the north east of the lease areas to achieve acceptable travel times to the workforce.

Raw Coal from Nattai South Colliery is currently conveyed up the escarpment to Wollondilly Washery. Output from Brimstone No. 1 and most of Oakdale coal is road hauled to Wollondilly Washery, and after washing is transported by road to Glenlee or Port Kembla. The remaining production from Oakdale Colliery is road hauled as run of mine coal to Glenlee Washery and is blended there with washed fine coal reclaimed from old tailings ponds. Product coal is either hauled by rail to Port

Kembla or Balmain coal loaders, or carried direct to Port Kembla by road. In the current year, up to one million tonnes of coal will be carried by rail from the Glenlee rail head and remaining production will be transported by road.

Predicted truck haul tonnages along each section of road passing through the village of Oakdale are given in Table 5.11. These are based on data contained in the materials flow diagrams for future operation of the Burragorang Valley Mines given in Figure 2.4, and an average product yield of 78%.

TABLE 5.11
TONNAGE PREDICTION IN 1000 TONNES

Year	Stevys Forest Road	Burragorang Road Route		Barkers Lodge Road	
		Oakdale Village to Wollondilly	Wollondilly to Oakdale Village	Oakdale Village to Glenlee	Oakdale Village to Picton
1988/89	1845	1708	2470	1030	1200
1994/95	4050	2496	1638	1992	1200
1996/97	2750	1109	468	953	1200

5.6.4 Existing Road Traffic Volumes

Average Annual Daily Traffic (AADT) counts for the coal haulage routes along Burragorang Road and Barkers Lodge Road to Picton have been obtained from the Roads and Traffic Authority - Illawarra Division. In addition, the number of truck movements has been derived from tonnage figures given in Table 5.11 with the assumption that trucks return to their point of origin. AADT for Egans Road has been assessed from land use generation. Traffic volumes, based on 280 working days per year,

providing for road haulage six days per week with an allowance for industrial stoppages are given in Table 5.12.

Actual traffic counts for Stevys Forest Road were obtained for the period 12.8.88 to 28.8.88 inclusive and are shown in Table 5.13.

TABLE 5.12
TRAFFIC VOLUMES

	AADT		Truck Movements/Day - 1988/89 (25 tonne trucks - full and empty)
	1982	1988*	
Stevys Forest Road	-	-	526 (based on tonnages)
Burraborang Road			
. West of Oakdale	-	1501	1194
. East of Oakdale	2560	2174	294
Barkers Lodge Road	970	888	342
Egans Road	-	500	0

Source: Roads and Traffic Authority: AADT

* Pers. Comm.

Truck movements: MMA

TABLE 5.13
RESULTS OF TRAFFIC FLOW COUNTER
FOR STEVYS FOREST ROAD

Date	Day	Vehicle Count	Truck Movements - full & empty
August 1988			
12	Friday	1198	-
13	Saturday	553	-
14	Sunday	910	-
15	Monday	2147	438
16	Tuesday	1828	410
17	Wednesday	2288	480
18	Thursday	1918	528
19	Friday	2140	648
20	Saturday	407	-
21	Sunday	637	-
22	Monday	2590	586
23	Tuesday	2660	754
24	Wednesday	2089	514
25	Thursday	2188	388
26	Friday	1971	214
27	Saturday	520	-
28	Sunday	-	-

From the survey results for Stevys Forest Road, the AADT calculated from average weekday traffic events is 2092. The average number of truck movements is 496 trucks/day.

Based on traffic volume data, there is a high proportion of trucks (80%) travelling the 6km section of Burraborong Road between Stevys Forest Road and Wollondilly. Trucks travelling east to Glenlee from Stevys Forest Road make up approximately 17% of AADT while the density of trucks along Stevys Forest Road is around 24% based on actual traffic counts.

5.6.5 Road Network Infrastructure

The existing road network infrastructure accommodating traffic from the Burragorang Valley to the rail loading facilities at Glenlee is shown in Figure 4.11.

(i) Stevys Forest Road

Stevys Forest Road extends 2.5km north west from Burragorang Road, then north for a distance of approximately 2.5km. This road connects the Brimstone No. 1 and Oakdale Collieries via Ridge Road to the major haul routes in the south.

There are 54 residences along the southern section of Stevys Forest Road, the majority on suburban sized lots which extend for approximately one kilometre from Burragorang Road. The older houses were built and owned by the original coal mine owners.

From the Burragorang intersection to Ridge Road, Stevys Forest Road is a sealed two lane divided road with a lane width of 3 metres, 1 metre shoulders and 1 metre table drains. The road alignment and sight distances are good and pavement condition is in reasonable order. However, deterioration along the road edges and infilling of potholes is evident. The section of Stevys Forest Road running east from the Ridge Road intersection is undivided with a reduced pavement width of about 6 metres. The pavement is in good condition and traffic is generated by a few local farms and consists mostly of light vehicular trips.

Truck accident statistics along Stevys Forest Road are not available. However, from lease hold survey results in Section 5.5. the main concern was related to safety aspects involving children.

(ii) Burragorang Road

This road carries traffic in an east-west direction between the Camden Bypass and the Burragorang Valley at Nattai. A 4km section of road from

the Camden Bypass to Burragorang Road is named Druitt Lane. The length of road from the Camden Bypass to the Stevys Forest Road turn off at Oakdale is approximately 22km. The distance from Oakdale to Nattai is 6km and Oakdale to the Wollondilly washery 7.3km.

From Table 5.12, the traffic volume along Burragorang Road has decreased from 2560 in 1982 to 2174 in 1988. Of this volume, about 17% are coal trucks with the remainder consisting principally of tourist and local traffic.

There have been extensive road improvements in recent years such as pavement lane widening to at least 3.5 metres, realignment to eliminate sharp curves and resurfacing. Lane width is a minimum of 3.5 metres and up to 4 metres along most of the route, however this decreases to 3 metres near Oakdale and towards Nattai. The condition of the pavement is good, although small sections of road are showing signs of deterioration. About 5km of road has a speed limit of 60km/hour with the remainder being 80 to 100km/hour. Overtaking opportunities are limited with just 2 km of passing lanes for vehicles travelling towards Camden and 4 km in the opposing direction.

The gradient from Wollondilly to the Oaks is predominantly downhill. The gradient up to Wollondilly from Oakdale for loaded trucks is subject to the least traffic.

For the greater part of Burragorang Road, there are no restrictions relating to sight distances or road alignment. An exception is a 1km section of road crossing Back Creek about 3km east of Oakdale. Here there are a number of sharp curves and sight distances are markedly reduced necessitating a speed limit of 55km/hour. A speed less than the specified limit is required for loaded trucks to safely negotiate this section.

The Burragorang coal haulage route from the Stevys Forest Road turnoff to the Camden Bypass passes the villages of Oakdale, The Oaks and Mt. Hunter with speed restrictions over approximately 5km or 23% of the route.

A study completed by the NRMA (1985) showed a decline in the number of accidents involving trucks on Burragorang Road mainly as a result of road pavement and re-alignment improvements. Truck involvement in accidents was found to be generally low. However, articulated trucks had a higher crash and fatality rate than rigid trucks.

(iii) Camden Bypass to Glenlee

This section of the Burragorang Road haul route includes the following:

- . a 1.8km section of the Camden Bypass which is a sub-arterial road linking Remembrance Drive at Camden to Camden Road at Smeaton Grange near Campbelltown. At the Burragorang Road (Druitt Lane)/Bypass intersection, the road consists of 4 lanes and a dividing concrete median strip. The road reduces to 2 lanes across the Macarthur Bridge and continues for 1km to a left turning ramp into Macarthur Road;
- . trucks turn left into Macarthur Road and continue for about 500 metres to Spring Road. This road is a 2 lane, sealed road with a pavement width of approximately 7 metres; and
- . at Spring Road trucks turn left and continue for 3km along a 2 lane, 7 metre wide sealed and undivided road to the Glenlee Washery and rail depot. The major land use adjacent to the road is sand mining.

(iv) Egans Road and Existing Employee Access

A 1.3 kilometre section of Egans Road between the existing Oakdale No 3 Shaft access and Burragorang Road will be affected by the proposal and consists of a sealed, 2 lane road in good condition. An employee and service road access to the mine extends 1 kilometre west from Egans Road and is 5 metres wide, sealed and in good condition.

(v) Picton Road

The Picton Road provides an east-west link between the Burragorang Valley coal mines and the export ship loading facilities at Port Kembla. It consists of a 15 kilometre two lane highway between Oakdale and Picton and a further 40 kilometre section between Picton and Mt. Ousley Road via Maldon and Wilton which crosses the F5 Freeway and the proposed Maldon to Dombarton rail link. As indicated in Section 4.11.2, the NRMA's 1988 level of service survey includes an assessment of the operational characteristics of both sections of this road. These are contained in Table 5.14. They reflect the results of major improvements to the road over recent years between Picton and Mt. Ousley as well as some substandard pavement conditions currently existing between Oakdale and Picton. An assessment of the suitability of the road to continue to accept Burragorang Valley coal traffic to Port Kembla at its current level of 1.2 mtpa is contained in Section 5.6.8.

TABLE 5.14
 PICTON ROAD OPERATIONAL CHARACTERISTICS
 % LENGTH OF ROAD

Operational Characteristic	Oakdale to Picton 15km	Picton to Mt. Ousley 40km
No overtaking	80	70
Speed zoning:		
60 kph	5	8
80 kph	-	11
100 kph	95	81
Road lanes:		
2	100	65
3	-	28
4	-	1
Divided	-	6
Pavement condition:		
Very good	-	4
Good	18	57
Fair	70	38
Poor	12	1

Source: NRMA, 1988

Historical crash data available from the NRMA (1985) along the Picton Road is restricted to the section between Picton and Mt. Ousley Road between 1979 and 1984. It shows a fluctuating level of crashes of between five and twenty per year, the truck involvement in which was consistently low. Further, such data reflects road conditions before recent improvements had taken place. Nevertheless, traffic safety issues in the Illawarra examined by the NRMA (1988) present pertinent data on crash standards relevant to road traffic exposure and engineering standard. Table 5.15 shows, on a macro scale, crash and injury rates per 100 million vehicle kilometres for the Picton Road compared to Mount Ousley Road F6 based on values for 1986 which are the

most recently available figures for both AADT and crash statistics. They clearly reflect the benefits of road improvement.

TABLE 5.15
CRASH RATES FOR PICTON ROAD PER 100 MILLION VEHICLE KILOMETRES

Accident Characteristics	Oakdale to Picton	Picton to Mt. Oulsey	Mt. Ousley Road - F6
Crash rate	355	41	41
Injury rate	29	52	49

5.6.6 Existing Coal Transport Operations

Clutha currently has an operational truck fleet consisting of 59 tippers rated to haul 25 tonnes and 7 tippers rated to carry 29 tonnes. Company owned trucks are preferentially used, but, contractors may occasionally be hired to haul coal from the Wollondilly Washery to Port Kembla. When not operational, trucks are kept either at the Narellan workshop near Glenlee or the driver's residence.

Trucks begin loading at the Brimstone and Oakdale collieries at 5.30am so that empty trucks are travelling along Stevys Forest Road from about 5am onwards. The mines are operated so that stockpile bins and surrounding stockpile areas are empty by 9pm at which time the last truck leaves. This provides sufficient storage capacity for mine work to continue until 5.30am the following day. Although there are no time restrictions on coal haulage, the Company has endeavoured to contain haulage hours between 5.30am and 9.00pm.

Truck travelling time to Glenlee is approximately half an hour, while that to Port Kembla is around one and half hours. Trucks are covered at all times for ROM coal, product coal and rejects. Company inspectors patrol the haulage routes throughout the day and are responsible for enforcing driver adherence to traffic and operational regulations.

Train loading facilities at Glenlee consist of a 1.5 km single spur line branching off the Main Southern Line which provides for train movements in the direction of Sydney. The spur line ends at the coal washery located immediately north of Menangle and west of Mount Annan overlooking a prominent bend in the Nepean River. Coal is loaded into trains from a 900 tonne overhead bin over the track. There are no provisions for unit trains, but the facility can accommodate 4 trains of 31 rail cars at any one time. A south bound spur is under construction to provide an alternative route to Port Kembla via Robertson. The facility has a Class 3 Category A rating from the State Rail Authority.

5.6.7 Coal Traffic Generated by Proposed Millar Mine

(1) Truck Haulage

Just over 1.8 million tonnes of raw coal is presently carried from the Brimstone and Oakdale Collieries. Prior to 1982, about 2.6 mtpa were hauled annually along the road before the closure of Brimstone No. 2 Mine. Indeed, the output from the Burragorang Valley mines peaked at 5.3 mtpa of raw coal in 1975.

The new mine, together with possible improvements at Brimstone Colliery, would increase transport along Stevys Forest Road from 1.8 mtpa to around 4 mtpa.

ROM and product coal haulage along Burragorang Road between Oakdale and the Wollondilly Washery will remain essentially the same at 4.1 mtpa, while haulage along Burragorang Road from Oakdale to Glenlee is estimated to increase from 1 mtpa to 2.0 mtpa. The tonnage of coal transported through Picton via Barkers Lodge Road will remain constant at about 1.2 mtpa.

Clutha is proposing to upgrade its truck fleet from 25 to 29 tonne truck capacity over the next three years. The larger truck has been approved by the Roads and Traffic Authority and is rated at 42 tonnes. An

alternative option, which is currently not approved, is to upgrade to articulated B-Double trucks which have a carrying capacity of 35 tonnes.

The maximum predicted number of movements along each section of road, will occur in 1995/95 and has been calculated for 25, 29 and 35 tonne trucks. The 35 tonne capacity trucks are B-Double units with 8 operating axles. Results based on a 280 day working year are presented in Table 5.16.

TABLE 5.16
PREDICTED TRUCK MOVEMENTS FOR 25, 29 AND 35 TONNE TRUCKS

Road	Truck Movements/day for maximum production 1994/95 (% increase)		
	25 tonnes	29 tonnes	35 tonnes
Stevys Forest Road	1158	998	827
Mine Access Road	514	443	367
Burraborang Road			
-West of Stevys			
Forest Road	1182	1019	844
-Stevys Forest			
Road to Barkers			
Lodge Road	912	786	651
-Barkers Lodge Road			
to Glenlee	570	491	407
Barkers Lodge Road	342	295	244

The proposal will substantially increase truck densities along the section of Stevys Forest Road between the mine access and the Burraborang Road intersection. The increase will be about 2.2 times for existing 25 tonne trucks, 1.8 times for 29 tonne trucks or 1.5 times for the larger 35 tonne trucks. The Burraborang route from Stevys Forest Road to Glenlee will also cater for greater truck numbers with increases for 25, 29 and 35 tonne trucks of 2.0, 1.7 and 1.4 times respectively.

However, a 0.8km section of Burragorang Road between Stevys Forest Road and Barkers Lodge Road will also include trucks travelling to Port Kembla so that total movements for the various size of trucks will range from 651 to 912. Truck numbers along the section of Burragorang Road between Stevys Forest Road, Nattai and the Wollondilly Washery will remain essentially the same for the smaller trucks and will decrease if larger trucks are used. Movements along Barkers Lodge Road to Picton will remain constant or decrease for larger trucks.

(ii) Other Traffic Generation

There will be a total of 215 employees at the Millar Mine of which 177 will be allocated to the mine and 38 to the coal preparation plant. Underground employees will work a non-rotating 6 days per week roster system, Monday to Saturday. On each day there will be three shifts of 9 hours duration, these being (11pm - 8am), (7am - 4pm) and (3pm - 12pm). The shift times overlap and allow each shift 1 hour total travelling time. Coal processing plant employees will work 8 hour shifts with the plant operating six days per week.

Employees will commute to the mine by private means and it is assumed there will be an average car occupancy rate of 2.5 persons per vehicle. There will be about 10 commercial and visitor trips per day, to give a total generation of about 190 vehicle movements per day entering and leaving the site via Egans Road. Peak traffic can be expected to occur at the change between the day and afternoon shifts, which it is assumed may comprise about 100 and 50 employees respectively, and will therefore involve 20 entry movements followed by 40 exit movements.

Section 5.5.2 indicates a peak construction workforce of 95 per day of which 79 will commute to work. Assuming 2 persons per vehicle for transitory workers, this will generate 70 vehicle movements per day. Working one shift, it can be anticipated that 38 vehicle movements per hour will be generated at the beginning and end of each shift. This is less than the peak operational mine employee traffic at the change of the afternoon shift.

(iii) Truck Access to Mine

Three options are proposed for sealed coal haul road access between the Millar Mine pit head and Stevys Forest Road. These are shown in Figure 3.5.

Option "A" considers the haul road extending north from the mine for approximately 0.9 km then continuing west for 0.5 km to intersect with Stevys Forest Road. The land is Crown controlled and is under a permissive occupancy which is currently the subject of an application for a mining purposes lease. The road would cross Hurricane Creek and two smaller watercourses further north before joining Stevys Forest Road approximately 100 metres east of the Ridge Road intersection. This section of Stevys Forest Road would require widening of the pavement from 6 m to 8 m, also upgrading the existing Stevys Forest Road/Ridge Road intersection to accommodate coal traffic.

For Option "B", the haul road would consist of a direct east-west link between the pit head and Stevys Forest Road. The road would be approximately 0.5 km in length and would traverse privately owned land. Clutha has discussed the purchase of a strip of land from adjoining property owners required for this option. The road would cross Hurricane Creek and join Stevys Forest road 0.8 km south of the Ridge Road intersection.

The entrance to the mine for Option "B" would be on a straight level section of Stevys Forest Road with good sight distances in both directions. A tee intersection similar to a modified NAASRA Type 4 intersection layout would be constructed, including a separate right turning lane for vehicles turning right into the mine access road. The exit would be controlled by a suitably located stop sign on the access road.

For Option "C", the haul road would be about 1.4km long and would follow the route of Option "A" from the pit head site over Hurricane Creek up to the intersection with the existing transmission line. Here, it would

double back up the hill to follow an existing right of way over privately owned land, used for fruit growing, to an entrance on Stevys Forest Road that coincides with that proposed for Option "B". Its obvious disadvantage is that it would sever the use of the land that it traverses and which the Company would wish to avoid if possible.

For Option "A", trucks would need to travel 1.8 km further than for Option "B" and reconstruction of approximately 100 m of Stevys Forest Road and the intersection at Ridge Road would be necessary. Option "B" is more direct and would require less modification of the existing road. For Option "C", trucks would need to travel 0.8 km further than for Option "B" or 1.0 km less than for Option "A". Accordingly, as stated in Section 3.5.3, Option "B" is the Company's preferred haul route, while Option "C" is its second preference which would be adopted as its proposed route if the easement for Option "B" cannot be purchased.

The haul access road will have a sealed pavement width of 8 m, 1.5 m shoulders and table drain. The maximum grade will be 8% and horizontal and vertical alignments will conform to NAASRA standards for heavy vehicle use.

5.6.8 Transport Impacts

Impacts resulting from the proposal will be primarily associated with the increased volume of traffic generated by the new pit head operations described in Section 5.6.7 and a change in the proportion of vehicle mix caused by the greater number of trucks involved. Roads affected by increased coal and reject haulage will be the section of Stevys Forest Road between the mine access and the intersection with Burragorang Road, and the Burragorang Road route to Glenlee and the Wollondilly Washery. Lesser impacts will occur along the small section of Egans Road which will serve as an access for employee and service vehicles to the pit head, the traffic generation of which is quantified in Section 5.6.7; use of Egans Road for this purpose was temporarily stopped in 1986. The main issues arising from increased traffic generation will be the effects of noise and vibration, exhaust emissions, dust and spillages, road damage, road safety and traffic flows.

(1) Stevys Forest Road

For 25 tonne capacity trucks, daily movements along Stevys Forest Road between the pit head access and Burraborang Road will substantially increase from 526 to a peak volume of 1158 truck movements per day which for a 15.5 hour operational day is equivalent to 1.2 trucks per minute. AADT will increase to 2724 vehicles per day and the percentage of coal trucks from 25% to 43%.

The most immediate impact will be traffic noise which is addressed in detail in Section 4.7. Noise will become more prevalent and will adversely affect 55 residences along the section of the road which is subject to a 60km/hr speed limit. Historically, noise has been a continuing facet of life for the residents of Stevys Forest Road. However, the community consultation program results described in Section 5.5, show such noise is tolerated if normal truck operational times are followed. Section 4.7 indicates that existing noise levels from coal trucks along Stevys Forest Road are higher than the criterion of 55dB(A) and that predicted noise levels will increase by 5 to 6 dB(A) due to the development, ie by more than the criterion of 2dB over such levels. Imposition of a further restriction in speed limit to 40km/hr, the installation of hush kits on trucks, together with traffic management measures would enable the increase in traffic noise to be contained within the State Pollution Control Commission's criterion.

Invisible exhaust emissions for truck densities less than 200 trucks per hour will not adversely affect the surrounding air quality (Trucks in Suburbs, 1977), and although diesel engines emit quantities of particulate matter, dispersal is normally rapid and effects are not toxic. The major impact will be the deposition of some emission particles which is unsightly and unwelcome by most residents, but which occurs along all major roads.

Increased vibration from trucks may become a source of annoyance to residents, but is unlikely to result in property damage. Vibrations are primarily due to the roughness of the road surface, studies showing that

a truck passing over a bump of 44mm in height will produce clearly perceptible vibrations at a distance of 10 metres (Trucks in Suburbs, 1977). To a lesser extent, the magnitude of vibrations is also a function of truck type and speed, though with a restricted speed limit along Stevys Forest Road this is not a major concern.

Resident concerns relating to spillages along the roadside have mainly resulted from private contractors transporting coal in uncovered trucks from a stockpile at Allied Camp, half way along the eastern spur of Stevys Forest Road. This stockpile has now been depleted and stricter enforcement of covered roads should ensure future spillages will not occur.

An assessment of road capacity can be made in terms of level of service which is a measure of road performance derived from a number of contributing factors, including speed and travel time, traffic interruptions, freedom to manoeuvre, safety, driving comfort and convenience.

NAASRA (1982) defines specific levels from A (best) to F (worst). In this discussion a level of service C is assessed which is a zone of stable flow. Most drivers are restricted on their freedom to select their own speed or change lanes, overtake, etc although operating speeds are still reasonable.

The predicted maximum AADT of 2724 vehicles per day is well below the design capacity of 5000 vehicles per day for Stevys Forest Road. For a level of service C, the service volume is around 690 vehicles per hour which is greater than the predicted volume of 140 vehicles per hour when the Company's Burragorang Valley mines are operating at maximum production. The average delay suffered by entering and departing trucks at the mine access is estimated to be less than 1 second and similar delays are expected at the Burragorang Road intersection. From the above assessment, there will be little impact on traffic flows.

A greater impact will occur on the section of road between Stevys Forest Road and Barkers Lodge Road, which includes 342 truck movements to and

from Port Kembla. In this instance, trucks will consist of around 39% of AADT.

Stevys Forest Road is presently showing signs of pavement deterioration such as potholes and cracking, although substantial depression or upraised sections indicating foundation failure is not evident. The predicted increase in truck traffic will substantially impact on pavement quality and possibly foundation strength. Road damage increases with the fourth power of the ratio of axle loads, so that introduction of 29 tonne capacity trucks will increase wear by about 50%. The use of B-Doubles will greatly lessen the impact while increasing load capacity to 35 tonnes.

(ii) Burragorang Road Route

Daily truck movements will increase to a maximum of 570 between Oakdale and Glenlee which is about 26% of AADT. This compares with 1182 movements per day or 79% of AADT expected on the road west of Oakdale.

Residential areas between Oakdale and the Wollondilly Washery are restricted to within one kilometre of the intersection with Stevys Forest Road for which comments of the previous section will apply. For the remainder of this route, impacts will be predominantly related to pavement deterioration. Lane width is nominally three metres, but this is not considered a major restriction due to the low volume of non-truck traffic and the short road distance with good alignment and sight distances.

The service volume for level of service C traffic along Burragorang Road east of Oakdale is estimated to be approximately 390 vehicles per hour, which compares favourably to 115 vehicles per hour when the Company's Burragorang Valley mines are operating at maximum production. Truck numbers will increase by a maximum of 276 truck movements per day to give a total of 570 truck movements per day or 0.61 truck movements per minute. Impacts will be similar yet proportionally less than those predicted for Stevys Forest Road with the most noticeable detriments occurring near the residential areas of Oakdale, The Oaks and Mt.

Hunter. These areas are in 60km per hour speed zones and cover about 5km of the route. Noise levels within these areas can be expected to increase over existing levels, but not by significantly more than the criterion of 2dB over such levels. Increased noise will also be experienced by residents along a small section of Macarthur Road due to trucks rapidly changing speed and direction. Trucks decelerate off the Camden Bypass onto a circular ramp, come to a stop at a give-way sign, then turn left into Macarthur Road before turning left again into Spring Road.

The proposal may act to increase overall travelling times with just 2km of eastbound overtaking lanes between Oakdale and the Camden Bypass. However, this section of haul route is 22 km in length, so that only minor inconvenience is anticipated. A greater impact will occur along the 1km of road which crosses Back Creek. This section of road has poor alignment and sight distances and trucks will need to substantially reduce speeds below the 55km per hour limit. The use of articulated trucks such as B-Doubles may also be severely restricted unless appropriate road improvements by the Roads and Traffic Authority can be expediated. It is considered that the proposed development of the Burratorang Valley mines identified in this environmental impact statement should be sufficient justification for increasing the priority for improving this section of the Burratorang Road to accommodate coal traffic.

Minor road damage is evident along Burratorang Road, and the proposal will serve to increase the rate of pavement deterioration, the extent being dependent on the size and type of haulage truck. The selection of B-Double trucks will have a less severe impact, and will reduce the number of truck movements. The Burratorang Road haul route will not be greatly affected by the proposal, although noise may seriously affect a small number of residences along Macarthur Street and to a lesser extent on townships along Burratorang Road. Traffic flows may adversely change along the 1km section across Back Creek. However, this will not greatly affect overall travelling times. Road deterioration will increase in magnitude depending on the types of trucks used.

In conclusion, it should be noted that despite the increase in coal traffic along Burragorang Road resulting from the Millar Mine, future truck movements will still be significantly lower than those existing in the mid seventies.

(iii) Picton Road

Daily truck movements along the Picton Road generated by the Company's Burragorang Valley coal mining operations will remain at the current level of 342 or about 39% of AADT. Introduction of larger trucks will of course reduce such levels as shown in Table 5.16.

The service volume for level of service C along Picton Road between Oakdale and Picton is estimated to be approximately 220 vehicles per hour compared to the predicted volume of 45 vehicles per hour when the Company's Burragorang Valley mines are operating.

As the amount of coal traffic will remain at current levels, impacts experienced along the route will remain the same. Noise levels in residential areas traversed by the route, particularly in Oakdale and Picton will therefore meet the acceptable criterion for transportation noise. However, having regard for the operational characteristics of the road given in Table 5.16 it is considered that the proposed development of the Burragorang Valley mines indicated herein should also be sufficient justification for increasing the priority for upgrading those sections of the Picton Road that require improved pavement conditions in the first place, increased opportunities for overtaking and better alignment.

However, the future use of Picton Road for the transport of Burragorang Valley coal to Port Kembla requires consideration of the environmental acceptability of continuing coal truck movements through the centre of Picton and its compatibility with future development planning for the district.

While the hourly rate of traffic provides for stable traffic flow conditions, the high truck content in an urban environment is not conducive to a long term desirable amenity. Further, there is no practical option for a bypass route to the town that is economically feasible.

The recently published Draft Regional Environmental Plan for Macarthur incorporates the general location and extent of major land uses identified in the Metropolitan Strategy for the Sydney Region. These indicate significant areas for future development to the south east of Picton which are traversed by the Picton Road. No indication is given of its priority for development, but the acceptability of continuing truck traffic along the Picton Road in the long term within such a scenario is open to question.

It may therefore be concluded that the transport of all Burragorang Valley coal traffic to Glenlee is a future option that the Company may need to review. Any change in the existing policy would require competitive rail freight rates and an adequate level of State Rail Service with respect to train availability.

Its adoption would increase the maximum demand on the track capacity of the main Southern Railway at Glenlee by 1.2 mtpa more than the Company's proposal of 2.4 mtpa or by just over 2 trains per day. Further, it would increase truck movements along Burragorang Road from 570 to 912 movements per day which would result in a small increase in noise levels to residents along the route. It would also further justify the need to improve the one kilometre section of Burragorang Road across Back Creek. This option is discussed further in Section 6.4.

(iv) Railway System

The current demand on the Main Southern Line at Glenlee for coal traffic from the Burragorang Valley mines is 1.0mtpa. Assuming export trains haul an average 2300 tonnes per train over 250 days per year, this would be an average of 1.75 trains per day. Future saleable coal production

from the Burragorang Valley is expected to achieve a maximum 3.6 mtpa, 1.2 mtpa of which will be hauled to Port Kembla by road via Picton. Accordingly, up to 2.4 mtpa will be transferred to rail at Glenlee and therefore the coal train demand will increase from an average 1.75 trains per day to 4.2 trains per day. In fact, as indicated in Section 5.8.2, trains will be arranged to suit scheduling of ship loading.

Any long term adoption of Glenlee for the export of all Burragorang Valley coal by rail would require about 6.3 trains per day, a level which should be within the theoretical track capacities available.

(iv) Mitigation of Impacts

Impacts can be minimised by the following measures:

- . strict adherence by truck drivers to speed limits and traffic regulations. Clutha currently has officers patrolling the haul routes, checking drivers and where necessary enforcing road laws. The frequency of these patrols will increase in proportion to the expected increases in truck numbers;
- . extension of the existing 60km/hr limit along Stevys Forest Road to the pit head entrance and the possible reduction of posted speed limits to 40km/hr in residential areas;
- . extension of the existing 60km/hr speed limit along Burragorang Road to cover developed sections of Oakdale;
- . installation of noise suppression equipment on all trucks over a period of about 18 months from the commencement of the new colliery development;
- . upgrading of the mine access intersection with Stevys Forest Road; and
- . regular monitoring and maintenance of relevant conditions of roads traversed by coal traffic.

In the longer term, impacts will also be minimised by:

- . upgrading of the 1 kilometre section of Burragorang Road across Back Creek; and
- . upgrading of Picton Road for improved pavement conditions, opportunities for overtaking, and better alignment.

5.7 ENERGY ASSESSMENT

An energy statement for the project is given in Section 3.12. It indicates that the mine extension will be a significant nett producer of energy. Energy inputs will only represent about 0.30 percent of total energy outputs. Safeguards to minimise energy inputs include requirements for energy efficiency in original equipment specifications, preventative maintenance of all mining plant, careful scheduling of mining to avoid excessive haul distances and continuous maintenance of underground roadways and conveyor equipment. Energy outputs will be maximised by the Company's ongoing commitment to recovery of all economic reserves within the Bulli Seam and by the technologically competent design of the Company's mining proposals.

The proposed mining plan will ensure that full advantage is taken of all available reserves. The nett energy recovery of 58.7 percent of in-situ reserves and 94.6% of recoverable reserves indicates an efficient mine plan designed to optimise coal recovery. The proposal is therefore believed to be an appropriate utilisation of the remaining coal within the subject area.

6.0 ASSESSMENT OF ALTERNATIVES

6.1 STRATEGIC OPTIONS

The strategic option available to the Company for mining the remaining 50.6 million tonnes of recoverable reserves in its Oakdale lease area are to continue current mining operations from its existing pit head facilities at Oakdale Colliery located some 4 kilometres north of the village of Oakdale as shown on Figure 2.3, or to access same from a new location closer to these reserves.

The Company is in possession of all necessary consents to continue its current underground mining and surface coal handling operations, but as explained in Section 2.3, they do not present the most efficient or economic way of extracting the resource and maintaining the employment of the Company's current workforce.

Establishment of a new mine entrance closer to the remaining reserves together with the introduction of longwall mining will provide such a function. The coal brought to the surface will need to be washed and use of the existing washery at Wollondilly or the establishment of a new facility at the new pit head forms the second major subject for consideration together with options for dealing with washery rejects therefrom. The third major consideration involves the need to transport coal from the mine to the Balmain and Port Kembla coal loaders, the lack of a railway closer than the main Southern Line, and the economic and environmental acceptability of using road transport to gain access to that line or deliver it direct to Port Kembla in part by road.

Establishment of the new pit head requires a new mining purposes lease for determination under the provisions of the Coal Mining Act. It also requires development approval under the provisions of the Environmental Planning and Assessment Act. Further, as it is a designated development under the latter legislation, it requires preparation and processing of an environmental impact statement which necessitates a comprehensive assessment to be made of specific aspects of the proposal including

alternatives which are the subject of this section. The Company therefore does have the option of proceeding with the development without further approval, albeit with a less satisfactory scheme and implications for less productive capacity and employment potential.

6.2 ALTERNATIVE ENTRY LOCATIONS

Three alternative pit top sites have been investigated and discarded as unpractical. Compared with the proposed mine entry at the existing Oakdale No. 3 shaft site, they did not enable access to the Bulli Seam sufficiently to the east to optimise the capital costs of establishing a drift and associated underground workings and equipment, and the operating costs associated with employee and product transport and drift haulage were not competitive over the mine life. The locations of the alternative entry locations considered are shown on Figure 2.3.

Alternative 1 was a site on Crown Land above 1 kilometre south of the Oakdale Colliery pit head. The site was discarded as impractical due to the length of decline drift required; the need to operate with the mine workforce entering at the Oakdale No. 3 shaft, and coal egress and washing and materials ingress at a different location. The excessive length of decline, and the need to maintain long belt roads and supply lines throughout the mine life are not financially acceptable during times of severe market competition. Long belt roads and supply routes contribute significantly to the premature closure of a mine and thus the sterilisation of coal reserves because of the excessive cost burden in maintenance of roof support, belts and drives, as well as the time to travel with supplies, move heavy equipment in and out for maintenance, and the energy expended in driving the system.

Alternative 2 was a site on Crown Land about 1 kilometre east of the Oakdale Colliery pit head between the Oakdale Mine Road and the Brimstone Road. It was discarded as impractical for the same reasons as for Alternative 1.

Alternative 3 was a site in the Brimstone Creek Valley to the southwest of the Oakdale Colliery pit head. It also required a long flat decline to access the Bulli Seam and had similar disadvantages to those described for Alternative 1. It had further problems involving land ownership and access including the need for coal haulage up steep inclines requiring extensive road and/or conveyor works.

The proposed site at the Oakdale No. 3 shaft is suitably located to access the remaining coal reserves in the current mining lease area. It is also Company owned land with access for coal product export over Crown Land to Stevys Forest Road, which is a route currently used for coal transport from the Oakdale and Brimstone Collieries. Furthermore, it has the added advantage of possessing existing facilities for mine access of men and materials, a ventilation shaft, workforce and administration/amenities, effluent treatment works, an established vehicular access and car park for mining personnel as well as the necessary utility services.

Four alternative site layouts of coal handling facilities were considered for the chosen site. Three of these provided for establishment of the coal preparation plant and run of mine product coal storage and handling facilities on top of the spur north of Oakdale No. 3 shaft and Hurricane Gully. Option 1, included for a run of mine stockpile and loading of coal by front end loader until commissioning of the washery and associated product bins. Option 2 included for the immediate installation of product bins to be used for storing and loading run of mine coal until commissioning of the washery when a run of mine stockpile would be required and the product bins would be used for product coal. Option 3 included for a run of mine stockpile and loading of run of mine coal from special raw coal feed bins until commissioning of the washery and associated product bins. These options were rejected in favour of the proposed installation shown in Figure 3.4 because of their greater exposure to visual, noise and dust pollution, propensity for erosion and water pollution, greater energy usage and cost.

The proposal scheme is compact, has technical advantages in centralising the existing and proposed facilities, and environmental advantages with regard to visibility, pollution controls and cost, although it will require care in minimising disturbance to the slopes of Hurricane Gully.

6.3 MINING ALTERNATIVES

The constraints and options available to the Company for mining its remaining coal reserves, which are essentially located in the eastern portions of its existing leases, are described in Section 3.3.

The depth of the coal deposit dictates the use of underground mining, and the need to extract the resource with maximum productivity per employee requires the adoption of the latest longwall technology in view of the significance of labour/operating costs.

There is no alternative to using longwall methods if these objectives are to be obtained, except for employing continuous miner units to develop the longwall blocks and to extract those areas of the lease where geometry or geological anomalies preclude the use of longwall mining techniques in practice.

6.4 TRANSPORT ALTERNATIVES

6.4.1 Alternative Modes

Burraborang Valley coal is mined for export through the Balmain and Port Kembla coal loaders. A description of the regional transport infrastructure serving these facilities is given in Section 5.6.2 as shown in Figure 2.5.

Rail is the primary transport mode for transport to the Balmain coal loader, while road and rail serve the Port Kembla Loader.

Access to rail is available via the Company's existing coal loading facilities at Glenlee. These are located at the end of a spur line branching off the Main Southern Line providing for train movements in the direction of Sydney and hence direct to the Balmain coal loader. They also provide for train movements to Port Kembla via the Metropolitan rail system and the Illawarra Line. The Company is currently committed to the transport of 1.0 mtpa by rail from Glenlee.

The Main Southern Line is the nearest railway line to the Burragorang Valley. There are no other road/rail interchanges available on that line except for the existing facility serving the Tahmoor Colliery south of Picton.

A future direct rail link will be available to Port Kembla on completion of the Maldon/Dombarton railway, progress on which has recently been halted. Any future use of that railway will require siding extensions at Glenlee to provide for exit onto the Main Southern Line in the direction of Maldon. These are currently under construction.

Access to the Glenlee coal loader is available from the Burragorang Valley via the Burragorang Road shown in Figure 5.4. This route has been subject to extensive upgrading over recent years and has spare capacity to accommodate increased coal haulage.

Direct road access to the Port Kembla coal loader is available via the Picton Road (MR 95) from Oakdale via Picton and Wilton. The Company is currently transporting 1.2 mtpa of coal along this route for export. The Millar Mine proposal is to limit future road transport to Port Kembla to 1.2 mtpa. It proposes to remit the balance of 1.8 to 2.4 mtpa by rail via the Glenlee facility.

There are no other economically viable transport modes for transporting coal from the Burragorang Valley to Glenlee even in the long term.

6.4.2 Rail Options

The Main Southern Line provides a direct rail link from the Glenlee coal loader to the Balmain coal loader and has adequate capacity for servicing the future requirements of the Burragorang Valley coal mines for that purpose. No other option requires consideration.

The Illawarra Line provides the only direct rail link to the Port Kembla coal loader and has adequate capacity for serving the future requirements of the Burragorang Valley and coal mines for that purpose. However, it does require use of the Main Southern Line and transfer therefrom within the Sydney metropolitan system. No other option is available as the Moss Vale to Unanderra Line is not suitable for regular coal haulage and the Maldon to Dombarton rail link has yet to be completed.

6.4.3 Road Options

The draft Sydney Regional Environmental Plan - Macarthur Rural Lands contain an objective of minimising haulage of coal on public roads. This is complemented by a principle suggesting that consent authorities be satisfied there is a proposed environmentally acceptable mode of transport associated with the development which is capable of being integrated into a comprehensive system for handling all coal movements within the region. Further, that if public road haulage is the only feasible mode of transport, it should be restricted to the most environmentally acceptable route.

Sections 5.6.2 and 5.6.8 indicate that the recently upgraded Burragorang Road is capable of accommodating the future increased coal traffic for transfer to rail at Glenlee. However, they also describe certain adverse characteristics related to the continued use of Picton Road for coal haulage even at current rates particularly in the longer term. These include imperfections in the route particularly between Oakdale and Picton, the need for such traffic to proceed through Picton itself,

and the incompatibility of such traffic with future development planning for the area particularly between Picton and Wilton.

The option of the Company is to re-route all coal traffic from the Burragorang Valley to Glenlee. Road capacity for the increased traffic involved along the Burragorang Road is not a constraint, but there would be a small increase in environmental impact along the road and along the rail routes from Glenlee. However, the feasibility of adopting such an option is dependent on the transport costs involved and their impact on the economic viability of the Burragorang Valley coal industry. This will very much depend on the ability of the State Rail Authority to provide a competitive alternative to road transport. No double handling of coal with incumbent costs is associated with direct road transport to Port Kembla.

The Illawarra rail link has been disrupted in the past by land instability and structural problems to bridge structures. With the limited number of daily train paths available, and increased commuter traffic, conflict with coal haulage will increase until the system is augmented.

There is also the likelihood of closure of the Balmain coal loading facility in 5 to 10 years time, which will further increase the demand for rail transport of coal on the Illawarra Line by 2.2 mtpa.

Under these circumstances, the maintenance of an alternative transport system is important to the stability of Burragorang Valley coal production.

7.0 VALIDATION OF PROPOSED DEVELOPMENT

7.1 JUSTIFICATION OF PROPOSAL

Most of the remaining coal resources in the Burragorang Valley lie in those sections of the Bulli Seam within the eastern sections of the Company's existing Oakdale and Brimstone mining lease areas. While they can be reached by underground access from the existing colliery pitheads, the time needed for the workforce to traverse the increasingly extensive distances involved to the coal face, and to transport the coal back to the surface will become unproductive and together with the continuing bord and pillar working will make mining uneconomic.

The Company's proposal to access these reserves nearer the coal face by establishing pit head facilities at the Oakdale No. 3 shaft, and to introduce longwall mining techniques to optimise future coal extraction in its Oakdale lease will allow the Burragorang Valley coal to remain competitive. It will enable an increase in production above recent depressed levels and continued employment of the Company's current workforce under increasingly competitive market conditions. This will have obvious advantages locally and to the State and Federal Governments economically.

7.2 CONSEQUENCES OF NOT PROCEEDING

If the proposal does not proceed, there is a real possibility that the Burragorang Valley mines will not remain competitive and economically viable. They will lose export markets, as there is no replacement domestic market for the product coal involved, and closure will result.

In such circumstances, if closure occurs, the eastern sections will flood and underground roadways eventually collapse. Any future mining operation would then require new roadways and possibly entries to access the resource. Indeed, given the availability of other more competitive coal elsewhere and the capital cost of developing underground mines, it

is very likely that the remaining Burragorang Valley reserves would be sterilised and unworked.

The Company is the largest employer in the Burragorang Valley and contributes over \$17 million a year to the Federal Government through PAYE, income, fringe benefit, excise and fuel taxes. It also contributes about \$33 million a year to the NSW Government through payroll tax, mining royalties, rail and port charges, mining lease fees, subsidence levees, workers compensation, and pension levies. The workforce bill is some \$60 million per year.

It is evident that the loss to export revenue caused by any closure of the Burragorang Valley mines at a time when there is a considerable trade account imbalance would be significant. Further, the creation of a large unemployed pool of skilled workers, and the creation of socio-economic distress both directly, indirectly and induced in the region would have far reaching effects both to the workforce and for the State Government in compensation and loss of taxable income.

It is therefore apparent that the Company's proposal should be commended for its potential ability to maintain and indeed enhance the current socio-economic status quo for the Burragorang Valley.

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APPENDIX 1
LIST OF PLANT SPECIES RECORDED IN THE SURVEY AREA,
MILLAR MINE PROJECT, OAKDALE

Pteridophyta (Ferns)

ADIANTACEAE

- Adiantum aethiopicum L
- Adiantum hispidulum Sw
- Pellaea falcata (R.Br.) Fee

ASPENIACEAE

- Asplenium flabellifolium Cav

BLECHNACEAE

- Blechnum cartilagineum Sw
- Blechnum minus (R.Br.) Ettiingsh
- Doodia aspera R.Br

CYATHAECEAE

- Culcita dubia (R.Br.) Maxon
- Cyathea australis (R.Br.) Domin

DENNSTAEDTIACEAE

- Pteridium esculentum (Forst.f.) Cockayne

GLEICHENIACEAE

- Gleichenia microphylla R.Br
- Sticherus flabellatus (R.Br.) St John

GRAMMITIDACEAE

- Grammitis billardieri Willd

HYMENOPHYLLACEAE

- Hymenophyllum cupressiforme Labill

LINDSAEACEAE

- Lindsaea linearis Swartz
- Lindsaea microphylla Swartz

OSMUNDACEAE

- Todea barbara (L)T Moore

POLYPODIACEAE

- Pyrrosia rupestris (R.Br) Ching

PTERIDACEAE

- Pteris tremula R.Br

THELYPTERIDACEAE

- Christella dentata (Forst.) Brownsey et Jermy

Angiospermae

APIACEAE

Actinotus helianthi Labill
Hydrocotyle laxiflora DC
Platysace lanceolata (Labill) Druce
Xanthoisa tridentata DC

ARALIACEAE

Astrotricha latifolia Benth
Polyscias sambucifolia (Seiber ex DC) Harms

ASCLEPIADACEAE

Marsdenia rostrata R.Br
Marsdenia suaveolens R.Br
Tylophora barbata R.Br

ASTERACEAE

*Ageratina adenophora (Spreng) R.M. King & H. Robinson
Cassinia longifolia R.Br
*Gnaphalium calviceps Fern
Helichrysum bracteatum (Vent) Andr
Helichrysum diosmifolium (Vent) Sweet
Helichrysum elatum A. Cumm ex DC
*Hypochoeris radicata L
Lagenifera stipitata (Labill) Druce
Olearia microphylla (Vent) Maiden et Betche
Olearia erubescens (Sieber ex DC) Dippel
Olearia viscidula (F. Muell) Benth

ATHEROSPERMATAACEAE

Doryphora sassafras Endl

BIGNONIACEAE

Pandorea pandorana (Andr) Steenis

CAMPANULACEAE

Wahlenbergia gracilis (Forst. f) Schrad

CAPRIFOLIACEAE

*Lonicera japonica Thunb

CASUARINACEAE

Allocasuarina littoralis (Salisb) L. Johnson
Allocasuarina torulosa (Ait) L. Johnson

CUNONIACEAE

Callicoma serratifolia Andr
Ceratopetalum apetalum D. Don
Ceratopetalum gummiferum Sm

GOODENIACEAE

Dampiera purpurea R.Br
Goodenia hederacea Sm
Goodenia bellidifolia Sm
Scaevola ramosissima (Sm) Krause

HALORAGACEAE

Gonocarpus teucrioides Dc

IRIDACEAE

Patersonia sericea R.Br ex Ker
Patersonia longifolia R.Br

LAURACEAE

Cassytha paniculata R.Br

LILIACEAE

Dianella caerulea Sims
Dianella revoluta R.Br
Laxmannia gracilis R.Br
Stypandra glauca R.Br
Tricoryne simplex R.Br

LOGANIACEAE

Logania albiflora (Andr) Druce
Mitrasacme polymorpha R.Br

LORANTHACEAE

Amyema pendulum (Sieber ex Spreng) Tieghem

MIMOSACEAE

Acacia elata A. Cunn ex Benth
Acacia falciformis DC
Acacia linifolia (Vent) Willd
Acacia longifolia (Andr) Willd
Acacia mearnsii De Wildeman
Acacia myrtifolia (Sm) Willd
Acacia parramattensis Tindale
Acacia rubida A. Cunn
Acacia suaveolens (Sm) Willd
Acacia terminalis (Salisb) Macbride
Acacia ulicifolia (Salisb) Court

MYRSINACEAE

Rapanea variabilis (R.Br) Mez

MYRTACEAE

Acmena smithii (Poir) Merr & Perry
Angophora costata (Gaertn) J. Britt
Baeckea linifolia Rudge
Eucalyptus agglomerata Maiden
Eucalyptus consideniana Maiden
Eucalyptus eugenioides Sieber ex Spreng

Eucalyptus gummifera (Gaertn) Hochr
Eucalyptus notabilis Maiden
Eucalyptus paniculata Sm
Eucalyptus piperita Sm
Eucalyptus punctata DC
Eucalyptus sclerophylla (Blakely) L.A.S Johnson & Blaxell
Eucalyptus sieberi L.A.S. Johnson
Kunzea ambigua (Sm) Druce
Leptospermum attenuatum Sm
Leptospermum flavescens Sm
Leptospermum phyllicoides (A. Cunn ex Schauer) Cheel
Melaleuca linariifolia Sm
Syncarpia glomulifera (Sm) Nied
Tristaniopsis collina P.G. Wilson & J.T. Waterhouse

OLEACEAE

Notelaea venosa F. Muell

ORCHIDACEAE

Bulbophyllum exiguum F. Muell
Cumbidium suave R.Br
Liparis reflexa (R.Br) Lindl

PASSIFLORACEAE

*Passiflora edulis Sims

PHYTOLACCAEAE

*Phytolacca octandra L

PHILESIACEAE

Eustrephus latifolius R.Br

PITTOSPORACEAE

Billardiera scandens Sm
Bursaria spinosa Cav
Pittosporum revolutum Ait
Pittosporum undulatum Vent

PLANTAGINACEAE

*Plantago lanceolata L

POACEAE

*Briza maxima L
Cymbopogon refractus (R.Br) A. Camus
Echinopogon ovatus (Forst.f) Beauv
Entolasia stricta (R.Br) Hughes
Imperata cylindrica Beauv
Stipa sp
Themeda australis (R.Br) Stapf

PRIMULACEAE

*Anagallis arvensis L

PROTEACEAE

Banksia serrata L.f
Banksia spinulosa Sm var *spinulosa*
Grevillea phyllicoides R.Br
Hakea dactyloides (Gaertn) Cav
Hakea salicifolia (Vent) B.L. Burtt
Isopogon anemonifolius (Salisb) Knight
Lambertia formosa Sm
Lomatia silaifolia (Sm) R.Br
Persoonia levis (Cav) Domin
Persoonia linearis Andr
Persoonia mollis R.Br
Petrophile pedunculata R.Br
Stenocarpus salignus R.Br
Telopea speciosissima R.Br
Xylomelum pyriforme Sm

RANUNCULACEAE

Clematis aristata R.Br ex DC

RESTIONACEAE

Lepyrodia scariosa R.Br

RHAMNACEAE

Pomaderris ferruginea Sieber ex Fenzl

RUBIACEAE

Morinda jasminoides A. Cunn
Opercularia aspera Gaertn
Pomax umbellata (Gaertn) Soland ex A. Rich

RUTACEAE

Boronia ledifolia (Vent) J. Gray
Crowea exalata F. Muell
Eriostemon australasium Pers
Eriostemon hispidulus Sieb ex Spreng
Zieria pilosa Rudge
Zieria smithii Andr. s. lat

SANTALACEAE

Exocarpos cupressiformis Labill
Leptomeria acida R.Br

SAPINDACEAE

Dodonaea triquetra Wendl

SMILACAEAE

Smilax glycyphylla Sm

SOLANACEAE

Solanum pungetium R.Br

STYLIDIACEAE

Stylidium laricifolium Rich

THYMELAEACEAE

Pimelea linifolia Sm

TREMANDRACEAE

Tetratheca ericifolia Sm

Tetratheca rupicola Joy Thompson

Tetratheca thymifolia Sm

VIOLACEAE

Hybanthus vernonii (F.Muell) F. Muell

Viola betonicifolia Sm

Viola hederacea Labill

VITACEAE

Cissus hypoglauca A. Gray

XANTHORRHOEACEAE

Lomandra gracilis (R.Br) Lee

Lomandra longifolia Labill

Lomandra multifolia (R.Br) J. Britt

Lomandra obliqua (Thunb) Macbride

Xanthorrhoea resinosa Pers

APPENDIX 2
STRUCTURAL FORMATIONS IN AUSTRALIAN VEGETATION (after Specht 1981)

Life form of Tallest Stratum:	Projective Foliage Cover of Tallest Stratum:				
	100-70%	70-50%	50-30%	30-10%	<10%
Trees >30m	Tall Closed Forest	Tall Open Forest	-	-	-
Trees 10-30m	Closed Forest	Open Forest	Open Forest	Woodland	Open Woodland
Trees <10m	Low Closed Forest	Low Open Forest	Low Open Forest	Low Woodland	Low Open Woodland
Shrubs >2m	Closed Shrub	Open Shrub	Open Shrub	Tall Shrubland	Tall Shrubland
Shrubs 0.25-2m	Closed Heathland	Open Heathland	Open Heathland	Low Shrubland	Low Open Shrubland
Shrubs <0.25m	-	-	-	Dwarf Open Heathland	Dwarf Open Heathland
Hummock Grasses	-	-	-	Hummock Grassland	Open Hummock Grassland
Herbaceous Layer:					
Gramminoides	Closed Grassland	Grassland	Grassland	Open Grassland	Very Open Grassland
Sedges	Closed Sedgeland	Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland
Herbs	Closed Herbland	Herbland	Herbland	Open Herbland	Very Open Herbland
Ferns	Closed Fernland	Fernland	Fernland	Open Fernland	Very Open Fernland

APPENDIX 3
LIST OF MAMMAL SPECIES KNOWN OR EXPECTED TO OCCUR
IN THE SURVEY AREA AT OAKDALE
NOMENCLATURE FOLLOWS STRAHAN (1983)

Tachglossus aculeatus	Short-beaked Echidna
Antechinus stuartii	Brown Antechinus
Vombatus ursinus +	Common Wombat
Pseudocheirus peregrinus +	Common Ringtail Possum
Petauroides volans	Greater Glider
Petaurus breviceps	Sugar Glider
Trichosurus vulpecula	Common Bushtail Possum
Cercatetus nanus	Eastern Pygmy-possum
Acrobates pygmaeus	Feathertail Glider
Macropus rufogriseus	Red-necked Wallaby
Macropus giganteus	Eastern Grey Kangaroo
Wallabia bicolor +	Swamp Wallaby
Rattus fuscipes	Bush Rat
Rattus rattus *	Black Rat
Mus musculus *	House Mouse
Oryctolagus cuniculus * +	Rabbit
Vulpes vulpes *	Fox
Felis catus *	Feral Cat

* - introduced species + - confirmed during survey period

APPENDIX 4

LIST OF BIRD SPECIES RECORDED IN OR NEAR THE SURVEY AREA AT OAKDALE
NOVEMBER/DECEMBER, 1988. NOMENCLATURE FOLLOWS BLAKERS ET AL (1984)

Maned Duck	<i>Chenonetta jubata</i>
Feral Pigeon*	<i>Columba livia</i>
Common Bronzewing	<i>Phaps chalcoptera</i>
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>
Galah	<i>Cacatua roseicapilla</i>
Gang-gang cockatoo	<i>Callocephalon fimbriatum</i>
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>
Crimson Rosella	<i>Platycercus elegans</i>
Eastern Rosella	<i>Platycercus eximius</i>
Fan-tailed Cuckoo	<i>Cuculus pyrrhophanus</i>
Laughing Kookaburra	<i>Dacelo novaeguineae</i>
Sacred Kingfisher	<i>Halcyon sancta</i>
Dollarbird	<i>Eurystomus orientalis</i>
Suberb Lyrebird	<i>Menura novaehollandiae</i>
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>
Eastern Yellow Robin	<i>Eopsaltria australi</i>
Jacky Winter	<i>Microeca leucophaea</i>
Golden Whistler	<i>Pachycephala pectoralis</i>
Rufous Whistler	<i>Pachycephala rufiventris</i>
Grey Shrike-thrush	<i>Colluricincla harmonica</i>
Black-faced Monarch	<i>Monarcha melanops</i>
Grey Fantail	<i>Rhipidura fuliginosa</i>
Rufous Fantail	<i>Rhipidura rufifrons</i>
Willie Wagtail	<i>Rhipidura leucophrys</i>
Eastern Whipbird	<i>Psophodes olivaceus</i>
Superb Fairy-wren	<i>Malurus cyaneus</i>
Pilotbird	<i>Pycnoptilus floccosus</i>
Large-billed Scrubwren	<i>sericornis magnirostris</i>
White-browed Scrubwren	<i>Sericornis frontalis</i>
Brown Thornbill	<i>Acanthiza pusilla</i>
Striated Thornbill	<i>Acanthiza lineata</i>
White-throated Treecreeper	<i>Climacteris leucophaea</i>
Little Wattlebird	<i>Anthochaera chrysoptera</i>
Noisy Miner	<i>Manorina melanocephala</i>
Lewin's Honeyeater	<i>Meliphaga lewinii</i>
Yellow-faced Honeyeater	<i>Lichenostomus chrysops</i>
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>
Spotted Pardalote	<i>Pardalotus punctatus</i>
House Sparrow *	<i>Passer domesticus</i>
Common Starling *	<i>Sturnus vulgaris</i>
Common Mynah *	<i>Acridotheres tristis</i>
Australian Magpie-lark	<i>Grallina cyanoleuca</i>
Australian Magpie	<i>Gymnorhina tibicen</i>
Pied Currawong	<i>Strepera graculina</i>
Australian Raven	<i>Corvus coronoides</i>

* - introduced species

APPENDIX 5
STREAM WATER MONITORING
SYDNEY WATER BOARD

=====
 Catchment Control Sub-branch.

SITE NO.	DATE	FLOW	TEMP. Deg C	COLOUR INTENSITY	TURBIDITY N.T.U. (ug/l)	IRON (ug/l)	PH UNITS	CHLORIDE (SALT) (mg/l)	PERMANGANATE VALUE (mg/l) Oxygen Cons.	SULPHATE (mg/l)	CONDUCTIVITY (mg/l)	DISSOLVED OXYGEN (mg/l)	BOD (mg/l)	FREE NITRATE AMMONIUM (mg/l)	TOTAL PHOSPHORUS (ug/l)	SUSPENDED SOLIDS (ug/l)
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↓ ?

* SITE NO: E531 Monkey Ck at Weir on Fire Road W10A. E 7440 N 3720

E531	06/02/81	WWF	23	150	24.0	3.00	6.80	55.0	2.0	-1.0	-1.0	6.7	-1	0.000	0.08	-1	-1
E531	01/05/81	DWF	-1	70	3.5	1.90	6.70	57.0	-1.0	-1.0	-1.0	8.4	-1	-1.000	-1.00	-1	-1
E531	30/09/81	DWF	15	30	3.3	0.20	7.30	65.0	0.3	3.3	-1.0	8.0	-1	0.000	0.02	6	-1
E531	19/10/81	WWF	14	90	15.8	1.25	7.30	56.0	1.1	-1.0	-1.0	9.0	-1	0.000	0.02	-1	-1
E531	03/11/81	WWF	16	175	100.0	3.40	6.70	34.0	4.3	-1.0	-1.0	8.9	-1	0.030	0.48	86	-1
E531	21/09/82	WWF	10	70	24.0	2.00	7.00	54.0	2.2	-1.0	-1.0	10.5	-1	0.000	0.06	14	-1
E531	10/08/83	DWF	-1	42	3.8	1.09	6.84	85.9	0.4	1.9	33.5	11.1	-1	0.002	0.12	5	-1
E531	24/10/83	WWF	15	175	93.0	2.40	7.00	63.0	3.1	2.7	21.5	8.8	-1	0.004	0.32	36	-1
E531	30/11/83	-	-1	-1	-1.0	-1.00	-1.00	-1.0	-1.0	3.7	17.8	-1.0	-1	-1.000	-1.00	-1	-1
E531	20/02/84	-	20	90	24.0	0.60	7.00	56.0	-1.0	2.8	23.7	7.8	-1	0.010	0.10	30	-1
E531	04/11/85	-	-1	45	6.5	1.08	7.02	65.3	2.8	2.0	27.7	-1.0	-1	0.005	0.02	-1	-1
E531	03/12/85	-	-1	25	5.5	0.69	6.03	90.4	1.2	3.4	32.3	-1.0	-1	-1.000	-1.00	-1	-1
E531	09/12/85	DWF	-1	50	6.0	0.90	7.42	82.6	2.7	3.7	-1.0	-1.0	-1	-1.000	-1.00	-1	-1
E531	18/12/85	DWF	-1	52	3.1	1.14	-1.00	84.0	-1.0	-1.0	36.2	-1.0	-1	-1.000	-1.00	-1	-1
E531	17/01/86	DWF	-1	55	2.4	-1.00	7.36	-1.0	-1.0	-1.0	38.3	-1.0	-1	0.024	0.03	-1	-1
E531	18/09/87	dwf	-1	55	5.7	1.32	7.34	89.1	1.7	-1.0	36.5	-1.0	-1	0.020	0.14	-1	13
E531	21/11/87	DWF	-1	55	17.0	1.60	7.21	-1.0	2.4	-1.0	-1.0	-1.0	-1	0.020	0.05	15	-1
E531	11/02/88	-1	-1	-1	-1.0	-1.00	-1.00	-1.0	-1.0	1.0	22.4	-1.0	0	-1.000	-1.00	-1	0

SITE No. E541 Horse Creek at Ford E7070 N 2890

E541	10/8/83	DWF	-	17	2.0	0.29	7.90	42.0	0.4	4.2	36.0	10.7	-	0.002	0.23	3	-
E541	24/10/83	WWF	15	90	23.0	0.95	7.10	26.0	3.0	5.0	13.1	8.7	-	0.000	0.24	21	-
E541	4/11/85	-	-	20	3.2	0.40	7.59	42.0	1.8	6.4	31.6	-	-	0.000	0.05	-	-

SITE NO. E547 Horse Creek at Road to Nattai Shaft

E547	10/8/83	DWF	-	7	0.5	0.19	5.30	52.0	0.1	1.4	18.9	10.2	-	0.006	0.02	-	-
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UB DWF = Dry weather flow
 W.F. = wet weather flow

APPENDIX 6
BOREHOLE MONITORING
WATER RESOURCES COMMISSION

APPENDIX 6
BOREHOLE MONITORING
BY
WATER RESOURCES COMMISSION

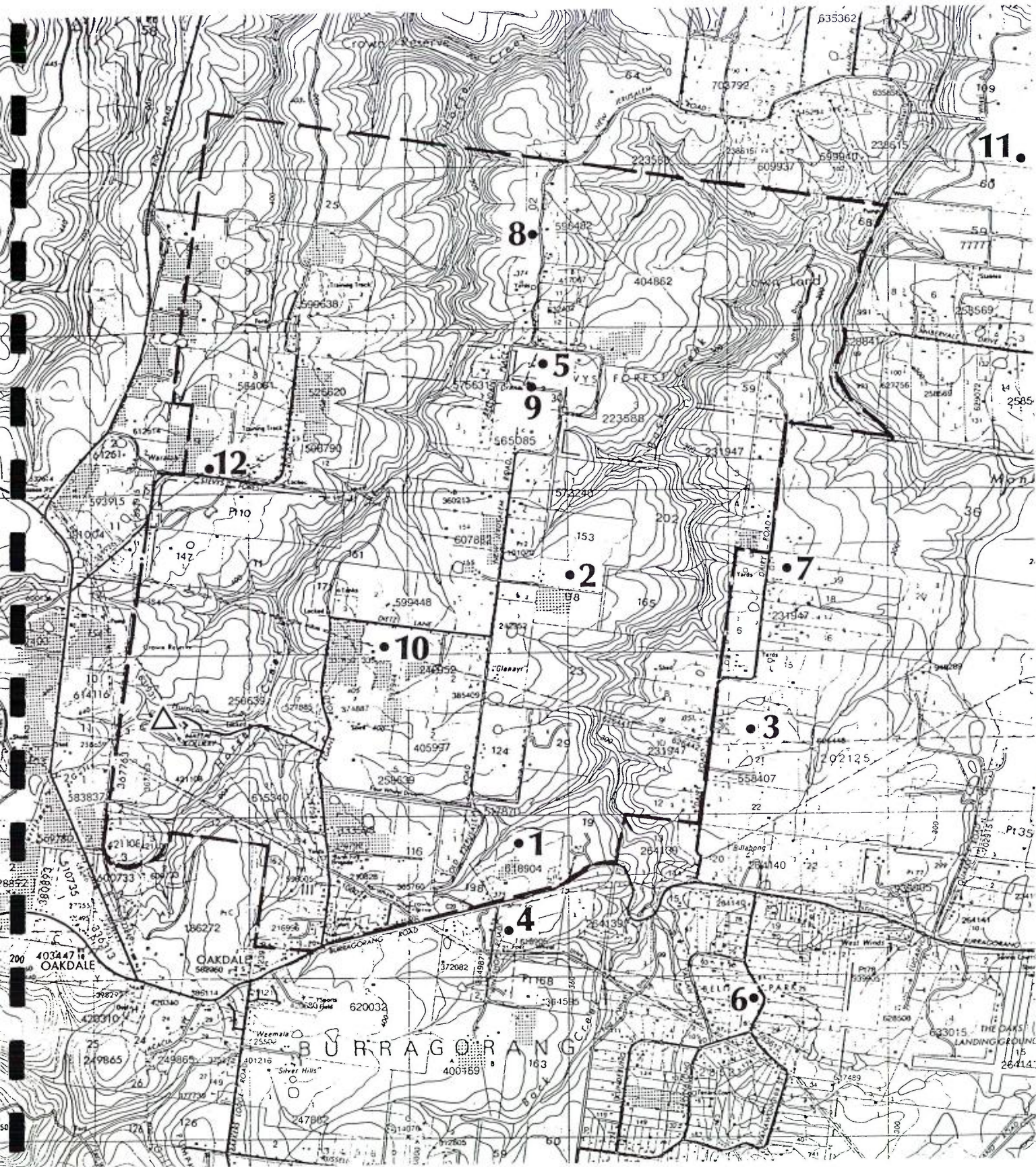
Borehole Location	1	2	3	4	5	6
No.	23483	23189	37496	37745	37746	37452
Date	05/06/67	25/02/66	28/11/72	15/01/78	23/09/77	01/01/79
Ca	40.04	132.14	160.18	2.00	28.06	1.80
Mg				10.94	19.44	6.80
Na				19.08	206.91	22.07
K				0.78	12.9	0.78
Co ₃						
HCO ₃	69.56	368.54	122.03	25.63	21.36	27.46
SO ₄				0.48	4.80	
Cl				47.15	416.57	58.50
pH	5.80	7.20	6.10	5.70	7.00	5.60
Total Dissolved						
Salts				94	699	
Electrical						
Conductivity	278	757	2220	183	1420	265
Total Ions				106.1	710	
Total Alkalinity	60.4	320.1	106	22.3	18.5	23.8
Hardness	100.0	330	400	50.1	150.2	32.5
Residual Alkalinity	0.0	0.0	0.0	0.0	0.0	0.0
No ₃ (N)						0.42
Fe					8.00	
SiO ₂					0.19	
F						

Note: Unspecified units generally mg/L

APPENDIX 6 (continued)
BOREHOLE MONITORING
BY
WATER RESOURCES COMMISSION

Borehole Location	7	8	9	10	11	12
No.	38040	42695	47129	47710	47998	59075
Date	08/04/76	27/09/76	30/08/78	05/12/80	12/11/86	06/02/84
Ca	28.26		3.00	1.60	6.78	
Mg	155.55		13.00	12.03	22.33	
Na	542.56		89.00	30.81	87.13	
K	15.64		2.00	1.56	2.34	
Co ₃				0.00		
HCO ₃	6.10		9.75	0.00	14.94	
SO ₄	21.61			32.66	4.20	
Cl	1347.21		275	106.00	215.5	60.00
pH	4.90	4.35	4.4	3.95	6.17	4.00
Total Dissolved Salts	2114			185	346	
Electrical Conductivity	4000		820	365	709	
Total Ions	2116.9	10.6		184.7	353.2	
Total Alkalinity	5.3		8.5	0.0	13.0	0.00
Hardness	711.2	85.0	61.0	53.6	108.9	20.0
Residual Alkalinity	0.0	0.0	0.0	0.0	0.0	0.0
No ₃ (N)					0.35	0.1
Fe	14.00		34.6			0.12
SiO ₂					8.62	
F					.25	0.00

Note: Unspecified units generally mg/L



- Proposed Millar Coal Mine Lease Area
- △ Proposed Millar Coal Mine Pithead Facilities
- 4 Borehole Locations



0 0.5 1km

APPENDIX 7
MINE WATER MONITORING
CLUTHA DEVELOPMENT PTY LTD

LABORATORY REPORT

Clutha Development Pty. Ltd.,
 19-29 Queen Street,
 Submitted by: NARELLAN N.S.W. 2567 Date Received: 4.11.81
Date of Collection: 4.11.81
Attention: Mr. D. Crouch Sampled by: Client

Description of Sample: Water from Nattai shaft, as below:

<u>Reference Number:</u>	368/111	369/111
<u>Sample Origin:</u>	Raw	Treated
pH	7.3	7.3
Total dissolved solids, 103-105°C, mg/L	388	359
Non-filtrable residue, mg/L	6	18
Grease & oil (Soxhlet Extraction Method) mg/L	Less than 1	3
Biochemical oxygen demand, BOD ₅ , mg/L	2	Less than 1
Colour, Pt-Co units	4	3
Turbidity, N.T.U.	5.2	1.0
Total hardness, as CaCO ₃ , mg/L	148	110
Calcium hardness, as CaCO ₃ , mg/L	90	70
Alkalinity to pH 4.5, as CaCO ₃ , mg/L	213	158
Total Manganese, Mn, mg/L	0.20	0.10
Total Iron, Fe, mg/L	0.5	Less than 0.1
Filtrable Iron, Fe, mg/L	Less than 0.1	Less than 0.1
Total Copper, Cu, mg/L	0.02	0.02
Total Lead, Pb, mg/L	Less than 0.05	Less than 0.05
Total Zinc, Zn, mg/L	0.27	0.73
Chloride, Cl ⁻ , mg/L	22.5	29.4
Sulphate, SO ₄ ⁼ , mg/L	11	22
Nitrogen-nitrate, N, mg/L	0.07	0.15
Nitrogen-Kjeldahl, N, mg/L	0.26	0.25
Standard Plate Count, organisms/mL	780	290
Faecal coliform organisms/ 100mL	5	Nil
Total coliform organisms/ 100mL	TNTC	78

JUDELL, PLATT, THOMAS & ASSOCIATES PTY. LTD.

Incorporated in N.S.W.

Incorporating the practice of Water and Trade Waste Consultants

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TELEPHONE (02) 439 4677
TELEX AA27468

LABORATORY REPORT

No. 8502C38

Client: Internal

Date Received: 13.2.85

Date of Collection: 13.2.85

Description of Sample: Mine water samples, as below:

<u>Reference Number:</u>	139	14C	141
<u>Sample Origin:</u>	Oakdale Discharge	Brimstone No.1 delivery to surface (from pipe discharge)	Brimstone No.2 delivery to surface
pH (Method 423*)	6.4	6.2	7.6
Specific Conductance, at 25°C, microsiemens/cm (Method 2C5*)	804	1 000	662
Calcium hardness, as CaCO ₃ , mg/L (Method 311A*)	206	200	150
Alkalinity, to pH 4.5, as CaCO ₃ , mg/L (Method 4C3*)	386	507	307
Total Iron, Fe, mg/L (Methods 3C2D*, 315A*)	0.22	0.37	0.08
Filtrable Iron, Fe, mg/L (Methods 3C2A*, 315A*)	< 0.04	0.04	< 0.04
Filtrable Manganese, Mn, mg/L (Methods 3C2A*, 3129A*)	0.04	0.08	< 0.02
Sodium, Na, mg/L (Method 325A*)	30	84	24
Chloride, Cl ⁻ , mg/L (Method 4C7C*)	27	30	27
Sulphate, SO ₄ ⁼ , mg/L (Method 426C*)	9.2	15	17

< = less than

* Standard Methods for the Examination of Water and Wastewater
15th Edition, 1980
A.P.H.A. - A.W.W.A. - W.P.C.F.



J.D.C. ANDERSON

APPENDIX 8
DISPERSION MODEL FOR DUST EMISSIONS

The dispersion model for emissions of particulate matter was based on the concept of a Gaussian plume represented by the formula

$$C = \frac{2}{\sqrt{2\pi} \cdot \Delta \theta'} \sum_{i,j,k} \frac{Q_{i,j,k} f_{i,j,k}}{\bar{u}_{i,j,k} \cdot \sigma_z} S(\theta) \exp \left[-\frac{1}{2} \left(\frac{H}{\sigma_z} \right)^2 \right]$$

where C = the ground level concentration of particles in the air in the direction θ at a distance x from the source, in mass per unit volume,

$\Delta \theta'$ = the section width in radians,

Q = the pollutant emission rate in mass per unit time,

f = the combined frequency of occurrence of wind speed class i, wind direction sector j and atmospheric stability category k,

u = the mean wind speed at the plume height H,

σ_z = the standard deviation of the vertical concentration distribution at a distance x.

In the model, which was developed from the ISC computer code, the area surrounding each source of dust was divided into sectors of equal angular width of 22.5 degrees corresponding to one of the 16 sectors of annual frequency distributions of wind direction. The emissions from each source were partitioned among the sectors according to the frequencies of wind blowing towards the receptor.

Dust emission rates were calculated for each type of operation. A number of volume sources of variable size, height and initial lateral and vertical dimensions were used to represent the operations in the computer model. Exposed areas and stockpiles were modelled for wind erosion of the surfaces.

Parametric equations were used to fit Pasquill-Gifford curves of dispersion parameters (Turner, 1969). The equations varied with downwind distance and atmospheric stability. Lateral and vertical virtual distances were determined from the initial dimensions of the volume sources and added to the actual downwind distance for calculating the standard deviations.

Dust emissions were divided into 3 particle size categories comprising particles with a diameter below 2.5 microns, particles between 2.5 and 15 microns, and particles larger than 15 microns. In each particle size range the reduction of the dust concentration in the ambient air by deposition to the surface was modelled by reducing the height of the dust plume.

Dry deposition velocities were determined for particles in each particle size category from Sehmel and Hodgson (1974). Land surface roughness length of 0.10m and a mean friction velocity of 0.20m/s were used to represent the average conditions under the travelling plume. Wet deposition through precipitation was not included in the model.

The deposition velocities were also used to determine the deposition rate of atmospheric dust to the surface as

D (deposition) = C (concentration) x v_d (deposition velocity).

Seasonal and annual dust deposition rates were calculated for each emission source and summed to obtain the predicted value at each point of a grid array. A computer plotting routine was then applied to fit isopleths to the grid calculations.

The dust deposition model was previously validated at the request of the State Pollution Control Commission using the monitoring results collected at an existing coal mine in the Hunter Valley. The validation indicated a systematic agreement between the modelling predictions and monitoring results with a degree of overprediction by the model still in evidence.