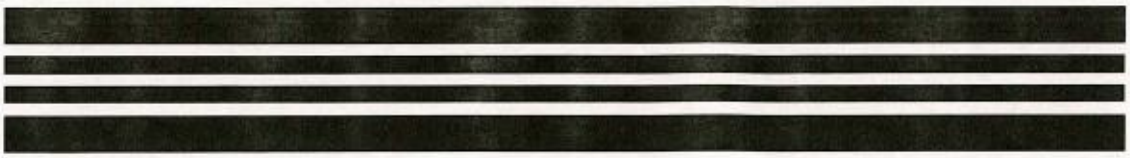

EIS 395

AA054624

Southland Coal Pty. Ltd. Bellbird south project : draft : environmental impact statement

BELLBIRD SOUTH COAL PROJECT

SOUTHLAND COAL PTY. LIMITED

SOUTHLAND COAL PTY LTD

BELLBIRD SOUTH PROJECT

DRAFT

ENVIRONMENTAL IMPACT STATEMENT

Prepared by

Epps & Associates Pty Ltd

July, 1987

FORM 4

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

ENVIRONMENTAL IMPACT STATEMENT

This Statement has been prepared by or on behalf of Southland 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:

> Southland Coal Pty Ltd, Bellbird South Project, comprising the existing Bellbird and part of the Cessnock No. 1 underground mining leases, south of Cessnock N.S.W.

The development application relates to the land described as follows:

> Portions 2, 3, 4, 19, 32, 35, 64, 65, 66, 67, 75, 99, Pt 100 and 125; Parishes of Ellalong and Quorrobolong, County of Northumberland.

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

Name, Qualification and address of person who prepared Environmental Impact Statement	Janet M. Epps BSc M. Environmental Studies 3 Julian Street, MOSMAN, N.S.W. 2088

CERTIFICATE: I, Janet Epps of Epps and Associates Pty Ltd hereby certify that I have prepared the contents of this Statement in accordance with Clause 34 and 35 of the Environmental Planning and Assessment Regulation, 1980.

_____ _____

Signature Date

ARTIST'S IMPRESSION OF THE
BELLBIRD SOUTH PIT TOP AREA.

PLATE 1

PROPOSED REJECT DISPOSAL SITE -
OLD OPEN CUT VOID AT ABERDARE No7

CURRENT INFILLING OF PART OF
THE SITE WITH PELTON COLLIERY'S
WASHERY REJECT MATERIAL.

BELLBIRD SOUTH PROJECT

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BELLBIRD SOUTH PROJECT

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ABBREVIATIONS

ABS	Australian Bureau of Census and Statistics
cal/kg	Calorie per kilogram
CEC	Cation Exchange Capacities
CES	Commonwealth Employment Service
CSN	Crucible Swelling Number
dB(A)	A weighted decibel
EIS	Environmental Impact Statement
FIFO	First-in-first-out
FR	Filterable residue
g/s/ha	grammes per second per hectare
gm^{-2} $month^{-1}$	grammes per square metre per month
GSG	Great Soil Group
ha	hectares
HGI	Hardgrove Grindability Index
J	Joule
kcal/kg	kilocalorie per kilogram
km	kilometre
km^2	square kilometre
km/h	kilometres per hour
kV	kilovolt
kW	kilowatt
l	litre
l/s	litres per second
L_{A1}	Maximum noise level
L_{A10}	The A weighted sound level exceeded 10% of the time
L_{A90}	The A weighted sound level exceeded 90% of the time
L_{Aeq}^{24}	Equivalent continuous 24 hour noise level
MJ/kg	Megajoules per kilogram
max	Maximum
mEq/l	milliequivalents per litre
m	metre
m^3	cubic metre
m^3/s	cubic metre per second
mm	millimetre
m/s	metres per second
m^3/t	cubic metres per tonne
10^6m^3	million cubic metres
mg/l	milligrams per litre
Ml	megalitre
Ml/day	megalitres per day
$M/annum	Millions of dollars per year
Mt	million tonnes
Mtpa	million tonnes per annum
min	minimum
MVA	million volt amps
Mw	megawatts
NFR	non filterable residue
ppm	parts per million
ROM	run-of-mine
SMR	South Maitland Railway

SPCC	State Pollution Control Commission
SRA	State Rail Authority
t	tonne
TDS	Total Dissolved Solids
temp	temperature
tpa	tonnes per annum
tpd	tonnes per day
tph	tonnes per hour
TSP	Total Suspended Particulate
US EPA	United States Environment Protection Authority
µS/cm	microSiemens per centimetre
μgm^{-3}	micrograms per cubic metre
v	volts

1.0 SUMMARY

Southland Coal Pty Limited, a subsidiary of Devex Ltd, proposes to mine the old Bellbird and Cessnock No. 1 (Kalingo) leases on the southern perimeter of Cessnock in the lower Hunter Valley of New South Wales (see Figure 1.1). The Bellbird South Project will be an underground operation on in situ reserves of about 100 million tonnes of Greta Seam Coal. The seam was previously worked by the Bellbird and Cessnock No. 1 Collieries from 1908 to 1977 and 1917 to 1961 respectively.

An annual production of 1.6 million tonnes (Mt) of Run of Mine (ROM) coal will provide 1.5Mt of washed product that can supply both steaming and coking coal to export and domestic markets.

Coal will be washed on site, loaded onto rail and transported some 65km to the Port of Newcastle for shipment.

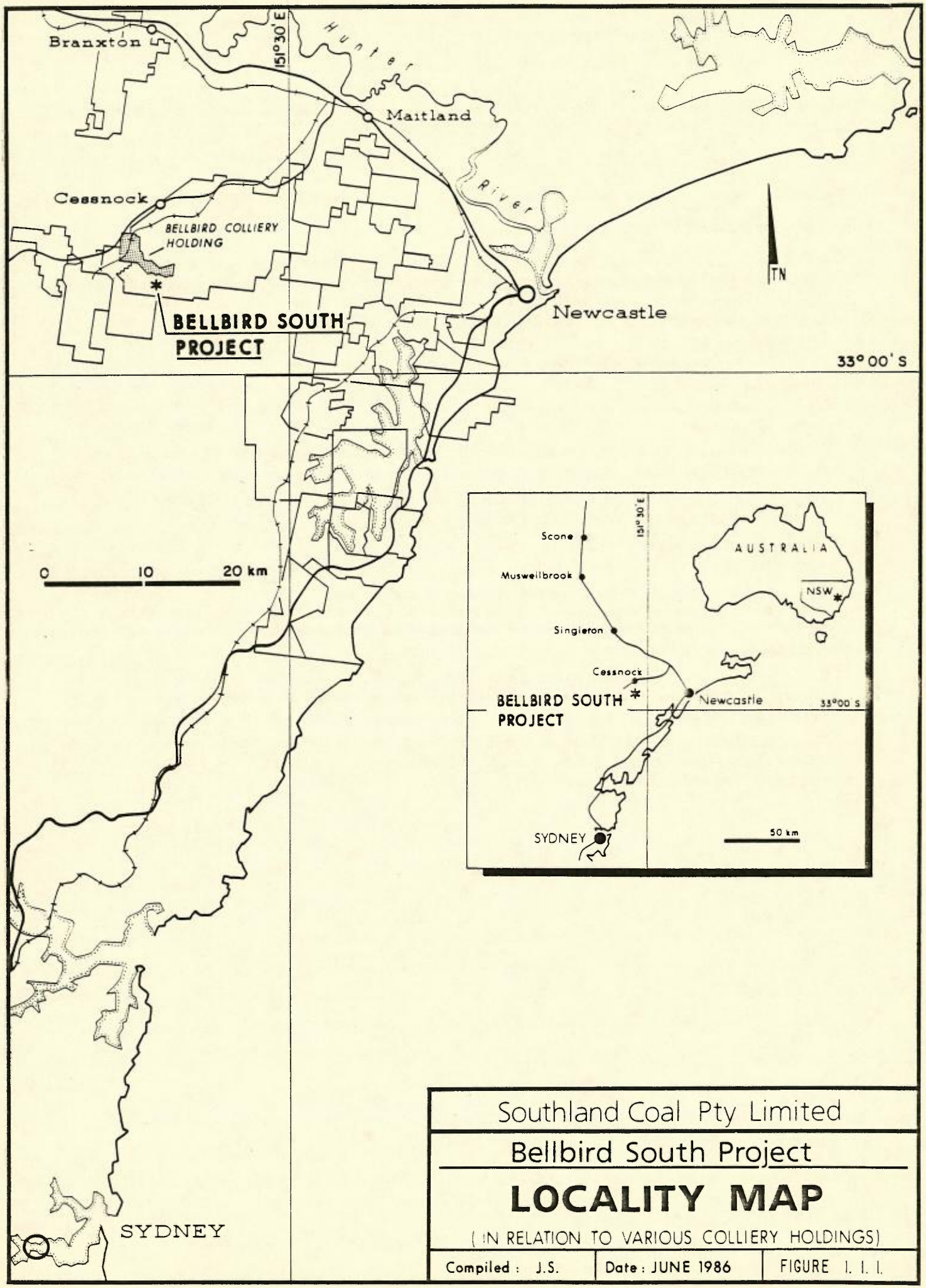
Development of the new operation will involve the upgrading of existing buildings and rail easement and the re-opening of the two existing shafts at Cessnock No. 1 Colliery.

The workforce of approximately 340 will be largely drawn from the local pool of skilled workers.

The site, while being close to the perimeter of Cessnock, is also surrounded by a substantial buffer zone of natural vegetation. The vegetation will effectively screen the project from public vantage points and mitigate any acoustic effect of the operation. The almost flat topography will further enhance these mitigating effects.

The area is largely held under existing mining leases with some private individuals and the Forestry Commission through its holding of the Aberdare State Forest, complementing the coal industry as landholders.

Re-establishment of the old mine operations will provide a beneficial economic and employment effect on the Cessnock area and will result in existing idle infrastructure gaining a new and productive use.



Southland Coal Pty Limited

Bellbird South Project

LOCALITY MAP

(IN RELATION TO VARIOUS COLLIERY HOLDINGS)

Compiled : J.S.	Date : JUNE 1986	FIGURE 1.1.1.

2.0 BACKGROUND INFORMATION AND PROJECT OBJECTIVES

2.1 Ownership Structure

Devex Limited is a diversified Australian mining company with interests in a range of minerals.

The Company's ownership structure is illustrated in Figure 2.1.1.

2.2 Status Of The Project Site

Bellbird Colliery mined the Great Greta seam for about 70 years until 1977. In the closing stages, some small amounts of coal were won by pillar extraction and by open cut operations on previous workings close to the seam outcrop.

The potential for extraction of the remaining deep reserves now exists, with the consolidation of additional coal leases and the acquisition of the old surface facilities from the adjoining Cessnock No. 1 Colliery. The additional leases, previously held by Coal and Allied Industries Limited, as part of its Abedare North Colliery Holding, have been acquired by Southland Coal together with about 587ha of surface land.

Figure 2.2.1 shows the present colliery holdings and the various mining leases covering the Project area.

		Lease Numbers
Bellbird Colliery Holding:		
Mineral Lease	(C&S Act 1906)	5, 6, 325, 1149, 1158
Mineral Lease	(48 Vic No. 10)	747, 748, 749, 798, 799, 803, 804
Coal Lease	(Act 1973)	196, 555
Mining Purposes Lease	(Act 1906)	1, 152, 305, 314
Aberdare North Colliery Holding:		
Mineral Lease		104, 106, 108, 110, 326, 1150, 1236, 1242, 1338
Private Lands Lease		1, 2, 3, 5, 6, 7, 88,110, 476, 518
Coal Lease		552

2.3 Project Objective

Southland Coal's objective for the Bellbird South Project is to extend the old Bellbird and Cessnock No. 1 Collieries as a profitable, technically sound and environmentally acceptable coal mining operation.

The operation will produce high quality coal products targeted at domestic and export markets and suitable for many applications including:

- soft-coking;
- semi-coking;
- high quality steaming;
- blending;
- gas making; and
- pulverised coal injection.

GROUP STRUCTURE

YOUNG MINING CO. PTY LTD
Magnesite mining at Young and Fifield NSW and Princhester Queensland

GYMPIE ELDORADO GOLD MINES PTY LTD
Holds tenements over the Gympie Goldfields, Queensland

DEVEX LIMITED
Devex Limited owns 100% of all subsidiary companies

CAUSMAG ORE COMPANY PTY LTD
Magnesite processing and Marketing

SOUTHLAND MINING PTY LTD
Holding company which owns 100% of Southland Coal and Soricom SRL

SOUTHLAND COAL PTY LTD
Holds authorisations and options over deposits at Bellbird and Glennies Creek NSW

SORICOM SRL
Fluorspar mining concessions at Pianciano, Italy

FIGURE 2. 1. 1.

SOUTHLAND COAL PTY LIMITED

BELLBIRD SOUTH PROJECT

MINING TITLES

Compiled: J.S.	Date: JUNE 1986	FIGURE 2.2.1

The Project described in this Environmental Impact Statement (EIS) is a longwall coal mining development. The acquisition of coal leases and unmined land adjacent to the Bellbird Colliery Holding will provide an in situ coal reserve of 100 million tonnes (Mt), which is desirable for a commercially viable longwall operation.

2.4 Environmental Impact Statement Objectives

The objectives of the EIS are to:

- describe the design and operation of a commercially and environmentally sound coal mining operation near Cessnock, NSW;
- outline alternatives considered;
- describe the existing environment of the Project area;
- identify the environmental effects of the proposed Project and describe suitable means of mitigating and managing these effects; and
- comply with requirements to obtain Development Consent for the Project.

2.5 Legislative Requirements

This EIS was prepared and submitted to satisfy the requirements of the NSW legislation.

2.5.1 Development Consent

The Environmental Planning and Assessment Act (1979) and associated Regulation (1980) provide the basis for development control in NSW. The activities associated with the proposed Project require Development Consent under the legislation. As this Project is classified as Designated Development, the development application must be accompanied by an EIS.

The Development Application was submitted to Cessnock City Council, which is the relevant Local Government Authority.

2.5.2 Coal Lease

The Department of Mineral Resources administers the Coal Mining Act (1973), under which coal leases are granted.

Coal leases are granted for 21 years and provision for renewal is contained in the Coal Mining Act (1973). The Project area is held under current coal leases (See Section 2.2).

2.5.3 Joint Coal Board Approval

The Company will need to obtain Joint Coal Board approval under Order No. 27 to open a coal mine.

2.5.4 State Pollution Control Commission Approvals and Licences

The Company will need to submit applications to the State Pollution Control Commission (SPCC) for approvals to construct and licences to operate the Project. Approvals to construct and annual licences to operate are required under the Clean Air Act, 1961, Clean Waters Act, 1970 and Noise Control Act, 1975.

2.6 Analysis Of Need For The Project

2.6.1 Corporate Need

Southland Coal Pty Ltd is a subsidiary of Devex Ltd. Devex's prime objective is to evolve into a significant Australian mining company with interests in a diversified portfolio of minerals.

At present it has interests in gold, magnesite, coal and fluorspar deposits which are at various stages of exploration and development.

For the long-term, Devex is committed to growth through further acquisitions in the mining industry.

Devex Ltd has a proven management team with both the technical and financial expertise to develop the Bellbird South Project.

The high quality deposits of coal at Bellbird South will come from the Greta Seam, which has traditionally been valued for its steaming and soft-coking qualities.

The longstanding and strong market acceptance of Greta Seam Coal, and its reduction in supply from some other sources, provide the Company with encouraging prospects for long-term stable markets for Bellbird coal.

Devex's plans to finance this project will be finalised after consideration of the completed feasibility and marketing study.

2.6.2 Export Prospects

Greta Seam coal has a long established and diverse market reputation. Coal production is however, now confined to the Pelton/Ellalong Colliery Complex (owned by Newcastle Wallsend Coal Company).

Domestically, Greta Seam coal has been the traditional source of coal for steam locomotives, gas works, brick and pipe works, chain grate stoker plants and domestic uses. Today the major domestic tonnage is sold to chain grate stoker plants.

Export of Greta Seam coal in recent times developed from the early 1960's, with the first phase of development of the Japanese market. The coal was exported mainly to the Japanese steel, coke, gas and chemical industries and, while tonnages have decreased significantly, the same markets are still being supplied. In addition, coal is being sold to high quality steaming coal markets, and for screening and subsequent export.

The Greta Seam coal has several advantages, apart from the minor disadvantage of a higher sulphur content, compared with other Australian coals (see Table 2.6.1). These advantages include:

- high volatile matter content (for gas making);
- low ash content (for gas, coke and steaming coal);
- high percentage of reactive components;
- high fluidity, wide plastic range and positive dilatation (for coking applications); and
- high specific energy and volatile matter (for a steaming coal).

Greta Seam coal from Bellbird could have potential in several markets, especially in the Pacific Basin. These markets could include the traditional soft-coking coal markets and the growing semi-coking coal market in Japan, South Korea and Taiwan. The steaming coal market is a substantial and variable sector with potential for a wide range of applications, to which Greta Seam coal is ideally suited. For example, low ash washed coal could be sold for screening into various fractions and distributed in Europe, where appropriate premiums can be anticipated.

Coking coal at 6.5% ash could be easily achieved at high yields. This is a lower ash than any other coal exported from Newcastle.

Semi-coking coals can be produced at the very competitive level of 8.5% ash.

Steaming coal will have 12% ash and 7,300kcal/kg gross specific energy, at which quality it is a most attractive steaming coal. While other coals have comparable high specific energy values, they are mainly low to medium volatile coals and are not usually competing for the same markets.

The potential 1% sulphur content of Greta coal, assists in ash precipitation characteristics. Blending with low sulphur coals can ensure that sulphur oxide emissions are contained to acceptable levels.

TABLE 2.6.1

INDICATIVE BELLBIRD SPECIFICATIONS

	Soft-Coking Coal	Semi-Coking Coal	Steaming Coal
Size (mm)	50 x 0	50 x 0	50 x 0
% Total Moisture	8.0 max	8.0 max	8.0 max
Proximate Analysis (adb)			
• % Moisture	1.7	1.7	1.7%
• % Ash (+0.5 tol)	6.5 max	8.5 max	12.0 max
• % Volatile Matter	42.5	42.0	41.5
• % Fixed Carbon	49.3	47.8	44.8
% Sulphur	1.0 max	1.0 max	1.0 max
% Gross Specific Energy (kcal/kg)	7,850 min	-	7,300 min
CSN	6-7	4-5	4
HGI	-	-	32
Ash Fusion Temps (°C) – reducing atmosphere			
• Initial deformation	-	-	1,300
• Spherical	-	-	1,400
• Hemisphere	-	-	1,450
• Flow	-	-	1,500

adb – air dried based
CSN – Crucible Swelling Number
HGI – Hardgrove Grindability Index
tol – tolerance

2.6.3 National Benefit

Coal exports are a major contributor to Australia's trade balance and current account. A trade balance which continues to be unfavourable will jeopardise national growth, by eroding the power to import goods required to maintain living standards.

A new export oriented Project will contribute positively to the level of national foreign debt and will help foster the trade base for international relations. The latter is particularly important for Australia's future involvement in the Pacific Region.

The Federal government will benefit from export taxes, while State and local revenue will be generated by State taxes, royalties, up-front payments and charges for services. Similarly, diversification of local industries, decentralisation of NSW industry and improved utilisation of State rail and port facilities has long-term economic benefits for the tax paying community.

Southland Coal believes the Bellbird South Project is strategically beneficial in achieving its corporate objectives. At the same time, it provides benefits at international, national, state and local levels. The Project represents a significant capital investment with most of this expenditure occurring in Australia. This investment will benefit both Australian industry and the community by providing additional employment, expendable income and government revenue.

3.0 PROJECT DESCRIPTION

3.1 Project Outline (Stage 2)

Details of the Project are as follows:

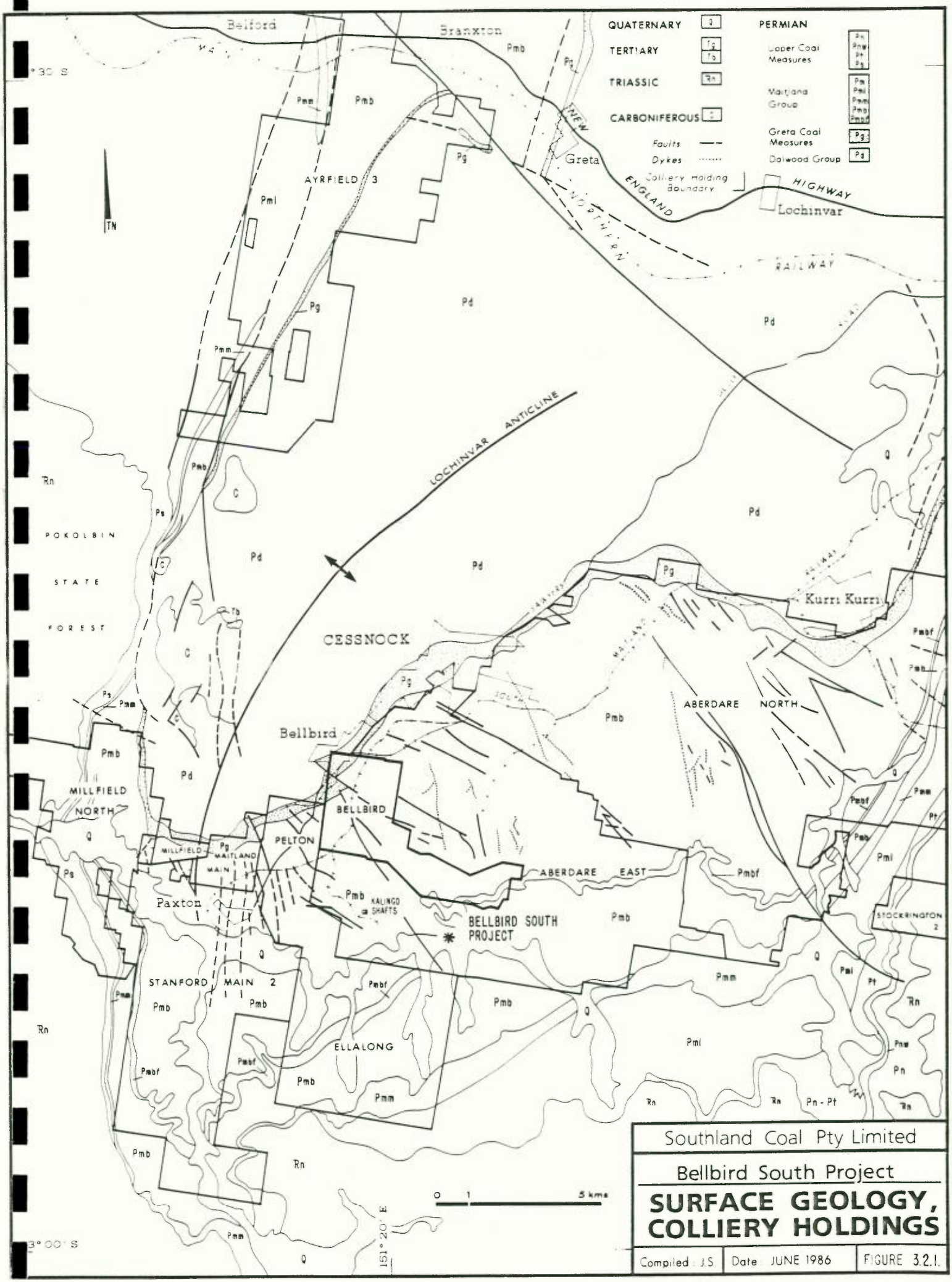
Project Objective	Complete economic extraction of the Bellbird and Cessnock No. 1 (Kalingo) coal reserves.
Coal Mining Leases	Project covered by current leases.
Type of Operation	Underground.
Coal Reserves	Approximately 100Mt of Greta Seam Coal.
Project Surface Area	1.5km^2
Total Lease Area	20km^2
Mining Method	*Longwall system:* Max height 5m. Length 200m. Capacity 2,000tph.
Access to Seam	New cross measure drift, and re-use of existing shafts.
Shaft Winder	Carrying capacity 80 people.
Ventilation	Intake airways via No. 1 shaft, new drift. Exhaust via twin variable speed centrifugal fans mounted on No. 2 shaft.
Raw Coal Transport	Drift Conveyor – Capacity 1,000tph.
Rotary Breaker	Capacity – 600tph.
Coal Preparation Plant	Capacity – raw coal 7,600tpd in Year 6.
Stockpile	60,000t ROM 180,000t washed coal, fed at 400tph.
Surface Coal Handling	Stacker & Reclaim Conveyer Capacity – 500tph. Preparation Plant Rejects – 100t rejects bin. Rail Loading Facility – Category C Standard. Rail Loading Bin Capacity – 500t. Elevated Conveyor Capacity – 2,000tph.
Product Volumes	1.664Mtpa ROM; Average 1.5Mtpa washed product. Range: 1.45Mt of 6% ash content soft-coking coal, to 1.58Mt of 12% ash content steaming coal.
Transport to Port	Upgrade existing abandoned rail formation. New rail (4.3km) spur and balloon loop (1.5km). Train capacity 1,700t. Capacity of line – 3.5Mtpa (1.4Mtpa of this required by Pelton).
Train Length	Maximum – 29 wagons.
Distance to Port	65.2km.
Tailings and Rejects	180,000tpa, or 3.5Mt over 25 years. Moisture Content – 18%.
Reject Disposal	Aberdare No. 7 Open Cut Capacity 3 x 10^{6}m^3 (Also to accommodate Pelton waste). Medium term option to incinerate for power generation.

	Alternative option – 30ha on-site reject emplacement (capacity 3.5Mt).
Principal Service Area (Rail Loop Site)	*Facilities to be Constructed:* Coal preparation plant and ancillaries. Raw coal and washed coal storage and reclaim. Rejects temporary storage and loading. Preparation plant office and laboratory. Bath house and amenities. Central workshop, store and yard. Plant service bay and fuel store. Effluent treatment plant and settling ponds.
Secondary Service Area (Pit Top Site)	*Facilities to be Renovated:* Shafts (2). Bath house and amenities for miners. Mine office. Car parking areas.
Road Access	Off the Cessnock-Ellalong Road, 7km south of Cessnock.
Production Hours	Mining – 24 hour operation for 5 days per week. Preparation plant – Three shifts per day, 5 days per week.
Power Supply	Shaft site supplied from existing 11kV system.
Underground Transport	Rail, load capacity 80t.
Underground Storage	Capacity – 1,000t.
Subsidence	Estimated maximum 2m.
Monthly Water Usage	Water Board Supply 11,800kl. Mine Water – pumped from mine 22-25,000kl. Tailings water available 18,000kl.
Water Storage	Dam Capacity – 98Ml.
Personnel	340 employees.
Area of Disturbance	74ha.
Mine Life	20 years.

3.2 Mining History

The Greta Coal Measures, located in the lower Hunter Valley (see Figure 3.2.1), lie in two sections separated by the axis of the Lochinvar Anticline. The Greta Coalfields lying on the north-west of the anticline were first developed by the Greta Company starting in 1886, mining within 4km of the township of Greta. The South Maitland Coalfields lie on the south-east of the anticline extending from Farley in the north-east to Millfield in the south-west. This coalfield was first mined by the South Greta Coal Company in 1887 on the outcrop near the Great Northern Railway at Farley. Development of further mines was rapid, the quality of the Greta coal being most sought after, particularly for the production of town gas. The coal was exported through the Port of Newcastle to Japan, California and the Pacific Region.

By the mid 1920's the field had reached its zenith, employing over 9,000 staff. In 1924, 60% of the total Australian output was from the Greta Seam. Of the 70 or more collieries that have exploited its riches, only two mines operate today. The remaining companies, Coal and Allied and Newcastle Wallsend Coal Company, have been producing coal continuously for 130 years in the Hunter Valley.



Southland Coal Pty Limited

Bellbird South Project

SURFACE GEOLOGY, COLLIERY HOLDINGS

Compiled : J.S. | Date : JUNE 1986 | FIGURE 3.2.1.

The reasons for the demise of the field are many and varied. For example, altered market conditions resulted in a reduction in the need for gas coal and the use of small coal-fired industrial boilers. There were also mining difficulties due to creep and spontaneous combustion. Inability of the industry to work multiple shifts, or to employ mechanical extraction of pillars, resulted in significantly increased costs. For many years the Greta Seam had a reputation for being unmineable at depths below 370m. That theory has since been disproved with the development of Ellalong Colliery, south of Bellbird, where depths of 480m are currently being mined using the latest technology, including longwall.

The Bellbird Colliery, 5km south of Cessnock, was established as a tunnel mine in 1908. It was then owned by the Hetton Coal Company Limited, and was known as the Hetton Extended Colliery. The colliery was renamed Bellbird Colliery in 1911

The 1922 Annual Report of the Department of Mines, placed the average daily production at 1,700t from a workforce of 615, including 441 underground personnel. This was over 30 years before the introduction of mechanisation. Production was suspended for about one year after a disastrous explosion in 1923, in which 21 lives were lost. From 1924 to 1958, the mine was operated by Hetton Bellbird Collieries.

In its second heyday in the 1950's, the mine had a workforce of 573 men. In a report published at that time, Bellbird Colliery had produced 10Mt of coal since its inception, and at the then daily output of 1,600t, had a remaining life of 98 years. Fire and creep eventually prevented access from the existing entries to the remaining virgin areas of the original holding and in 1977 the mine closed.

From 1958, the mine was owned by Eric Newham (Wallerawang) Pty Limited, which subsequently changed its name to Southland Coal Pty Limited and was taken over by Devex Limited in 1986.

The Cessnock No. 1 Colliery (referred to locally as Kalingo Colliery) operated between 1917 and 1961. The mine was originally owned by Cessnock Collieries Pty Ltd, and was subsequently purchased by Caledonian Collieries, which became Coal and Allied. Before its closure, the mine was one of the most modern in the area, equipped with a high capacity shaft winder. Development to the south was suspended due to the presence of a fault and high sulphur. The main workings were in a northerly direction. Hence the shafts are very close to virgin coal in the east. No pillars were extracted from the holding and no spontaneous combustion was recorded. The area is now part of Aberdare North Colliery Holding.

Figure 3.2.2 shows the outline of the underground workings to date, and the Colliery Holding boundaries relating to Bellbird and the adjacent collieries.

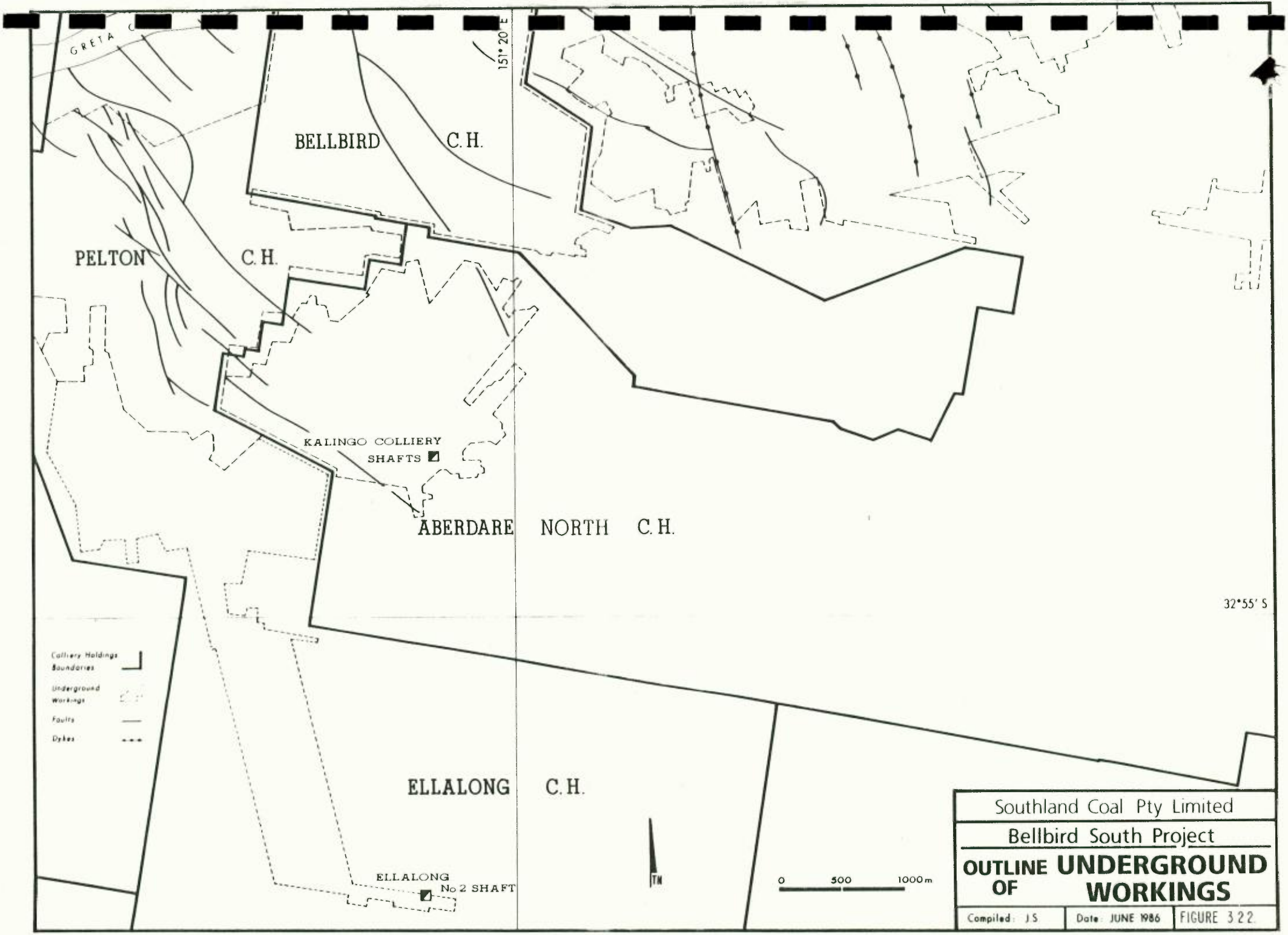
3.3 Coal Resource

3.3.1 Exploration

A number of deep exploratory bores have been drilled to the Greta Coal Measures on the south-eastern flank of the Lochinvar Anticline by various coal companies. A few deep penetration reflection seismic traverses were run across the Lochinvar Anticline during petroleum exploration in the 1960's.

In 1975, the then owners of Bellbird Colliery had five boreholes drilled in the unworked area of the Bellbird leases.

Southland Coal conducted 43.8 line kilometres of seismic reflection in the Bellbird South Project area, during the period October 1985 to January 1986.


GRETA
151° 20' E
BELLBIRD C.H.
PELTON C.H.
KALINGO COLLIERY SHAFTS
ABERDARE NORTH C.H.
32°55' S
Colliery Holdings Boundaries
Underground Workings
Faults
Dykes
ELLALONG C.H.
ELLALONG No 2 SHAFT
TM
0 500 1000m
Southland Coal Pty Limited
Bellbird South Project
OUTLINE OF UNDERGROUND WORKINGS
Compiled: J.S
Date: JUNE 1986
FIGURE 3.2.2

The Company concurrently drilled the deep SCK1 to SCK3 boreholes in the same area at sites spaced down-dip from the old mine workings of the Bellbird and Cessnock No. 1 Collieries. In addition to supplying coal thickness and quality information, these bores were spaced to provide initial coal reserve data. The boreholes were drilled to a depth of approximately 30m below the Greta Seam and showed that the Homeville Seam does not occur in this area.

3.3.2 Geology

The mining target in the Bellbird South Project area is the Greta Coal Seam, a stratigraphic unit of the Greta Coal Measures as they occur in the South Maitland Coalfield, within the Sydney Basin.

Major sedimentary units of the Sydney Basin and their maximum thicknesses are, in descending stratigraphic order:

•	Triassic	(terrestrial, occasionally very minor coal)	1,000m
•	Permian	Singleton or Newcastle/Tomago Coal Measures	1,500m
		Maitland Group (predominantly marine, minor coal)	1,200m
		Greta Coal Measures	300m
		Dalwood Group (predominantly marine, minor coal)	1,800m

Figure 3.2.1 shows the surface geology of the South Maitland Coalfield with the various colliery holdings superimposed.

The Bellbird South Project area is located on the south-eastern flank of the large north-south trending Lochinvar Anticline. This structure has been eroded to below the level of the Greta Coal Measures, which consequently crop out around all flanks of the anticline. Here they attain a maximum thickness of about 90m, and contain the well known Greta Coal Seam.

The Greta Coal Seam has been mined for over a century at various locations around the anticline, but particularly on the relatively undisturbed and gently dipping south-eastern flank. In this locality, the seam has been largely worked out down to the 370m of cover line. The Bellbird South Project is in the same locality, but proposes to exploit the Greta Coal Seam between the 400m and 600m cover lines (see Figure 3.3.1).

The recent seismic survey extended previous contour mapping on the Greta Seam down to approximately the 600m of cover line. It confirmed continuation of the regional dip of about 1 in 15, with the exception of a local synclinal area near the eastern limits of the survey, where the dips steepen to about 1 in 5. No major faulting was encountered; the greatest throw on any of the few suspected faults is unlikely to exceed the minimum level of detection (7m), with the exception of one (expected throw of 14m) which lies outside the planned longwall panels.

Of the coal members documented in Table 3.3.1, only the Pelton and an unsplit Greta Seam are recognised in the Bellbird South Project area. Of the seams, the Pelton seam is less than 1m thick and is regarded as too thin to be of economic interest. Consequently, it has not been included in the in situ reserve calculations.

The single Greta Seam in the project area thickens in a north-easterly direction from about 4m to over 6m. It is a generally bright coal with minor shaly bands and some canneloid lenses towards the base.

Greta Coal contains pyritic and organic sulphur. Pyritic sulphur is distributed throughout the seam. Mostly however, pyritic sulphur is concentrated in the uppermost 1m of seam which is known locally as the 'brassy tops'. In contrast to the organic sulphur, the pyritic sulphur of the coal can be reduced by washing processes. It is also sometimes reduced by selective mining practices whereby the 'brassy tops' is left in the roof.

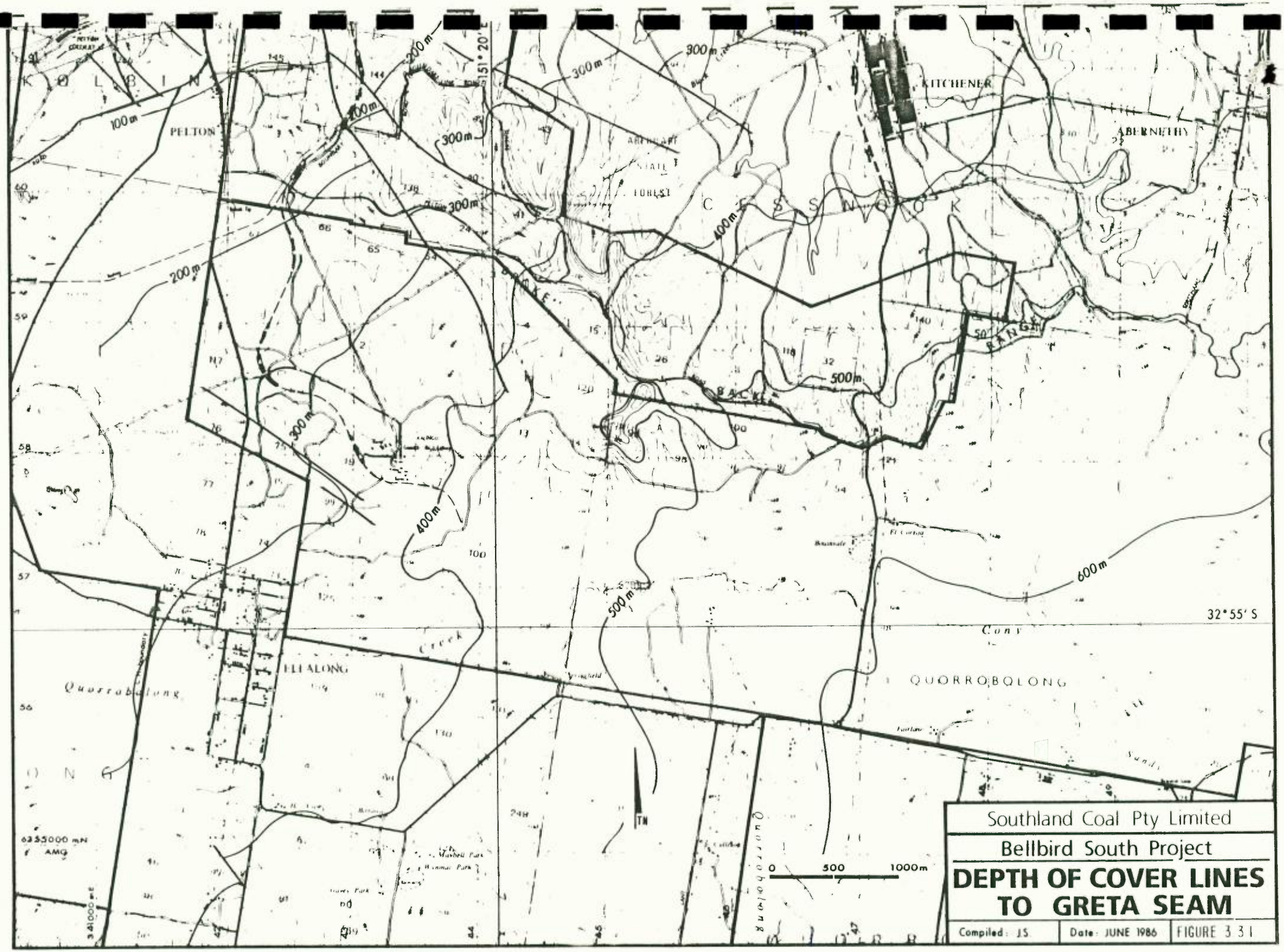

PELTON
KITCHENER
ABERNETHY
QUORROBOLONG
ELLALONG
Quorrobolong
Creek
100m
200m
300m
400m
500m
600m
151° 20'
32° 55' S
6355000 mN
AMG
341000 mE
TN
0 500 1000m
Southland Coal Pty Limited
Bellbird South Project
DEPTH OF COVER LINES TO GRETA SEAM
Compiled: J.S.
Date: JUNE 1986
FIGURE 3.3.1

TABLE 3.3.1

STRATIGRAPHIC TABLE, GRETA COAL MEASURES, SOUTH MAITLAND COALFIELD

Group	Formation (Fm)	Member	Split or Lens
Maitland Group	Branxton Fm	Cessnock Ss (15m)	
Greta Coal Measures (60-90m)	Paxton Fm (10-49m)	Pelton Coal (0.5-1.0m)	
			Bellbird Lens (9-48m)
	Kitchener Fm (4-14m)	Greta Coal (3-11m)	Upper Split (2m)
			Kearsley Lens (0-6m)
			Lower Split (2-8m)
	Kurri Kurri Cgl (36-43m)		Stanford Lens (20-30m)
		U Homeville Coal (2-4m)	
			Abernethy Lens (0-10m)
		L Homeville Coal (1-3m)	
	Neath Ss (11-18m)		
Dalwood Group	Farley Fm		

Ss – Sandstone
Cgl – Conglomerate

3.3.3 Coal Quality

The Greta Seam of the South Maitland Coalfield is a high volatile, low ash coal of high specific energy and having coking characteristics. Much of the earlier production from this field was directed towards the domestic gas making and the steam locomotive markets but future production will be directed towards export markets. Greta Seam coal properties complement the characteristics of coals of the Singleton Coal Measures, now being extensively mined in other parts of the Hunter Valley. This provides an ideal opportunity to supply a component for a blended coal product in addition to direct sales.

Raw coal will vary from 6-16% ash content in situ, and ROM production will probably vary from 8-18% ash content (average 12%) after allowing for unavoidable dilution.

Sulphur content is typically variable for the area, but levels generally below 1% sulphur are anticipated.

Two basic products will be produced; a raw (bypass) coal at 12% ash average (suitable for steaming coal applications), and a 6% ash average coal (suitable for coking coal applications). Products between these two extremes may also be produced to supply semi-coking coal and special steaming coal markets.

Typical qualities of the raw and cleaned products are set out in Table 3.3.2.

3.3.4 Coal Reserves

Southland Coal has obtained additional reserves of coal adjacent to the virgin coal area of its Bellbird Colliery Holding to provide approximately 100Mt, by the addition of reserves from the old Cessnock No. 1 Colliery Holding. This reserve tonnage will support a modern colliery using longwall mining methods, as opposed to the bord and pillar methods previously used in the Greta Seam down to the 400m of cover line.

In situ reserve figures, as calculated in accordance with the 1980 Reserves Code of the Standing Committee on Coalfield Geology of New South Wales, represent a mixture of measured, indicated and assumed reserves. The reserves down to the 600m cover line as shown by the recent seismic survey (see Table 3.3.3) total 148.78Mt.

TABLE 3.3.2

QUALITY OF POTENTIAL BELLBIRD PRODUCTS

	Raw Coal	Washed Coal
% Total Moisture	7.0	8.0
Proximate Analysis (adb)		
• % Moisture	1.7	1.7
• % Ash (+0.5 tol)	12.0	6.0
• % Volatile matter	41.5	42.5
• % Fixed carbon	44.8	49.8
% Sulphur (adb)	1.0	1.0
% Phosphorus (adb)	0.04	0.03
Gross specific energy (kcal/kg) (adb)	7300	7850
HGI	30	34
Abrasion Index	24	15
Ultimate Analysis (daf):		
• % Carbon	82.50	83.50
• % Hydrogen	6.30	6.00
• % Nitrogen	1.80	2.00
• % Sulphur	1.20	1.20
• % Oxygen	8.20	7.30

	Raw Coal	Washed Coal
% Analysis of Ash:		
• SiO_2	47.00	49.00
• Al_2O_3	28.00	31.00
• Fe_2O_3	10.80	7.00
• CaO	4.00	3.50
• MgO	2.00	1.50
• Na_2O	1.80	1.50
• K_2O	1.00	0.80
• TiO_2	1.50	1.80
• Mn_3O_4	0.10	0.10
• SO_3	2.80	3.00
• P_2O_5	1.00	0.80
Petrographic Analyses:		
• Maceral analysis		
– % Vitrinite	60	68
– % Exinite	10	10
– % Inertinites	23	19
– % Mineral matter	7	3
• % Reflectance		
– Vitrinite A	0.70	0.70
– Vitrinite A + B	0.66	0.66
Ash Fusion Temps (°C) – reducing atmosphere:		
• Initial deformation	1300	-
• Spherical	1400	-
• Hemisphere	1450	-
• Flow	1500	-
Gray-King Coke Type	-	G5
Giesler Plastometer:		
• Initial soften temp (°C)	-	395
• Max fluidity temp (°C)	-	430
• Max fluidity (dd/min)	-	2000
• Resolidification temp (°C)	-	460
• Plastic range (°C)	-	65
Audibert Arnu Dilatometer:		
• Initial soften temp (°C)	-	360
• Max contraction temp (°C)	-	415
• Max dilatation temp (°C)	-	450
• Max contraction	-	25
• Max dilatation	-	+ 40
CSN	4.0-5.0	6.0-6.5

Table 3.3.3

IN SITU COAL RESERVES

Description	Million Tonnes	Category
Virgin coal area of Bellbird Colliery	32.85	Measured
Contiguous triangular area of virgin coal in old Aberdare Central Colliery to the north of Bellbird Colliery	5.22	Measured
Triangular area south-west of fault separating old Cessnock No. 1. and present day Ellalong workings	6.12	Indicated
Area between old Cessnock No. 1. workings and north-south Quorrobolong-Kitchener road towards eastern margin of project area	60.62	Measured & Indicated
Total:	**104.81**	

3.4 Conceptual Mine Plan

3.4.1 Overview

The conceptual mine plan for the Bellbird South Project parallels the operation at Ellalong Colliery which commenced mining the Greta Seam in 1980, and has subsequently been successfully developed. Core samples from recent drilling indicate that mining conditions will be similar to those at Ellalong Colliery.

3.4.2 Mining Methods

The mining method proposed for the Bellbird South Project is a retreat longwall system using a single longwall unit. Planned faces would be 200m in length and capable of mining to a height of 5m. The necessary development work for in-seam drivage would be undertaken by full face, profile cut machines, capable of roof bolting whilst mining, and supported by a continuous haulage system from the face.

3.4.3 Mine Concept

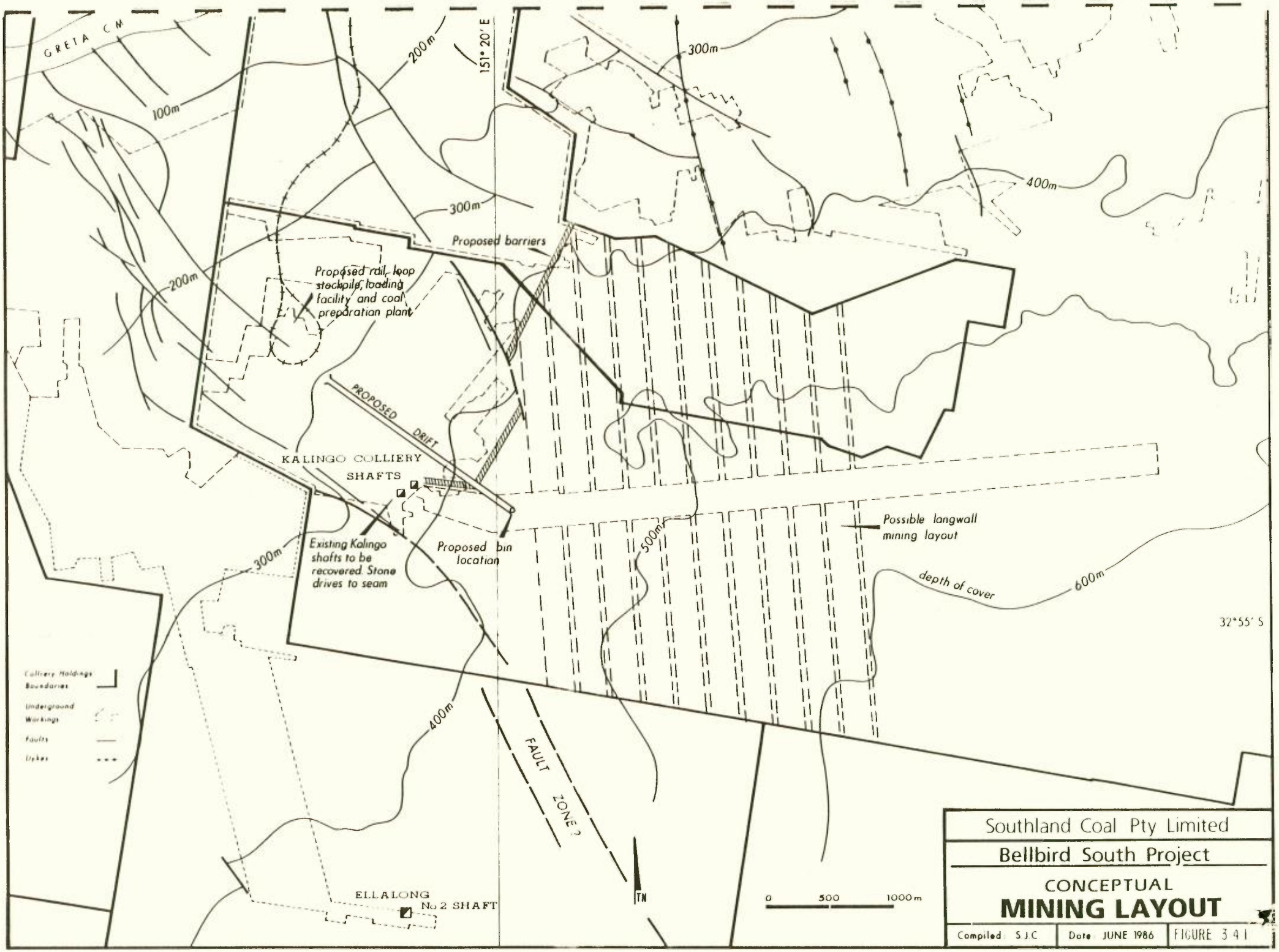
Longwall Panels

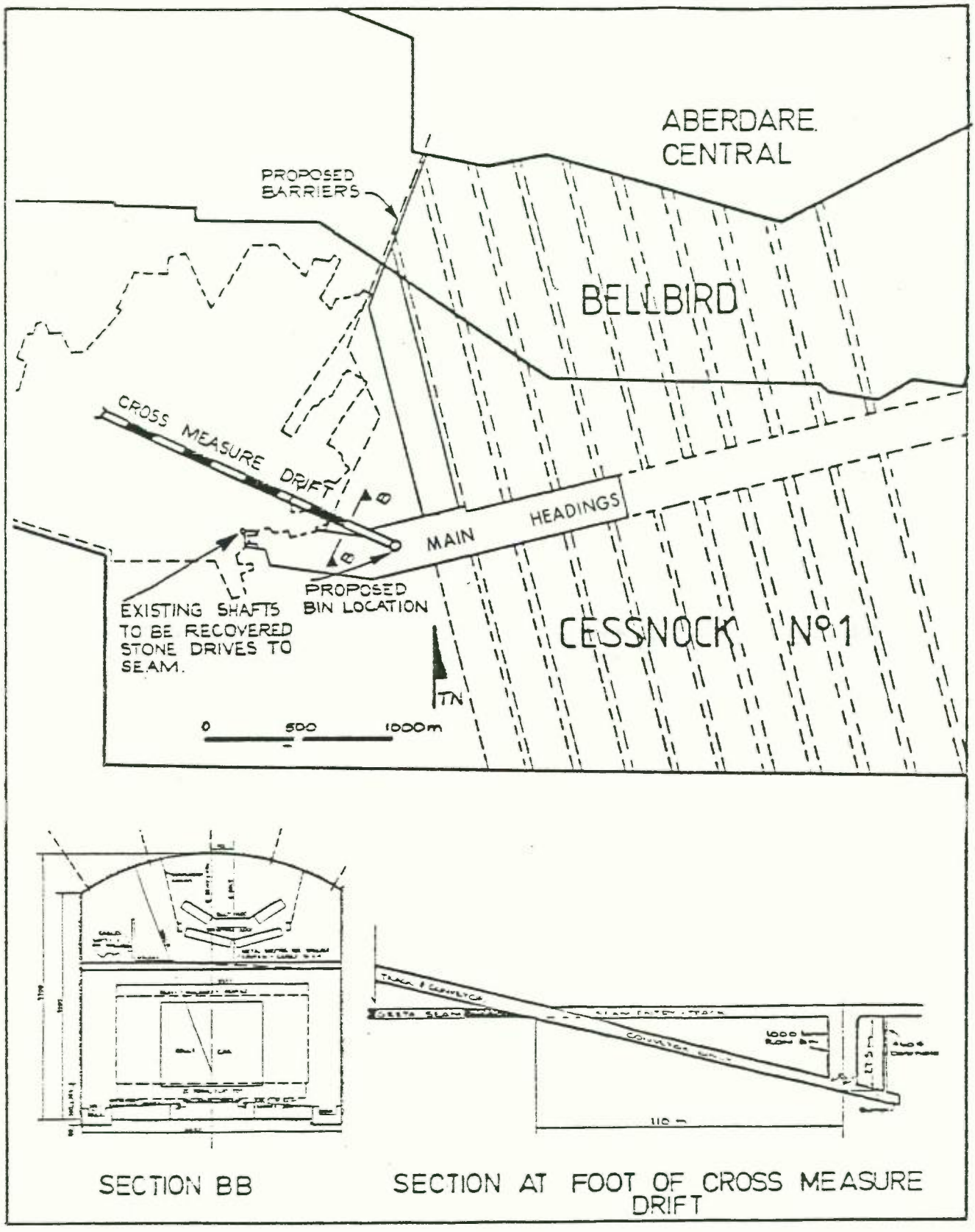
The longwall panels have been set out as shown in Figure 3.4.1. This layout takes into account the major faults located by the seismic investigation and geological interpretation. Each panel has an anticipated life of approximately one year.

Access to Seam

Access to the seam will be provided by a new cross measure drift and recommissioning the Cessnock No. 1 Colliery shafts. Figure 3.4.2 shows the location of the drift and shafts and a section through the drift.

The cross measure drift will be driven at a slope of 1 in 4, commencing from the surface near the rail loop and coal handling facilities, and intersecting the coal seam east of the shafts.


GRETA CM
100m
200m
151° 20' E
300m
400m
Proposed barriers
Proposed rail, loop stockpile, loading facility and coal preparation plant
PROPOSED DRIFT
KALINGO COLLIERY SHAFTS
Existing Kalingo shafts to be recovered. Stone drives to seam
Proposed bin location
Possible langwall mining layout
500m
depth of cover
600m
32°55' S
Colliery Holdings Boundaries
Underground Workings
Faults
Dykes
FAULT ZONE?
ELLALONG No 2 SHAFT
TN
0 500 1000m
Southland Coal Pty Limited
Bellbird South Project
CONCEPTUAL
MINING LAYOUT
Compiled: S.J.C
Date: JUNE 1986
FIGURE 3.4.1



SECTION BB

SECTION AT FOOT OF CROSS MEASURE DRIFT

SOUTHLAND COAL PTY LIMITED
BELLBIRD SOUTH PROJECT
LONGWALL PANEL LAYOUT
FIGURE 3. 4. 2.

The existing shafts are both 5.49m diameter and have been fully lined and sunk to a depth of 380m. The No. 1 shaft was previously equipped with an electric winder hauling coal in 3t skips, and No. 2 shaft with a second egress winder and the main ventilation fan. These shafts will be dewatered and sealed against the old workings. Stone drivages from the shafts to the coal seam will be driven at an angle to provide the necessary barrier to the old workings (see Figure 3.4.3). During the initial development period, it is expected that some in-seam development will be undertaken using access via these shafts prior to the drift being completed.

Ventilation

The mine ventilation system will be provided by using the new drift and the No. 1 and No. 2 shafts. An exhaust system provided by twin variable speed centrifugal fans mounted on No. 2 shaft will provide adequate ventilation over the life of the mine. The No. 1 shaft and drift provide intake airways. The centrifugal fan system has the advantage of giving a low decibel rating.

Dewatering

Recent measurement of the water level in No. 1 shaft showed a 15.25m head of water and analysis indicated it was alkaline, slightly hard and high in dissolved solids requiring treatment or dilution before discharge. Experience in the Greta Seam indicates that water from the seam is alkaline, but with oxidation by the pyrite content of the coal, acidities of the order of a pH of 2 can occur.

Permanent pumping stations with acid and alkaline resisting pump and mains will be located at the bottom of the drift (adjacent to the old workings near the shafts) and near the face. The water will be treated near the coal preparation plant and used in the washing process. It may also be necessary to pump water from the old Cessnock No. 1 Colliery workings to provide sufficient water for the coal preparation plant and control water make.

3.4.4 Underground Transport

Coal

Belt conveyor systems will be used to transport coal to the surface. The main drift conveyor will have a capacity of 1,500tph in a single flight, using steel cord or cable belt construction.

A 1,000t underground storage facility, with drift conveyor extended below it (see Figure 3.4.3) will reduce the effects of surges in production.

All major functions of the conveyor system will be monitored and supervised from a central location.

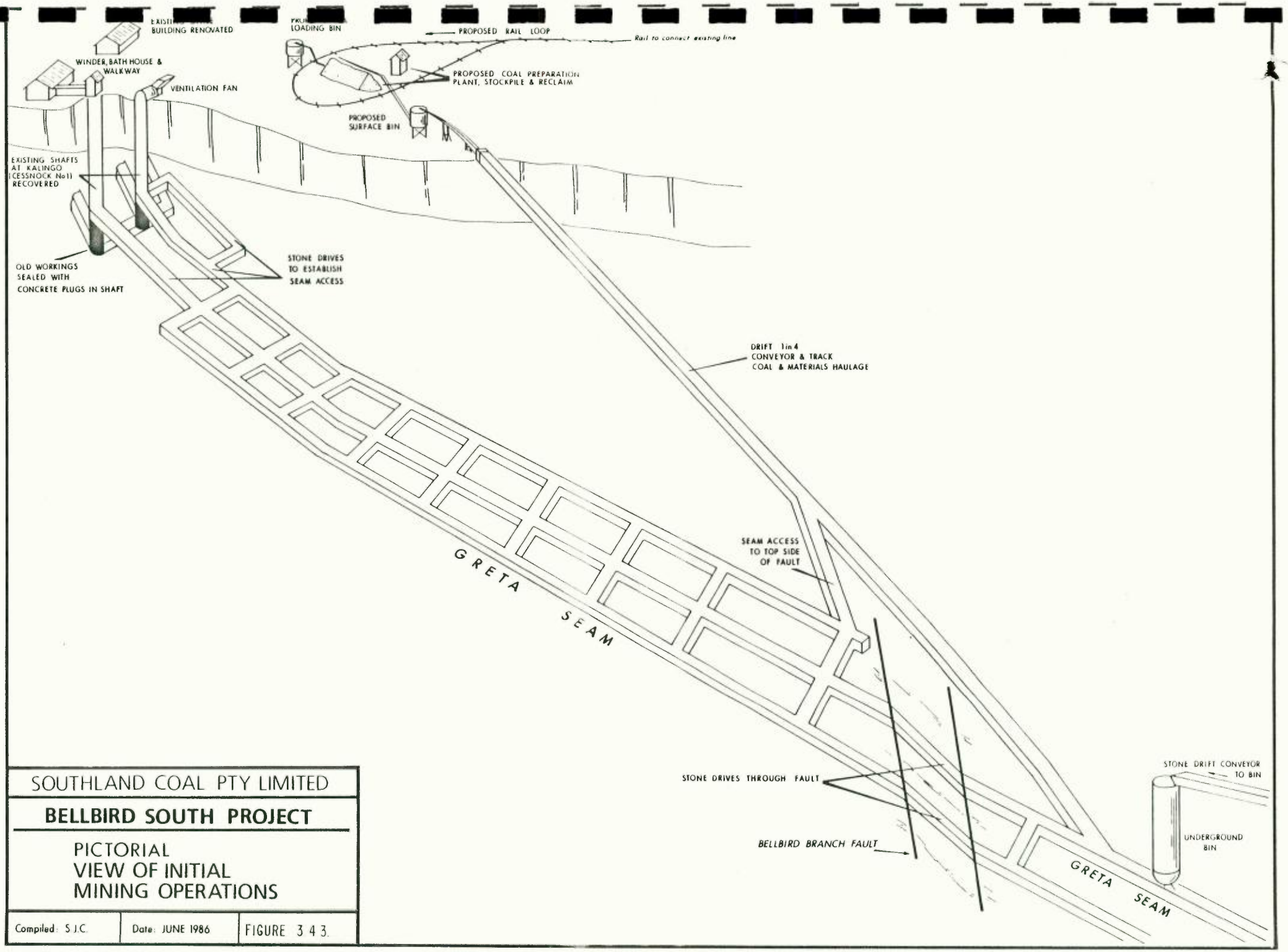
Materials

The cross measure drift will be large enough to accommodate both the conveyor and the trolley haulage system. The rail haulage system will be capable of handling loads up to 80t. The winder will be an electric powered drum type having two modes of operation, one for loads up to 30t with a speed of 4m/s, and the other for loads up to 80t to handle large items such as shearers and continuous miners at a considerably reduced speed, without the necessity for dismantling. The track system will be continued underground where heavy duty locomotives will be used. Shunts will be provided at seam level to allow free flow of supplies in and out of the mine with provision for storage.

A rubber tyred rail system is envisaged to give the maximum flexibility over the life of the mine, recognising the expected grades and the logistics of moving longwall equipment.

Man Access

The No. 1 shaft will be equipped with an automatic head mounted friction winder capable of raising or lowering one complete shift of 80 people in a double deck cage. Weatherproof access facilities will be provided for personnel (see Figure 3.4.4).

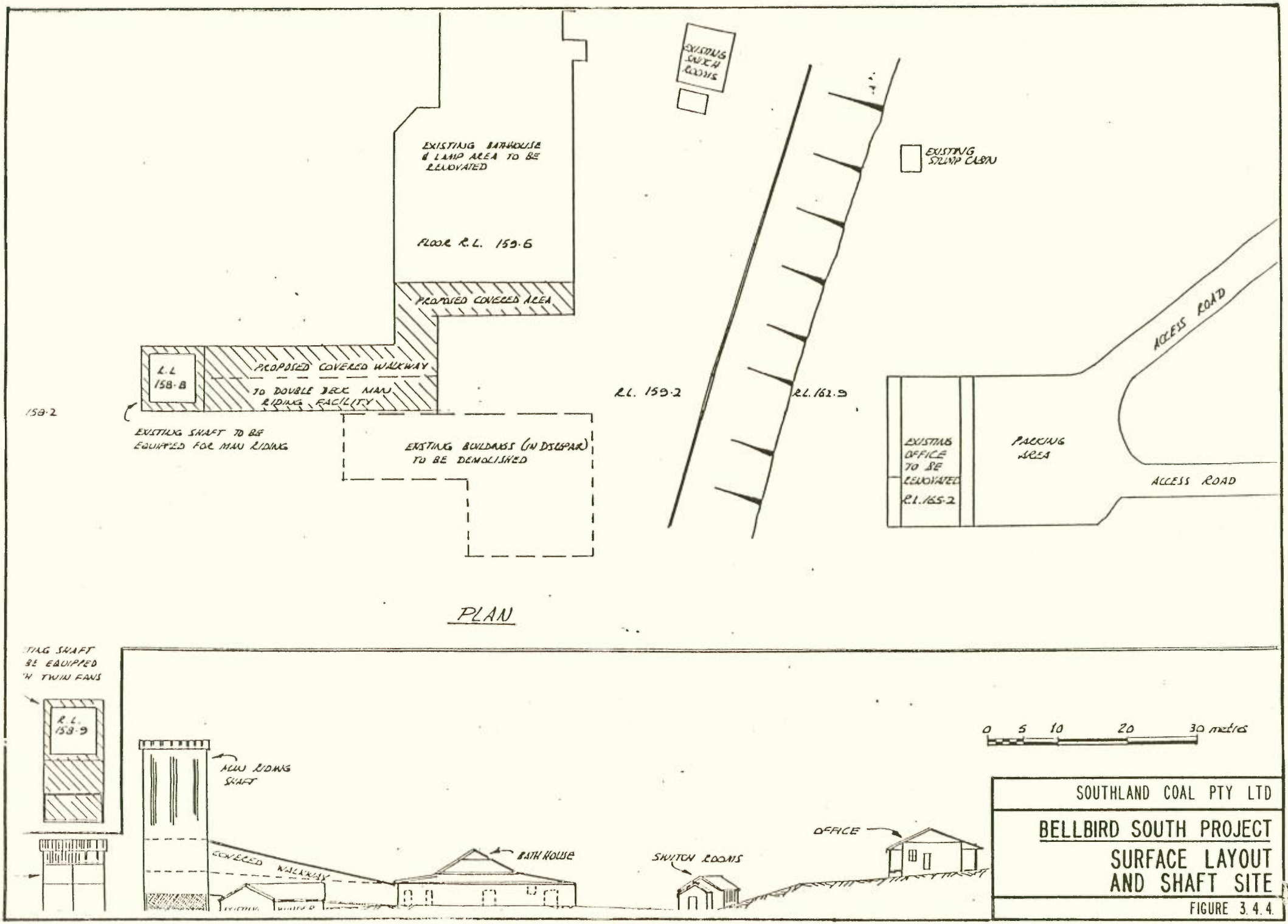


SOUTHLAND COAL PTY LIMITED

BELLBIRD SOUTH PROJECT

PICTORIAL
VIEW OF INITIAL
MINING OPERATIONS

Compiled: S.J.C.	Date: JUNE 1986	FIGURE 3 4 3.


EXISTING SHOWER ROOMS
EXISTING BATHHOUSE & LAMP AREA TO BE RENOVATED
FLOOR R.L. 159.6
PROPOSED COVERED AREA
EXISTING STUMP CABIN
ACCESS ROAD
L.L 158.8
PROPOSED COVERED WALKWAY TO DOUBLE DECK MAN RIDING FACILITY
158.2
EXISTING SHAFT TO BE EQUIPPED FOR MAN RIDING
EXISTING BUILDINGS (IN DISREPAIR) TO BE DEMOLISHED
R.L. 159.2
R.L. 162.9
EXISTING OFFICE TO BE RENOVATED
R.L. 165.2
PARKING AREA
ACCESS ROAD
PLAN
TING SHAFT BE EQUIPPED H TWIN FANS
R.L. 158.9
MAN RIDING SHAFT
COVERED WALKWAY
BATH HOUSE
SHIFTON ROOMS
OFFICE
0 5 10 20 30 metres
SOUTHLAND COAL PTY LTD
BELLBIRD SOUTH PROJECT
SURFACE LAYOUT AND SHAFT SITE
FIGURE 3.4.4.

Men and materials access routes will be predominantly separated, except in the panels. High speed rubber tyred transport will be provided from the bottom of the shaft.

3.5 Mine Operations

3.5.1 Production

A four-shift system of 7 hours each, over 5 days, is planned for the mine. This will enable 24 hour continuous face operation and it is assumed that 220 days will be worked each year.

Annual Production		Daily Production	
Longwall	1,400,000t	Longwall	7,000t
Development	264,000t	Development	1,200t
Total	1,664,000t	Total*	8,200t

* This is an average figure allowing for standdowns/longwall changeover etc.

The estimated annual production rate would not be reached until Year 6. The first development coal will be produced in the second half of Year 3, with production over 110 days to give 99,000t. For the following 2 years, development coal only will be produced at the rate of 198,000tpa.

3.5.2 Equipment

The longwall unit will mine seams to a height of 5m, with a minimum capacity of 2,000tph. A belt conveyor system will carry the coal to the underground surge bin.

The development units will be full face profile cut development machines, with a continuous haulage system from the face.

The underground support will include fans, pumps, compressed air and electrical reticulation, and all necessary transport systems for men and materials.

3.5.3 Services

The electrical power requirement will be 2MVA for the mining units, and it is planned that this will be supplied via the drift. A further 1MVA would be required at the shafts to provide power for the winder, fans and pumps.

Fresh water will be supplied down the mine via the drift. Mine water will be pumped from the mine either via the drift or the shafts, and used in the preparation plant after appropriate treatment.

3.5.4 Monitoring

A comprehensive monitoring system will be installed to maximise safety and efficiency. The system will monitor the underground environment and control the mine operations, based on the use of computers and micro-processors. A centrally located control centre at the surface, manned 24 hours each working day, will oversee all the operations.

3.5.5 Mining Constraints

No major faults have been identified in the geological assessment of the area where the longwall panels are proposed. Minor faults may occur and these will be assessed and accommodated as they are identified during the development work for each longwall panel.

Some surface movement can be expected, even with the relatively thick cover, as a result of the extraction of coal by the longwall system. The area has not been gazetted as a mine subsidence area, however there is only limited surface development.

3.5.6 Spontaneous Combustion

Historically the thicker measures of the Greta Seam were notorious for self heating. At the time of mining, the problem was not fully understood and was exacerbated by driving of large panels, extraction of top coal, provision of too small a pillar allowing crush, and injudicious ventilation systems. Current knowledge and modern technology can significantly reduce the risk and cope with the eventuality should it occur.

A sample of coal from Southland's recent Kalingo borehole drilling programme was subject to an adiabatic test to indicate the coal's propensity to spontaneous combustion. The test indicated that this coal should not cause problems associated with self heating if it is mined, handled and stored with appropriate precautions.

3.5.7 Gas Make

The gas content of the Greta Seam in the subject area appears to be very low, averaging 1.5m^3t. This is far below that encountered in the gassier mines of the South Coast (13m^3/t), at similar depths.

The average composition is 77% methane and the remainder is carbon dioxide. As a result of experience in the South Maitland field, confirmed by the above test, no provision has been made for methane drainage.

3.6 Coal Preparation

3.6.1 Coal Preparation Plant

Plant capacity of 450tph is proposed for a ROM production of 1.664Mtpa.

The plant will normally be operated three shifts a day, with 3 hours a day for maintenance.

The full capacity of 450tph will not be required until Year 6, hence the plant will be built in two stages. The first stage, of 255tph capacity, will operate one shift a day from Year 3 to Year 5 inclusive.

As there are few bands or middlings in the coal, coal will be washed at a coarse size in a heavy medium bath.

Small coal will be washed in heavy medium cyclones, the fines in spirals and the slimes in froth flotation. This combination gives the highest possible yields.

To minimise water consumption and ground water pollution, and to economise on land usage, all of the reject and tailings material will be dewatered.

Initially, one 200tph to 255tph module will be built, operating one shift a day for Years 3 to 5 inclusive. This module will wash coal crushed to -45mm. When the coarse coal washing section is added in Year 6, the size of the coal feeding the plant will be increased to 125mm. The plant will then be operated three shifts a day, to handle a raw coal output of 7,600tpd.

For Stage 1, a preparation plant building of 20m length will be constructed. When Stage 2 is completed, the building will be approximately 30m long, 20m wide and 25m high. It will be serviced at full length by an overhead travelling 5t capacity crane.

The building will be a steel framed structure with concrete bottom floor, steel grid upper floors and will be clad with corrugated colourbond steel sheeting.

A control building, 6m wide x 20m long and approximately 15m high, will be free-standing on separate foundations from the coal preparation plant and and will accommodate electrical switch rooms, control room, offices, laboratory and amenities. This building will be of masonry construction.

3.6.2 Control System

The system from the rotary breaker through the raw coal handling, coal preparation plant, washed coal products stockpiling, and rejects conveying, will be operated from the central control room. The system will control and monitor start-up and shut-down, flow rates, medium densities, tank levels, motor sequencing and other operational parameters. It will also signal and protect against electrical and mechanical failures, overloads, blockages, overflows and other malfunctions.

Operational parameters such as feed rates, production delays, product yields, relative densities, ammeters on key motors, automatic sampling, production tonnages, water quality and reject rates, will be automatically monitored and hard copy printouts will be produced continuously.

In addition to the supervisor and control room operator, two roving operators will patrol the plant, make all the necessary adjustments and inspections, and carry out routine quality control checks.

A Coalscan or similar automatic nucleonic ash monitor will provide a continuous indication and record of product ash and moisture.

3.6.3 Pre-treatment of Raw Coal

For Stage 1, raw coal from the ROM surge bin will be fed by vibratory feeder at a maximum rate of 300tph to the ROM surface conveyor delivering to the screening and crushing plant.

Oversize from the ROM scalping screen will feed to the rotary breaker, while undersize will bypass the breaker and will deliver to the breaker product conveyor (see Figure 3.6.1).

Crushed product will pass to the crushed raw coal conveyor, while rejects will be discharged to a concrete bin at ground level from which they will be periodically removed by front-end loader.

For Stage 2, the rotary breaker will have its capacity increased to 600tph.

The product from the screening and crushing station will be handled in one of three modes:

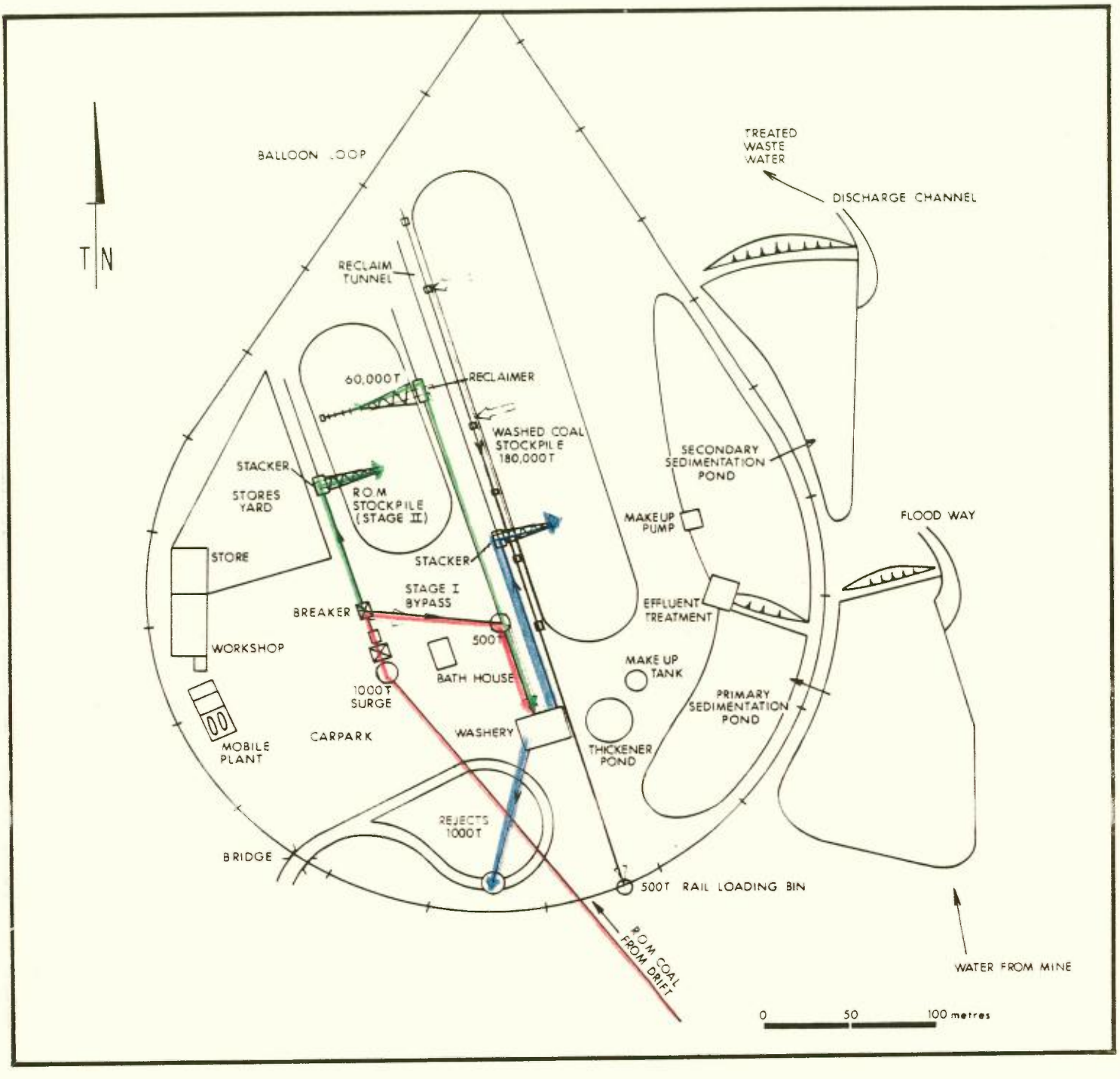
- For Stage 1, by conveyor to the preparation plant feed surge bin or, when this bin is full, by short boom conveyor to the Stage 1 raw coal stockpile.
- For Stage 2, to the raw coal stacker feed conveyor.
- By raw coal bypass conveyor direct to product stockpiles for production of 12% ash coal.

During Stage 1, coal will feed through the raw coal surge bin to the coal preparation plant on day shift, while on the other shifts it will be discharged to the conical stockpile. From this stockpile, it will be reclaimed by front-end loader on day shift and fed to the preparation plant by vibratory feeder.

When Stage 2 of the plant is built, the coal will go via stacker feed conveyor to the travelling stacker feeding the 60,000t stockpile. A travelling reclaimer will feed coal at up to 500tph via reclaim conveyor to the preparation plant feed surge bin (see Figure 3.6.2).

For efficient operation of the coal preparation plant, maintenance of the raw coal stockpile will have the following features.

- The first-in-first-out (FIFO) handling method will be employed.
- The stockpile will have a capacity of about one week's production and will effectively separate the mine operation from that of the coal preparation plant, allowing either operation to be shut down for up to one week without inconveniencing the other.
- The employment of the FIFO method minimises oxidation and heating of the coal, ensuring maximum recovery of fine coal. It also ensures that quality parameters of the coal are maintained at a high standard.

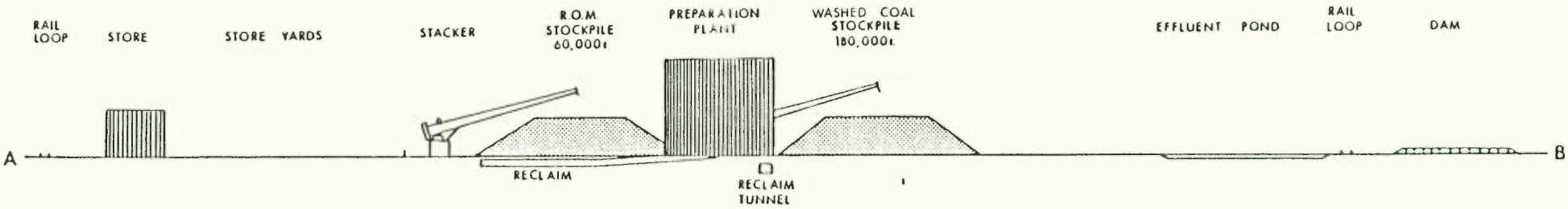


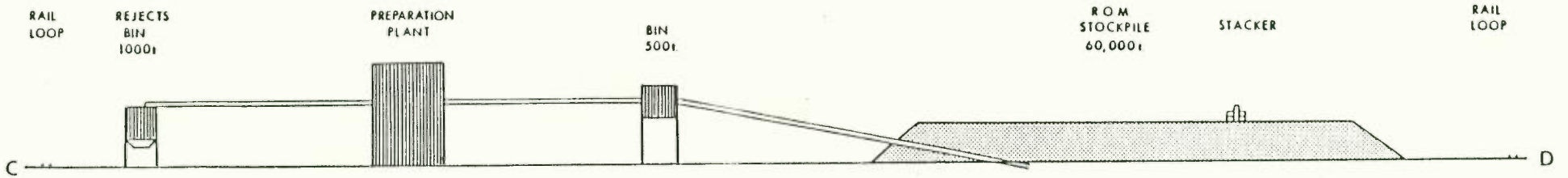
SOUTHLAND COAL PTY LIMITED

BELLBIRD SOUTH PROJECT

SURFACE COAL HANDLING SYSTEM

FIGURE 3. 6. 1.





0 20 40
METRES

SOUTHLAND COAL PTY LTD

BELLBIRD SOUTH PROJECT

SURFACE HANDLING SYSTEM

FIGURE 3. 6. 2.

- Segregation of sizes will be minimised; this is necessary for balanced operation of the various circuits in the coal preparation plant.
- Acid generation will be minimised, thereby controlling corrosion of the process equipment and pipework in the preparation plant.
- Flocculation of tailings and clarification of circulating water will be maximised, ensuring good magnetite recovery.

3.6.4 Coal Washing

In Stage 2, raw coal will be fed at the rate of 450tph from the 500t surge bin via vibratory feeder to the preparation plant feed conveyor.

In Stage 2, underflow from the primary sizing screens will feed to the small coal distributor at the rate of 255tph. Prior to construction of Stage 2, raw coal at the rate of 200-255tph, sized -45mm, will feed direct to the distributor. Coal will be slurried with water prior to screening and desliming.

Screen product will be delivered to two vibrating centrifuges prior to discharge to the washed coal product conveyor.

Reject from the cyclones, at the rate of approximately 16tph, will be drained, rinsed and dewatered. Underflow from desliming screens will be cleaned and dewatered. Washed coal from the centrifuge will be discharged to the washed product conveyor.

Froth concentrate will be dewatered in a screen bowl centrifuge while tailings will flow to the tailings thickener. The screen bowl product will join the other washed coal products on the washed conveyor feeding to the washed coal stacker.

3.6.5 Product Handling

Washed coal will be transported via stacker feed conveyor to a travelling, slewing boom stacker which will feed the stockpiles. Feed rate will rise from approximately 200tph to 400tph after completion of Stage 2.

The outloading systems will be complete with:

- continuous weighing and recording of washed coal production;
- continuous automatic sampling of the product;
- continuous monitoring of ash and moisture with a Coalscan or similar gamma ray analyser; and
- recording and monitoring of all read-out values.

3.6.6 Water Recirculation and Make-up System

Clear water overflowing from the thickener to the clarified water tank is pumped through the clean water system in the plant. Clean make-up water will be automatically added to the clarified water sump at an average rate of 10 to 11l/s.

3.7 Tailings And Rejects Handling

3.7.1 Reject Disposal

Flotation plant tailings will be flocculated by the addition of poly-electrolyte flocculant in the thickener. Thickened tailings sediment will then be delivered by pump to a band press filter, where further flocculation will be carried out. This pressure filter will dewater the tailings to a moisture content of approximately 40%, while the filtrate will be recycled back to the thickener.

The reject streams from the coal preparation plant will consist of screened coarse material, dewatered reject smalls, dewatered spiral reject fines from the high frequency screen, and tailings filter cake from the band press filter. All of these streams will be mixed in a road base mixer to form a homogeneous mixture of solids having a total moisture of 17 to 18%.

Present projections indicate up to 180,000tpa of tailings and rejects, or 3.5Mt over a 25 year period. Rejects will be stored in a 1,000t bin with sufficient overnight storage to permit trucking and dumping in daylight. A bypass chute will permit additional storage in a ground stockpile. At 18% moisture, the material can be suitable for spreading and compacting in a reject emplacement area to support vehicular traffic. Incidence of leachate from compacted fill will be minimal.

The Company has several options available for refuse disposal, including emplacement in an old open cut, incineration of waste for power generation or development of an on-site emplacement.

The preferred means of disposal is emplacement of the mixed tailings and coarse reject in the old Aberdare North Open Cut just south of Cessnock (Figure 3.7.1). This area is owned by Coal and Allied and is currently being used by Newcastle Wallsend to dispose of washery waste from Pelton Colliery (see Plate 2). The open cut has a capacity of about 3 x $10^6 m^3$ if the void was filled to ground level. Adequate capacity exists to accommodate reject disposal from both Pelton and Bellbird South Collieries for about 15 years. Surplus capacity exists should emplacement above ground level be considered.

Coal and Allied, in conjunction with Newcastle Wallsend, are rehabilitating this degraded area on the perimeter of Cessnock to enable its return to a productive form of land use. Bellbird South reject would be emplaced in the same manner as is currently being done by Newcastle Wallsend. Emplacement involves deposition of shallow layers of reject that are properly compacted before addition of a new layer. This method ensures that no water can percolate through the material, nor any air permeate the reject to generate leachate or facilitate oxidation or spontaneous combustion.

Disposal of Bellbird South reject at the Coal and Allied site would involve about 33 truck loads per day being transported the 8km distance from the Rail Loop Site to the disposal area (see Figure 3.7.1). Trucks would use the Cessnock-Ellalong route for about 5km before turning into the old Bellbird Mine site access point, after which the route would remain on property owned by either Southland or Coal and Allied.

3.7.2 Alternative Options

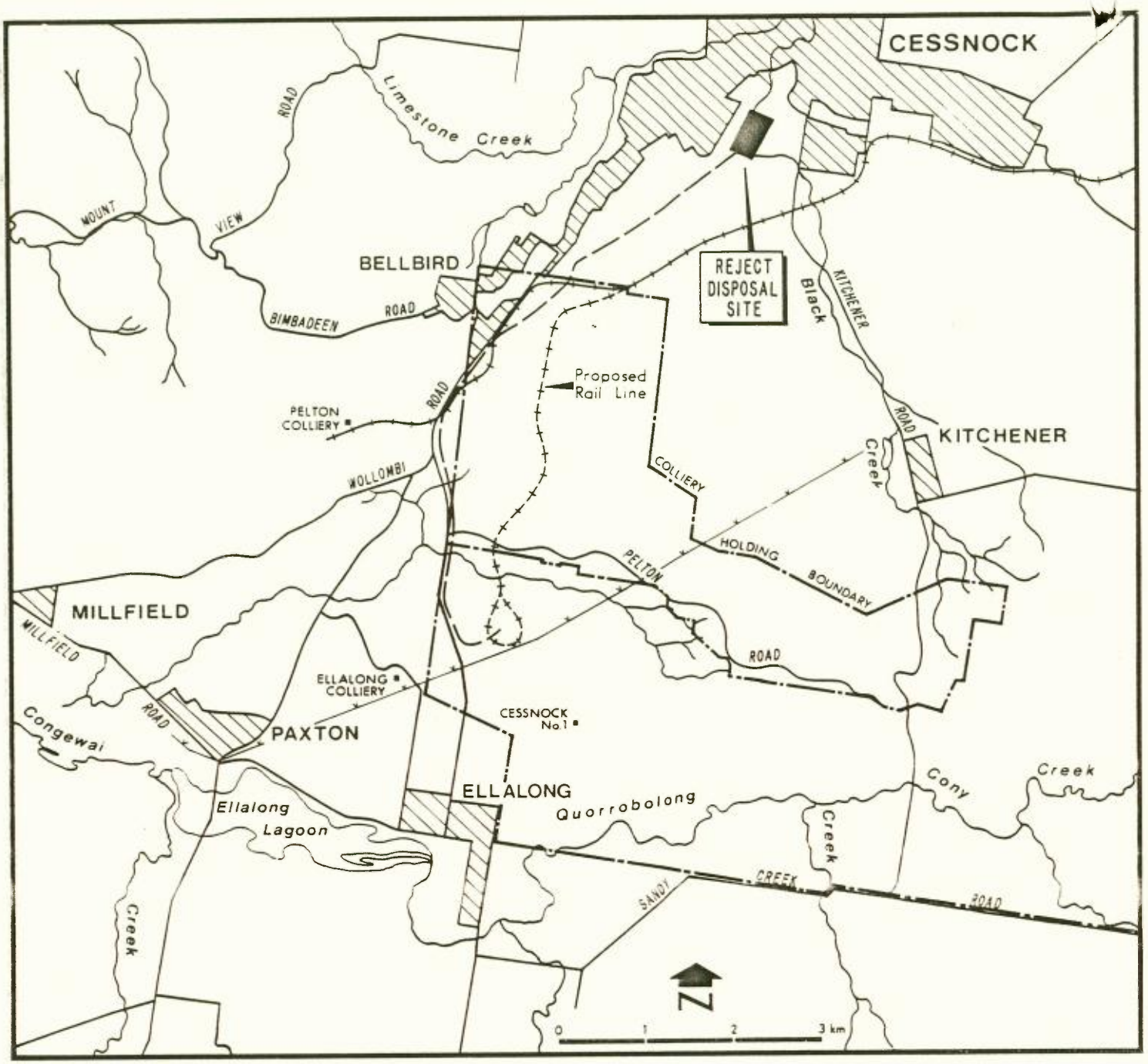
Southland has been following developments in technology for burning coal reject in a fluidised bed combustion chamber for power generation. Discussions have been held with parties promoting this technology and should this option become feasible, Bellbird South coal reject would be utilised for power generation. The much reduced volume of totally inert material would be either disposed of for landfill or other uses or if necessary emplaced in the old Coal and Allied open cut.

It is not likely that Southland would commit itself to constructing a power generation unit on its own. It is possible, however, that a unit could be justified in the medium term if it were to also serve other mines in the district.

Rejects could also be disposed of in a 30ha dump east of the drift portal, which could accommodate a 25 year mine life. It would be necessary to progressively strip the surface soil as the dump is filled, and to spread and compact this soil on top of the dump to permit revegetation to seal the surface and to minimise any leaking of acidic components of the waste. The top of the dump could be graded to discharge stormwater harmlessly at grade at a selected location. A 200-300kW tracked dozer/loader would be used for this duty.

Two 25t, three axle dump trucks would be necessary for the 3km round-trip from the washery to the dump.

All refuse disposal options would be daylight hours only operations (except operation of a power generation unit, where the transport mode would be a slurry pipeline.)



LEGEND

_ _ _ *Haul route for transport of reject material*

SOUTHLAND COAL PTY LIMITED
BELLBIRD SOUTH PROJECT
TRANSPORT ROUTE TO REJECT DISPOSAL SITE
FIGURE 3. 7. 1.

PROPOSED REJECT DISPOSAL SITE -
OLD OPEN CUT VOID AT ABERDARE No7

CURRENT INFILLING OF PART OF
THE SITE WITH PELTON COLLIERY'S
WASHERY REJECT MATERIAL.

3.8 Coal Transport

3.8.1 Overview

The expected annual ROM production when the mine is fully developed is 1.664Mt. After passing through the preparation plant, the output can vary from 1.45Mt of 6% ash content soft-coking coal to 1.58Mt of 12% ash content steaming coal. Possible production could be:

Soft-coking	0.350Mt
Semi-coking	0.250Mt
Steaming	0.954Mt
	1.554Mt

YEARLY PRODUCTION AND SALES (THOUSAND TONNES)

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7-25 (p.a.)
ROM Production	Nil	Nil	99	198	198	1,664	1,664
Sales	Nil	Nil	77	170	185	1,326	1,554

Coal will be carried by belt conveyor and rail from the coal face to the shiploader. All coal handling on-site will be by belt conveyor, assisted by some bulldozing to ground hoppers from stockpiles. Coal will be loaded to trains of 1,700t capacity from a 500t overhead bin.

An existing abandoned rail formation leads to the Bellbird South site. A short (4.3km) spur and balloon loop (1.5km) is proposed, using 4.0km of existing formation and 1.8km of new formation. The trains will use the tracks of the private Newcastle Wallsend Coal Company and South Maitland Railway (SMR) to the State rail network at East Greta Junction, and thence to the Port of Newcastle. Coal will be stockpiled and loaded to ships at either the Port Waratah or Kooragang Island coal loaders.

The proposed layout of the surface coal handling system is shown in Figure 3.6.1.

3.8.2 Mine to Preparation Plant

Raw Coal

The drift conveyor will bring coal from the mine at 1,500tph and will terminate at the raw coal stockpile near the coal preparation plant at the Rail Loop Site. Mining will be a four shift operation, but the preparation plant will operate on three shifts. Coal will generally pass to the coal preparation plant through the 60,000t ROM stockpile, carrying in excess of one week's nominal capacity of 40,000t.

To minimise susceptibility to spontaneous combustion and degradation by oxidation, raw coal will pass from the surge bin through a screen, with the coarse fractions over 125mm processed through a breaker to reduce the topsize fraction. The coal will be placed on the working stockpile by a fixed arm, rail mounted stacker.

Raw coal will be reclaimed from the stockpile by boom reclaimer, which will work through the stockpile on a weekly cycle. The stacker and reclaim conveyor capacity will be 500tph. Water sprays will be provided for dust control along the stockpile and at transfer points. Until the longwall unit is commissioned at the beginning of Year 6, breaker product will be bypassed to the preparation plant feed surge bin.

Rejects

Breaker rejects will be dumped to ground for load-out. The preparation plant rejects will be separately conveyed to a 1000t overhead rejects bin. There will be provision for diverting rejects to a ground stockpile. Dewatered tailings cake will be discharged onto the preparation plant rejects belt and disposed of with the rejects.

Washed Coal

The washed product comprises soft-coking coal. Semi-coking and steaming coals will be produced by blending with the 6% ash coal as required to meet specifications.

Total stockpile capacity of 180,000t will be provided along the same line by a single fixed arm, rail mounted stacker.

Reclamation will be by tunnel conveyor fed by ground hoppers. Coal from the stockpiles will be bulldozed into the ground hoppers, permitting progressive use of the stockpile.

Mobile Plant

Two large 300kW front-end loader/dozers will be used for bulldozing washed coal for rail loading. Normally, loading of rejects from the ground stockpile and any raw coal handling will be done by one of these machines. These operations occur only occasionally and at a relatively low rate.

3.8.3 Reclaim and Train Loading

A reinforced concrete or corrugated steel arch reclaim tunnel will run the full length of the washed coal stockpile. It will be equipped with 6 to 8 small ground hoppers, with discharge gates each capable of loading the reclaim belt at its required rate of 2,000tph. The 2,000tph reclaim conveyor will supply the 500t elevated rail loading bin. This will be sited over 550m from the entrance to the loop, with ample room for a 1,700t capacity train either side. A water spray system will be included where necessary to control dust.

A number of factors prevent a Category A or B rating being achieved for the project's rail loading facility. These are:

- **Train length** – The longest train allowed on the existing SMR spur line is 29 wagons; the standard train has 42 wagons.
- **Wagon Type** – Maximum axle loading allowed on the spur line is 20t, thus requiring the lower capacity CTS wagons to be used (with 56 nett tonne capacity), and not the larger CHS wagons (with 76 nett tonne capacity and 25t axle loading).
- **Train Nett Capacity** – The nett capacity of the shorter trains with CTS wagons is 1,700t, which is much less than the 4,200t in 39 CHS wagon trains.
- **Recharge Capacity** – The single track spur line will have two producing mines generating rail traffic. Speed limitations on the spur line also decrease train capacity. Reduced train capacity makes it difficult to assure the required distances between consecutive trains.

At present, Pelton has a Category C rated rail loading facility. It is understood that the SMR have no immediate plans for upgrading the line.

Accordingly the rail loading facility has been planned as a Category C standard. However, where cost effective, the rail loading facility will incorporate Category A standard features either for immediate or later implementation.

All facilities will comply with SRA specifications in regard to design, structure clearances etc, be equipped with electric lighting for night loading, and have signalling to assist the driver in controlling the train speed. The rail loading bin with a capacity of 500t will be used with a 2,000tph elevated conveyor providing feed to the bin from the reclaim stockpile.

3.8.4 Rail System

General Route

The disused railway to the Cessnock No. 1 Colliery provides the route for a railway to carry the coal to the SRA system. The balloon loop connects with the old railway formation which leads to the present railway line to Pelton Colliery, where the coal from the Ellalong Colliery is loaded. It is proposed to join the lines at the point where this disused line originally crossed over the line to Pelton Colliery. The railway line then joins the SMR system which, in turn, connects with the SRA main northern line at East Greta Junction just north of Maitland.

The total distance to the Port of Newcastle is:

Balloon Loop to Pelton Line	4.9km
Pelton Line to East Greta Junction	26.0km
East Greta Junction to Newcastle	34.3km
Total	65.2km

Some parts of the disused section have grades up to 1 in 70. The whole section will require complete reconstruction of the ballast and rails, but the formation and drainage are reusable.

The line to East Greta Junction has sufficient capacity to carry the output from this project and Pelton. By rearranging the train schedule and using the siding at Neath, over 10 trains a day could be handled to give an annual tonnage of over 3.5Mt. Pelton presently produces at a rate of about 1.4Mtpa which, with Bellbird South's proposed production of 1.554Mtpa, leaves spare capacity of at least 0.5Mtpa. The efficient use of the line therefore rises from about 40% to 84%.

The SRA system from East Greta Junction to Newcastle has four tracks and ample capacity to carry the additional tonnage from this project. The rail system in the Hunter Valley showing the various coal loading facilities is shown in Figure 3.8.1.

3.8.5 Emergency Coal Transport

In the event that the SRA has neither the capacity nor the ability to provide rail freight, such as in the case of an extended strike, the company proposes to:

(i) in the first instance rearrange its shipping until such times as rail haulage is again available, or

(ii) if that cannot be arranged, then the company will seek to freight a minimum tonnage of coal by road. The route likely to be taken in such an event is shown on Figure 3.8.2. It is emphasised that this will only be used under emergency conditions.

3.8.6 Port Facilities

The total capacity of the three loaders at the Port of Newcastle is 43Mtpa which is in excess of loading to date by at least 10Mt. There is also provision for further expansion at the Kooragang Island loader to increase its annual throughput from 15Mt to 45Mt.

3.9 Infrastructure

3.9.1 Service Areas

The mine will have two major service areas and a third activity site at the drift portal (see Figure 3.9.1). Road access is from the Cessnock-Ellalong Road, with the turnoff 7km south of Cessnock.

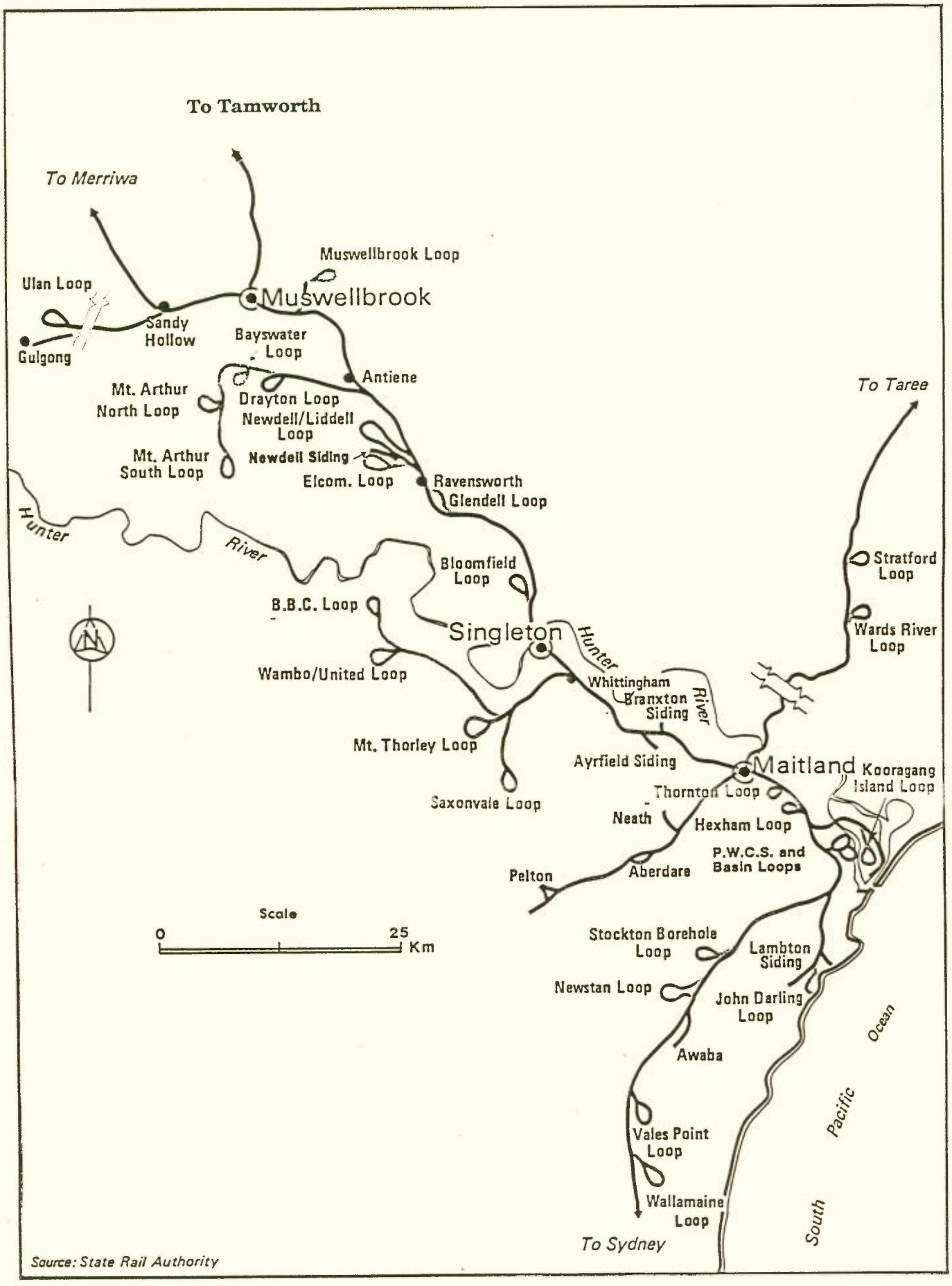
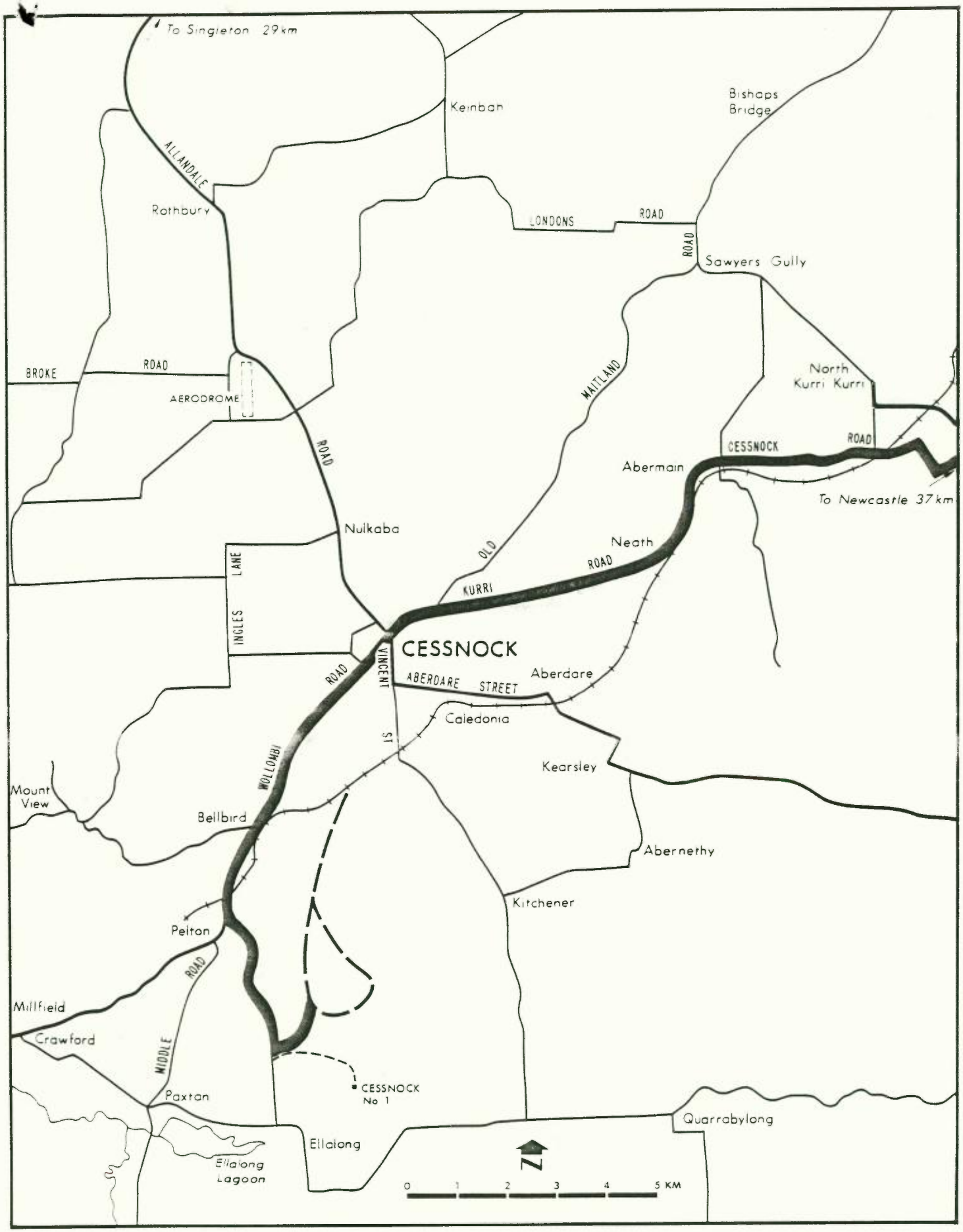


Figure 3.8.1 Rail Infrastructure in the Hunter Region



LEGEND

Route for emergency coal haulage by road

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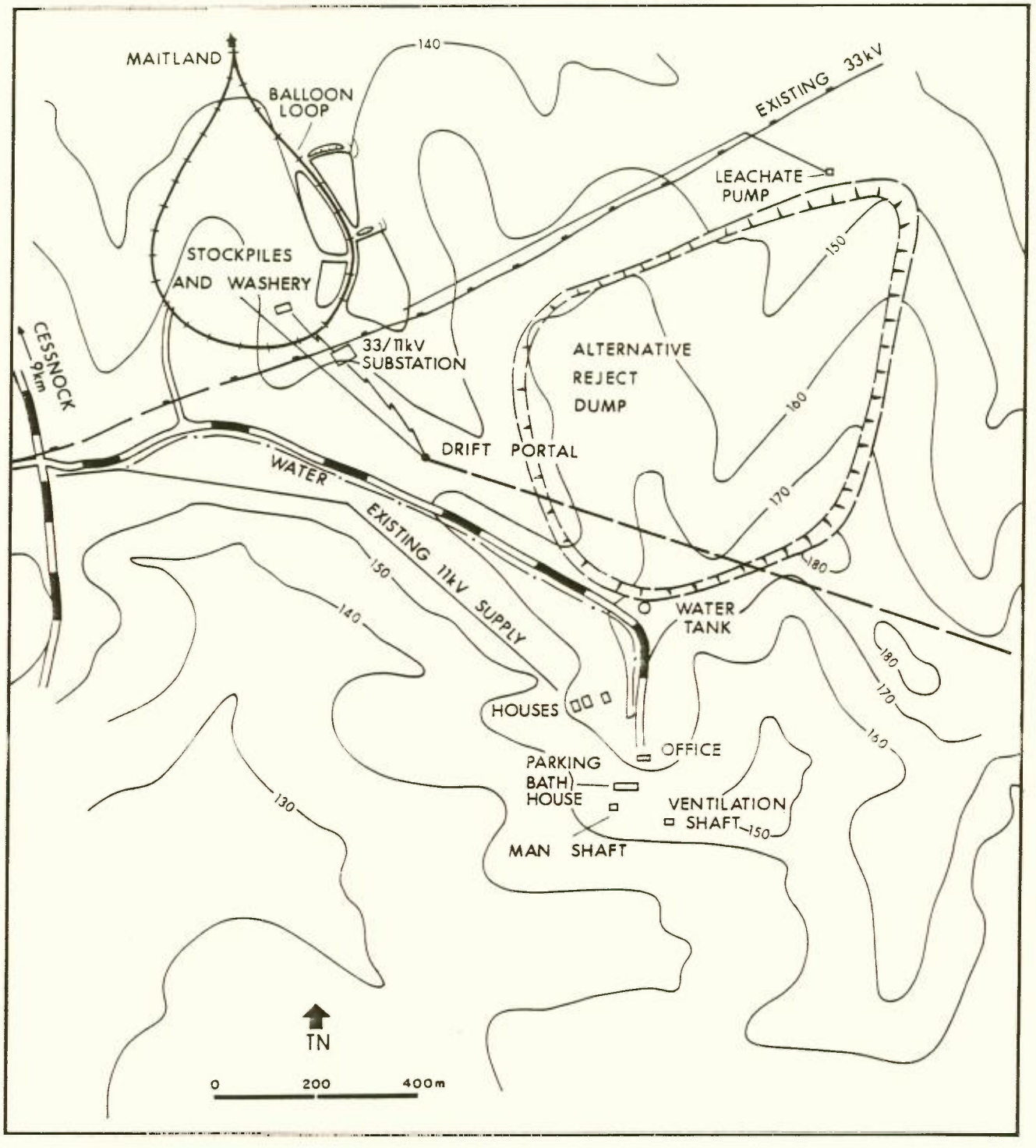
BELLBIRD SOUTH PROJECT

TRANSPORT NETWORK

FIGURE 3.8.2.



SOUTHLAND COAL PTY LIMITED
BELLBIRD SOUTH PROJECT
SURFACE INFRASTRUCTURE
FIGURE 3. 9. I.

The principal service area will be at the Rail Loop Site where the coal preparation plant and coal stockpiling will be sited. The land is over worked-out reserves of Cessnock No. 1 Colliery, but the pillars have not been extracted and the cover is approximately 300m. Under these circumstances, it is not expected that any surface movement would affect the plant and facilities proposed in this area. It is planned that all facilities, apart from some of the effluent ponds, will be sited within the loop. The facilities to be constructed are shown on Figure 3.6.1 and will include:

- coal preparation plant and ancillaries;
- raw coal and washed coal storage and reclaim;
- rejects temporary storage and loading;
- preparation plant office and laboratory;
- bath house and amenities;
- central workshop, store and yard;
- mobile plant service bay and fuel store; and
- effluent treatment plant and settling ponds.

The second service area (Pit Top Site) will be at the site of the former mine shafts. These will be used for ventilation and for man haul respectively (see Plate 1). Facilities will include:

- renovated bath house and amenities for miners;
- renovated mine office; and
- car parking areas.

The area at the drift portal will be used only for loading or unloading mining equipment for maintenance or replacement.

3.9.2 Administration

While limited office space will be provided within the balloon loop for preparation plant and workshop staff, the majority of mine staff will be stationed near the shafts at the Pit Top Site. Total staff will number 35, covering mining, maintenance, preparation plant and administration.

Office accommodation will include provision for conference and lectures, drawing office, data processing and records storage. A renovated mine office will be established at the Pit Top Site.

A Telecom connection with a minimum of 6 lines will be installed, with a small PABX serving phones at all working areas and telex and facsimile installations.

3.9.3 Maintenance Stores and Amenities

The workshop and stores complex is sited within the rail balloon loop and comprises a workshop, 20m x 40m, with 6m clearance to an overhead bridge crane of 5t capacity. The stores building, 20m x 30m, abuts and opens to a stores yard tentatively sized at 1ha.

An adjacent facility will provide a servicing and fuelling bay for mobile plant, lubricants store and an oil trap. The fuel storage will store 50,000l of diesel fuel. A fixed gantry monorail of 5t capacity will be required at the drift portal for transfer to road trucks of items requiring rebuild. Minimum mobile maintenance plant will include the following:

- general purpose tractor loader, with small backhoe;
- mobile mower/slasher; and a
- 2 tonne capacity fork-lift truck.

Much mine and materials handling equipment will be maintained and repaired on-site.

There will be about 65 employees based at the Rail Loop Site, and about 275 based at the Pit Top Site, 35 of whom will be staff. A bath house will be required at each location.

Lamps and safety gear issue, first aid room, rescue equipment room, assembly area and covered way to the personnel shaft will be provided at the Pit Top Site.

3.9.4 Access

Principal traffic to the site will be employees' cars and rejects disposal trucks.

Existing access from the Cessnock-Ellalong road into the Pit Top Site, is by a badly potholed, bitumen sealed road of insufficient width. Upgraded access will be provided to the Pit Top area, to the drift portal and to the Rail Loop.

The proposed main access standard will be to 250mm gravel or crushed rock, 10m wide to the shoulders, with a flush seal and 50mm hotmix wearing surface, 7m wide. The access roads are along ridges with reasonable subgrade quality but minimal drainage. Bitumen surfaced pavement will access the workshop, rejects bin and preparation plant.

Concrete pavement will extend 20m in front of the workshop and store, adjacent to the coal preparation plant and adjacent to the mobile plant service bay. Gravel or crushed rock pavement, 250mm deep, will be laid in all other access areas, including the stores yard. At the drift entry, a storage area will be required for material to be taken underground. Carparks will have a 200mm gravel pavement, flush sealed, with parking bays marked.

Car park areas will provide for 30 cars at the office, 140 cars at the mine bath house and 45 cars at the Rail Loop service area.

Disposal trucks will travel from within the Rail Loop to the Cessnock-Ellalong Road, along which they will travel until they reach the Bellbird Mine turnoff. The route from this point will be on Southland or Coal and Allied property (see Figure 3.8.1).

3.9.5 Power Supply

A 33kV transmission line passes between the drift and Rail Loop sites, and is little more than 1km from the Pit Top Site. Existing houses near the shafts are supplied by an 11kV line.

The Shortland County Council (the local power supply Authority), has advised that capacity exists in the 33kV transmission line to supply the above load. The Council also advised that the Pit Top Site can be supplied from the existing 11kV system.

A single transformer 33kV/11kV substation and metering point will be established at a convenient site adjacent to the 33kV transmission line. The Shortland County Council will connect the 33kV line to the substation, which is to be provided by the Company. Power at 11kV will be distributed to 11kV/415V substations located at the preparation plant, the breaker and the workshop, and to the drift portal.

3.10 Water Management

3.10.1 Water Management Objectives

A water management study for the Bellbird South Project was prepared by Mitchell McCotter & Associates Pty Ltd (Mitchell McCotter, 1987). The proposed water management programme has two main objectives. Firstly, to provide a safe and reliable water supply to permit the mine to operate under a range of weather conditions. A relatively small quantity of potable water will be needed for employee ablutions, however the main requirement will be for process water, which does not have to be of potable quality.

The second objective is to safeguard the ecological integrity of downstream watercourses and to protect the quality of groundwater aquifers. As discussed in Section 4.2.3, receiving watercourses are of good quality and may be sensitive to the discharge of saline water. Potentially important fresh water wetlands occur along Congewai Creek, particularly near the township of Ellalong. Adequate pollution controls are proposed to ensure the long-term viability of the wetland areas.

3.10.2 Water Requirements

Potable water will be required for employee amenities, showers and the site office. Based on a normal design allowance of 200l per person per day, approximately 15Ml per year of water will be consumed. In addition, it will be convenient to utilise the potable supply for miscellaneous purposes including vehicle washdown and the cleansing of workshops and maintenance buildings. A further 5Ml per year will be required for these needs.

The largest single use of water will be for make-up purposes in the coal preparation plant. The Company intends to mechanically dewater washery tailings and recycle the clarified water within the plant. Whilst this has the advantage of conserving water, make-up supplies will still be needed to compensate for moisture lost on the product coal and in coarse and fine washery rejects. A detailed process layout has not yet been prepared for the coal preparation plant, but based on coal throughput and expected product recovery rates, approximately 140Ml of make-up water is likely to be required per year.

Water will be reticulated to the underground workings for fire fighting and dust suppression. Supply for fire fighting is an emergency provision only, while dust suppression would require about 80Ml per year on continuous miners and the longwall shearer.

Finally, water will be used for dust suppression in coal handling and stockpile areas with a minor amount also required for rehabilitation/landscaping purposes. This use is dependent on weather conditions and will fluctuate monthly. Average rainfall and evaporation figures for the nearest climatic station at Cessnock are reproduced in Tables 4.3.1 and 4.3.4. They indicate that in all months except June, average evaporation exceeds average rainfall. To maintain surface stockpile moisture in accordance with the SPCC's requirements, approximately 85Ml per year will be needed. Emplacement of washery rejects could consume up to 40Ml per year on haul roads and working areas.

3.10.3 Sources of Water

The site is not currently served by town water, although a small Hunter District Water Board reticulation main is about 1.7km from the site. Two supply scenarios have been discussed with the Board. The first involves restricting project requirements to potable needs. This would involve an interconnection with an existing 100mm diameter pipeline, construction of a small pump station and the laying of a supply main to the site. Alternatively, the Board could furnish a larger annual quantity of water to serve the coal preparation plant and underground mine. This would require augmentation of existing mains for a distance of about 4.5km and the installation of a larger pump station. In either case the Company will be required to make financial contributions to the Board to offset the cost of capital works.

It is expected that the underground workings will provide a continuous source of water. A detailed groundwater study has not yet been undertaken due to the availability of information from the adjacent Ellalong Colliery, which is expected to represent very similar conditions and provides the most accurate indicator of measured inflow rates.

A range of possible inflow rates has been considered over an order of magnitude range between 5.3 and 53Ml per month. Ellalong Colliery is extracting coal from the same seam as is proposed for Bellbird South and the depth of cover and mine plan are comparable. Between 22 and 25Ml per month is currently being drawn from the underground workings and on this basis, between 264 and 300Ml per year would be available. Treated sewage effluent will be available from the project's package sewage treatment plant. However the quantity of effluent would be small and it is considered preferable on health and pollution control grounds to dispose of this by land irrigation.

The final source of water will be sedimentation ponds controlling surface runoff from the coal handling and preparation area inside the proposed Rail Loop. A harvestable yield from this area would only be about 10Ml per year.

3.10.4 Water Management Controls

Pit Top

The mine Pit Top will consist of an office, bathhouse and car parks together with two mine shafts. Surface runoff will be uncontaminated and the main water management issue will be sewage from employee ablutions. It is proposed to direct all sewage to an extended aeration package treatment plant. Treated effluent will then be disposed of by land irrigation. This is considered preferable to discharging into Quorrobolong Creek because nutrient enrichment in Ellalong Lagoon may be important during low flow conditions.

Rail Balloon Loop

The coal preparation plant will recycle the mechanically dewatered effluent from the fine rejects. A thickener dump pond will be provided to allow the tailings thickener to be emptied for maintenance. The pond will have sufficient capacity to accept the full contents of the thickener and will be kept empty when not in use.

Surface runoff from coal stockpiles will be directed to grit separators. These will be periodically cleaned and fine coal will be recovered and returned to the stockpiles. Clarified runoff will then drain to a primary settlement pond located as shown on Figure 3.6.1. The pond will also accept general runoff from the remaining area contained within the Rail Loop. To provide a minimum of one hour's detention under a 1 in 10 year storm, a pond capacity of about 1,000m^3 is required. Given the geometry of the site, the pond will probably be finally constructed with a capacity considerably in excess of this figure.

Owing to the characteristics of coal from the Greta Measures, it is possible that surface runoff and leachate from coal stockpiles could be acidic. Water collected in the primary sedimentation pond will be monitored and if found to be acidic, could be treated with lime to raise its pH. When the primary sedimentation pond is full, water will be pumped or displaced to an adjacent secondary pond of comparable size. Lime dosing, if required, could be undertaken between the two ponds. Collected water would be available for dust suppression on the stockpiles. Treatment for pH may only be required if all collected water cannot be recycled onto the coal stockpiles.

Sewage from employee facilities in the area will be drained to a holding tank and pumped to the sewage treatment plant at the Pit Top Site. Washdown water from the workshop and store will be passed through a grit and oil arrestor and the treated effluent combined with sewage in the holding tank.

Reject Emplacement Area

During the first 25 years of the mine's operations, some 3 x 10^{6}m^3 of coarse reject and filter cake from the fine rejects mechanical dewatering equipment will be produced. A number of options are available to dispose of this material (see Section 3.7). These include backfilling an abandoned open cut pit at Aberdare No. 7 Colliery, fluidised bed incineration for power generation or construction of a separate rejects emplacement to the east of the rail balloon loop. Aberdare No. 7 is currently being backfilled with rejects from Ellalong Colliery and the Company favours integrating its activities with these existing operations. From a water management viewpoint this is desirable as backfilling will occur within a contained pit. Surface runoff currently drains to underground workings which are understood not to connect directly with Black Creek, the main surface watercourse.

Although survey information is relatively sparse, it has been calculated that depending on the combined filling rate from the 2 collieries and the agreed final landforms, there will probably be sufficient capacity available within the open cut to accept rejects for the full life of Bellbird South.

The Company may seek to reduce the volume of wastes by fluidised bed incineration or alternatively a rejects emplacement could be constructed in a contained gully to the east of the coal preparation plant (see Section 3.7). The gully is well located and its geometry near a

drainage headwater makes it suitable for a rejects emplacement. During operations, all surface runoff from disturbed areas would be directed by cut-off drains to one or more sedimentation ponds. Collected water would be likely to be contaminated with sediment, but is not likely to be acidic. Containment would allow sedimentation to occur and would provide a positive monitoring and treatment point if pH correction is found necessary. A plan of the alternative emplacement area is given in Figure 3.9.1.

Although surface runoff is expected to be near neutral in pH, reject leachate will probably be moderately to highly acidic. Subsoil drains would be provided beneath the emplacement to collect infiltrated moisture and direct it to a holding well. As little is yet known about the hydraulic properties of the rejects, it is premature to predict the quantity of leachate that could be produced. A well graded emplacement surface and rehabilitation following closely behind active working areas, should ensure that the quantity of leachate generated would be insignificant. If this proved not to be the case, collected leachate would be pumped back to the make-up water line supplying the coal preparation plant. From experience at other open cut mines in the Hunter Region, this would not materially affect the overall water balance of the Project.

3.10.5 Water Balance

Aspects still to be refined during the detailed design phase include the likely quantity of make-up water to the coal preparation plant and potential inflow rates to the underground mine workings. Given these variables, there was little point in undertaking an unduly sophisticated water balance modelling programme. Best estimates of the likely water balance are shown in Table 3.10.1.

TABLE 3.10.1

SITE WATER BALANCES

Water Requirements	(Ml/annum)
Potable water	20
Underground mine	80
Coal Preparation Plant	140
Coal handling	85
Dust suppression	40
Total	365
Water sources	
Hunter District Water Board	20
Underground workings	64-640
Surface runoff	10
Sewage effluent	
Total	94-670

From Table 3.10.1 it can be seen that the potential water balance ranges from an annual shortfall of 271Ml to an annual surplus of 305Ml. Using the most likely range of inflows to the underground workings, this reduces to a nominal shortfall between 35 and 71Ml per annum. The options for making up this deficit include purchasing more water from the

Hunter District Water Board, drawing from the existing mine dam at Cessnock No. 1 Colliery or pumping from abandoned underground workings. The consequences of a site surplus are discussed in Section 4.2.5.

3.11 Workforce

The workforce can be summarised by location as follows:

Staff	35
Mine-underground	233
Coal handling system	37
Workshop	24
Bathhouse	11
Total	340

TABLE 3.11.1

WORKFORCE SUMMARY

Class	Required No	Absenteeism Allowance	Total
Staff	35	Nil	35
Deputies	20	10%	22
Miners	186	12%	206
Mechanical Trades	36	12%	40
Electrical Trades	28	12%	31
Apprentices	6	Nil	6
Total	311		340

3.12 Landscaping and Rehabilitation

An assessment of the landscaping and rehabilitation requirements of the Project was made by Wayne Perry and Associates (1987) in conjunction with Stuart Miller and Associates (1987).

3.12.1 Rail Loop Site

The Project site and adjacent areas are largely covered by Eucalypt-forest. It is proposed that clearing will be controlled by the establishment of a clearly defined construction zone. Consideration will be given if necessary, to penalty clauses being written into construction contracts to protect vegetation beyond the construction zone and trees identified within the Rail Loop. Stripping and storage of topsoil will be undertaken in accordance with the requirements listed in Section 4.1.2.

At the completion of the construction phase, landscaping will mainly comprise surface stabilisation of all cut and fill batters and bare areas subject to erosion. Batters will be regraded to maximum slopes of 1 in 3 and finished to form a smooth transition with adjacent natural contours. Topdressing material will be replaced to a minimum thickness of 100mm, with surface topsoil containing native seed material being spread last.

The topdressing material will require treatment to improve its suitability for revegetation purposes in accordance with the rates listed in Table 3.12.1.

TABLE 3.12.1

TREATMENT OF TOPDRESSING MATERIAL

Treatment	Rate
Lime	15t/ha
Molybdenised Superphosphate	200kg/ha
Grower 6	200kg/ha
Starter 18	150kg/ha

The subgrade will be deep ripped to improve infiltration prior to replacement of the topdressing material. Stabilising grasses will be established along cut and fill batters and on bare areas which are not to be hard-surfaced. Seed for tree and shrub species will be included with the seed mix in areas where visibility is not a requirement. The species listed in Table 3.12.2 provide an indication of the type of plant material to be established on-site. Consultation with the Soil Conservation Service of NSW and the preparation of more detailed landscape proposals will be undertaken during the construction phase.

TABLE 3.12.2

LIST OF SPECIES FOR REVEGETATION WORKS

Species			Rate (kg/ha)
Pasture Establishment			
Rhodes			15
Couch			20
Phalaris			15
Crimson Clover (inoculated)			10
			60
Native Vegetation			
Cover Crop	warm season:	Japanese millet	5
		Haifa clover	1
	cool season:	Oats (Cooba or Cooliba var.)	25
		Haifa clover	1

Native Species

Batters	*Open-forest*
Acacia falcata	Casuarina glauca
Acacia myrtifolia	Casuarina torulosa
Acacia terminalis	Eucalyptus capitella
Banksia spinulosa	Eucalyptus crebra
Leptospermum flavescens	Eucalyptus maculata
Melaleuca nodosa	Eucalyptus punctata
	Melaleuca linariifolia
	plus species listed for batters

3.12.2 Pit Top Site

As this area is already grassed and major earthworks are not to be undertaken, landscaping within this zone will comprise predominantly the establishment of amenity-type planting around buildings and the car park. Planting will include largely exotic species as listed in Table 3.12.3 to integrate the extensions with the 1920's architectural theme of the site and the existing planting.

TABLE 3.12.3

LIST OF SPECIES FOR PIT TOP SITE

Scientific Name	Common Name
Bauhinia acuminata	Bauhinia
Callitris columellaris	White Cypress Pine
Cotoneaster acutifolius	Cotoneaster
Lagerstroemia indica	Crepe Myrtle
Phoenix canariensis	Canary Island Palm

Bare areas, created during the demolition of old structures and the construction of new facilities, will be reinstated in accordance with the guidelines provided for the Rail Loop Site.

The existing Eucalypt-forest surrounding the site, will be retained in its present form, with the same site safeguards as outlined for the Rail Loop Site.

3.12.3 Proposed Rejects Disposal – Aberdare No. 7 Open Cut

Existing Site Characteristics

The proposed rejects disposal site, within the Aberdare North Colliery Holding and on land owned by Coal and Allied Operations Pty Ltd, represents the final void to an open cut operation which encompassed the Aberdare Extended, Cessnock No. 2 and Aberdare No. 7 open cut operations.

The linear void extends from Cessnock South to Bellbird Heights (see Plate 2) and is approximately 2km long by 150m wide at the northern end to 350-400m at the southern end. The maximum depth of the void is approximately 20m.

About 500m of the northern end of the void was backfilled between 1978 and 1982 by Coal and Allied, using tailings and coarse rejects from Aberdare Washery. This 18ha area has been successfully rehabilitated and comprises a stable grass cover with a number of Acacia species established by natural regeneration.

Currently, by agreement with Coal and Allied, the Newcastle Wallsend Coal Company is disposing of coarse washery reject from its Pelton Colliery within the northern section of the void and backfilling in a southerly direction.

Final Land Use Alternatives

Preliminary land use proposals for the site include the possibility of a golf course or other form of recreational open space within the northern section of the site, which is close to residential areas. It is envisaged that the southern section of the site could be filled to an undulating, elevated landform and revegetated with native tree and shrub species to create an Open-forest, which would be compatible with adjacent areas of land.

Final land use proposals will be prepared at a subsequent stage following agreement amongst the Company, Coal and Allied Operations, the Newcastle Wallsend Coal Company, Cessnock City Council and the Department of Mineral Resources.

Landform and Revegetation Criteria

Filling will be placed in accordance with detailed plans to ensure that a free-draining surface with maximum slopes of 1 in 6 (10°) is constructed. At these gradients, slope lengths will be restricted to a maximum length of 100m by the provision of benches. The landform will be designed so that it is compatible with adjacent existing landforms and will have a high surface drainage density to minimise surface erosion effects.

Prior to disposal on the site, any loose overburden material and soil will be stripped and stockpiled separately for later re-use. Combined dewatered tailings and coarse reject will be placed in 600mm thick layers and periodically spread by bulldozer to finished profiles. The emplacement surface will be systematically compacted by machinery movements.

Reject material has been analysed and found to be potentially acid forming with a low to moderate salinity and liable to surface crusting[1] (see Appendix 1). Based upon these results it is proposed that the rejects be covered by 600mm to 1m of inert material, prior to spreading of topsoil. The placement of the inert material is intended to minimise oxidation and thus acid generation within the rejects. However, subject to the results of further analytical testing and on-site trials, the treatment of the upper surface of rejects with lime to raise pH levels and to reduce surface crusting may be adequate.

Due to the absence of on-site topsoil, these trials will also be used to assess the fertiliser requirements of the rejects and inert material. It is expected that the current practice of dumping surplus topsoil from construction activities within Cessnock, will continue at the site. Prior to seeding, the surface will be ripped or harrowed along the contour to provide a rough surface to minimise surface erosion.

Seed and fertiliser will be spread during autumn or spring by agricultural implements, in accordance with procedures outlined in Tables 3.12.1 and 3.12.2 and after consultation with the Soil Conservation Service of NSW.

The linear nature of the site will allow progressive rehabilitation to be undertaken and this will have the effect of reducing water infiltration of the rejects, and potential dust and visual impacts. Existing site drainage into the abandoned underground workings represents a further advantage of this site, as leachate from the reject will be confined. Surface runoff will be controlled by the use of suitably designed and located catch dams.

While the acidic and saline nature of the reject material represents a potential problem in the revegetation of the reject disposal area, there are a number of examples of successful rehabilitation of Greta Seam reject within the Cessnock area. These include the adjacent Bellbird Colliery, and the nearby Millfield, Maitland Main, Aberdare, Aberdare No. 2 and Aberdare No. 3 Collieries. Spontaneous combustion of reject has not occurred within the existing dump and therefore is not expected to be a problem in this project.

3.12.4 Alternative On-site Reject Disposal Site

Existing Site Characteristics

The alternative reject disposal site is approximately 30ha in area and is located 500m southeast of the proposed Rail Loop Site. The area is covered by open-forest vegetation and comprises a small valley draining to Congewai Creek below Ellalong Lagoon. The site is completely screened from public viewing points by undulating topography and relatively dense vegetation cover surrounding the site.

Final Land Use Alternatives

Upon completion of the emplacement, the site would be returned to its previous open-forest vegetative cover and be used for the periodic harvest of timber.

[1] Geochemical Assessment of Drift Waste and Coal Reject and Implications for Waste Management – Bellbird South Coal Project.

Landform and Revegetation Criteria

It is envisaged that filling would commence at the bottom of the valley and proceed upslope. Site preparation would involve partial clearing with vegetation being windrowed and disposed of by burning, in accordance with local bushfire brigade regulations. Suitable topdressing material would be stored and stripped as specified in Section 4.1.2.

Filling of the site would proceed according to the procedure described previously for the Aberdare No. 7 void. Adequate capacity should be available on-site to accommodate the estimated 3.5Mt of combined dewatered tailing and coarse reject. Both surface drainage and leachates generated from the dump will be collected within storage dams, and treated prior to discharge in accordance with the guidelines described in Section 3.10.

Adequate topdressing material is available on-site to enable respreading to a depth of at least 400mm. This material would require treatment to improve its suitability for revegetation purposes in accordance with the rates listed in Table 3.12.1. Selection of grass and native shrub species would be made from the list provided in Table 3.12.2. Revegetation procedures would be similar to those described for the Aberdare No. 7 site.

3.13 Subsidence

The underground mine operation will undoubtedly create some surface subsidence (Figure 3.13.1).

The experience of Ellalong Colliery, working at similar depths with a similar seam thickness and in similar working conditions, indicates that surface subsidence will not present any significant problem. Maximum subsidence of about 1m has been recorded at Ellalong. A detailed monitoring programme by the Department of Mineral Resources continues to record any subsidence activity above the Ellalong workings.

The largely undeveloped nature of the surface above the Bellbird South Project area, provides a useful safeguard against subsidence induced damage. Buildings, Crown lands and significant natural features that could be affected by subsidence are shown in Figure 3.13.2. The Company is aware of the dislocation that may be caused to the owners of these structures or natural features, and resolution of any difficulties experienced by landowners will be negotiated by the Company in conjunction with the Departments of Mineral Resources and Industrial Relations.

The Howard Horizontal Control Point will be affected by subsidence. The Company is prepared to resurvey and re-establish the Control Point when subsidence is complete, in the same fashion that Newcastle Wallsend re-established the Ellalong Trig Station over its subsided land.

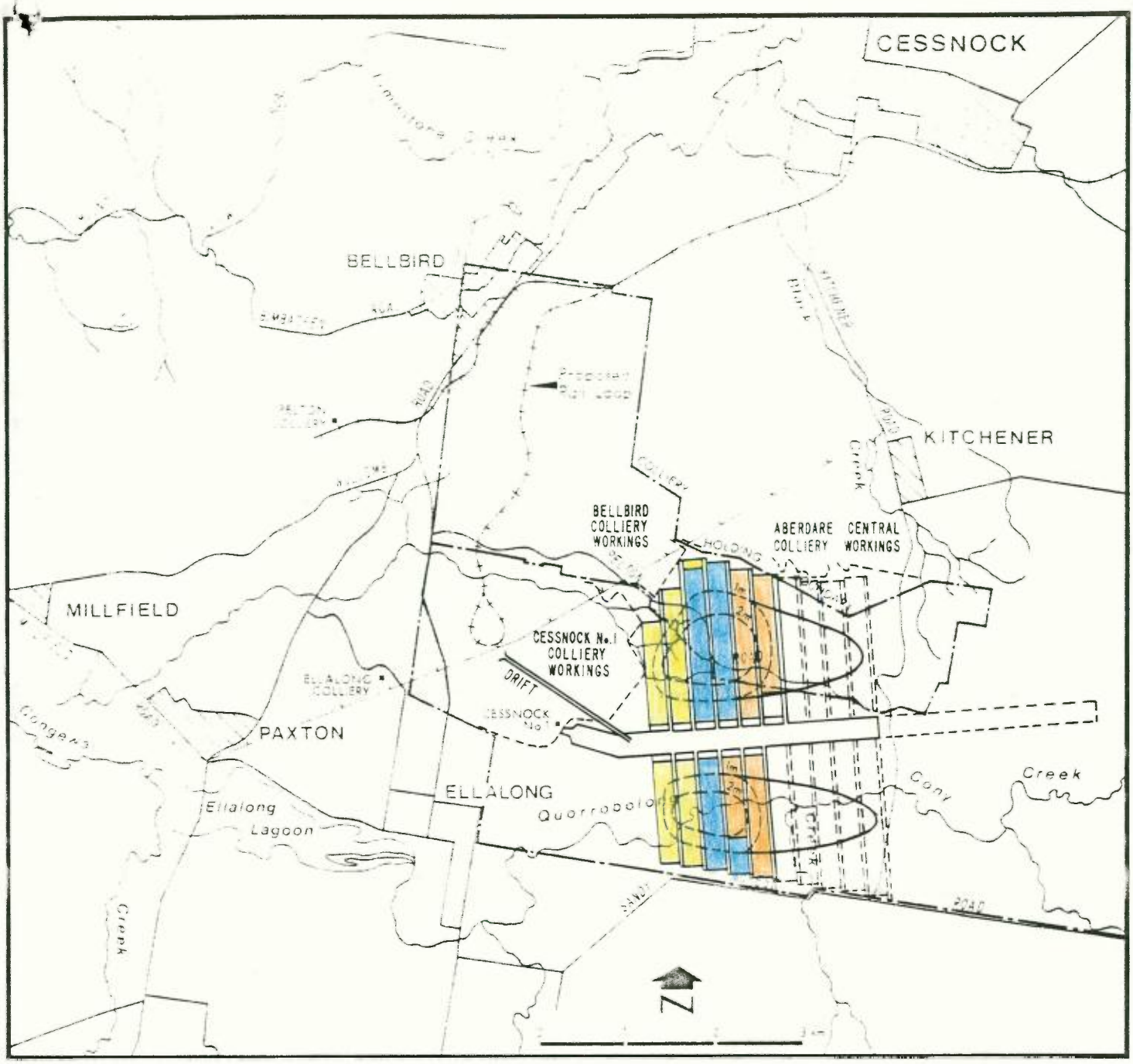
3.14 Fire Hazard

Fire hazard from mine activities is considered to be low, however potential fires could be generated from a variety of sources:

- bushfires passing through the area;
- fires originating from the mine area;
- spontaneous combustion of reject materials; and
- spontaneous combustion underground (see Section 3.5).

Fire fighting equipment will be provided at both the infrastructure service areas and will be available for fire fighting, including assistance with bushfires.

The mine development will be surrounded by cleared area with adequate access, to ensure an effective fire break between the mine and the State Forest.



LEGEND

- Year 1 - 5
- Year 5 - 10
- Year 10 - 15
- Maximum Subsidence Levels
- Subsidence beyond Year 15

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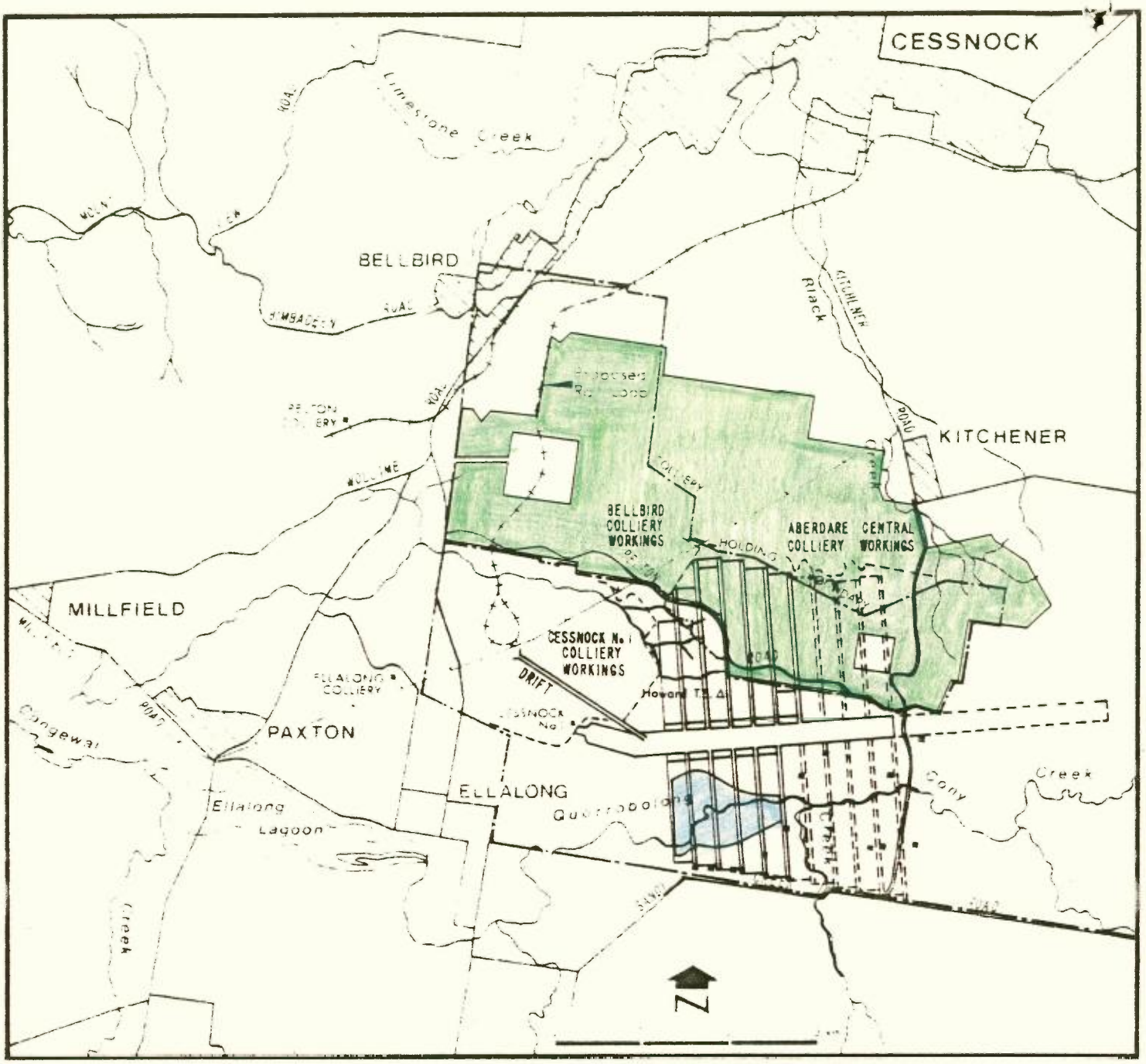
PROJECTED SUBSIDENCE TO YEAR 15

FIGURE 3.13.1



LEGEND

- Aberdare State Forest
- Residence
- Poultry Sheds
- Horizontal control point
- Road
- Creeks
- Area potentially affected by increased flooding

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BELLBIRD SOUTH PROJECT

FEATURES POTENTIALLY AFFECTED BY SUBSIDENCE

FIGURE 3.13.2.

Potential for fires originating from the surface and underground area is considered to be low, due to the stringent requirements placed on an operation of this nature for fire prevention by the Department of Industrial Relations.

The potential for spontaneous combustion from reject disposal is low, due to the manner in which the reject emplacement will be constructed. Construction involves placement of shallow layers of reject, each of which is compacted to an accepted standard, prior to the placement of the next layer. This procedure ensures that air cannot circulate within the emplacement, thereby minimising the potential for oxidation and self heating. The progressive rehabilitation programme proposed should further reduce this hazard.

Spontaneous combustion from coal stockpiles will also be minimised by the method of handling. Stockpiles will be restricted in height and a first-in-first-out (FIFO) handling method for stockpiles will be adopted. Adoption of this method minimises potential for oxidation and self heating of the coal. Should stockpiles need to be left for any length of time, the sides would be battered back to lessen potential for self heating.

3.15 Alternatives Considered

Some alternative options were considered for different aspects of the Project.

The major aspect that presented significant alternative options was the method of disposal of reject material. Three different approaches to waste disposal were considered, and these are discussed in Section 3.7.

Coal transport has been designed to accommodate government policy, cost-effectiveness and environmental acceptability. No other option could accommodate the government's policy of coal transport by rail and hence was not as acceptable on environmental grounds as the transport proposal adopted.

An alternative mine development option could be based on the use of the old shafts alone without the construction of the drift. Such an option would be inferior, although initially cheaper. Omission of the drift would downgrade the efficiency of the total operation to a point where it would lose its potential for cost-effectiveness.

The company perceives its development to be an optimal proposal involving a high degree of environmental acceptability and regard for the State's mining heritage, blended with careful consideration of good mining practice and cost-effectiveness.

Other alternatives involve the detail of design and are not significant in the context of an EIS.

3.16 Energy Statement

3.16.1 Energy Balance

The energy output from the proposed development will be considerably in excess of the energy consumed.

Coal, as the source of energy produced, will be marketed primarily for its soft-coking and by-product properties. The proportion of fuel coal from the total mine production has not yet been determined, but for the Project to be viable on current world prices for steaming and coking coals, it is anticipated to be less than 30%.

The Project will require energy during construction, mining, processing and transportation of coal.

3.16.2 Energy Output

The annual ROM production is 1.66Mt and the saleable product can vary from 1.45Mt of 6% ash content soft-coking coal to 1.58Mt of 12% ash content thermal coal.

The specific energy of the soft-coking coal is 32.9MJ/kg (7,850kcal/kg) and the thermal coal is 30.6MJ/kg (7,300kcal/kg).

3.16.3 Energy Consumption

Energy consumption will chiefly be in the form of electricity, diesel fuel and lubrication fluids.

Consumption figures for the various sources are not yet available as additional detailed engineering is required.

Electricity will be the principal energy source and will be used wherever feasible. Peak power demand is estimated at a total of 8Mw as follows:

Coal preparation, stockpiling and rail loading	2.5Mw
Drift portal including underground feeder	4.5Mw
Pit Top Site	1.0Mw

Supply will be provided by the Shortland County Council from an existing 33kV transmission line in close proximity to the project (see Section 3.9.5).

3.16.4 Energy Conservation

Power factor correction, computerised and load shedding will be practised to improve electrical efficiency.

As the Project progresses, the company will investigate the feasibility of using rejects from the coal preparation plant for fluidised bed consumption for power generation. This measure, if adopted, would further improve energy conservation.

3.16.5 Energy Sterilisation

As only one seam of coal, the Greta Seam, is available in the subject area, no additional seams are sterilised by mining. It is anticipated that the in situ reserves of the final negotiated colliery holding will be 100Mt yielding an estimated 68% recovery over the life of the mine.

4.0 EXISTING ENVIRONMENT AND IMPACT ASSESSMENT

4.1 Physiography And Soils

4.1.1 Physiography

The physiography of the sub-region is dominated by three broad morphological units. These are:

- the Broken Back Range;
- the alluvial flats and associated creeks; and
- the intervening, undulating lands.

The Broken Back Range is a major landform, extending from west of Pokolbin to Mulbring. It is characterised by steeply sloping land reaching a height of RL 228m at the Howard Horizontal Control Point, south-west of Kitchener (see Figure 4.1.1).

The alluvial flats occur adjacent to the major creeks draining the area. This landform dominates the areas surrounding Cessnock and to the east of Ellalong.

The area shown in Figure 4.1.1 consists of all three landform types. The proposed surface facilities sites and alternative rejects disposal area occur on undulating land with slopes varying between 1 and 20%.

Smaller areas comprise abandoned colliery sites, including the linear, final void at Aberdare No. 7.

The Broken Back Range represents the divide between northerly flowing creeks of the Black Creek catchment and southerly flowing creeks of the Wollombi Brook catchment. Both systems ultimately drain to the Hunter River.

The creeks in the vicinity of the surface facilities are mostly intermittent and flow either westward into Congewai Creek near Paxton or south into Quorrobolong Creek near Ellalong. Ellalong Lagoon is a large expanse of flat land located along Quorrobolong Creek, to the south of Paxton.

4.1.2 Soils

Soil Survey

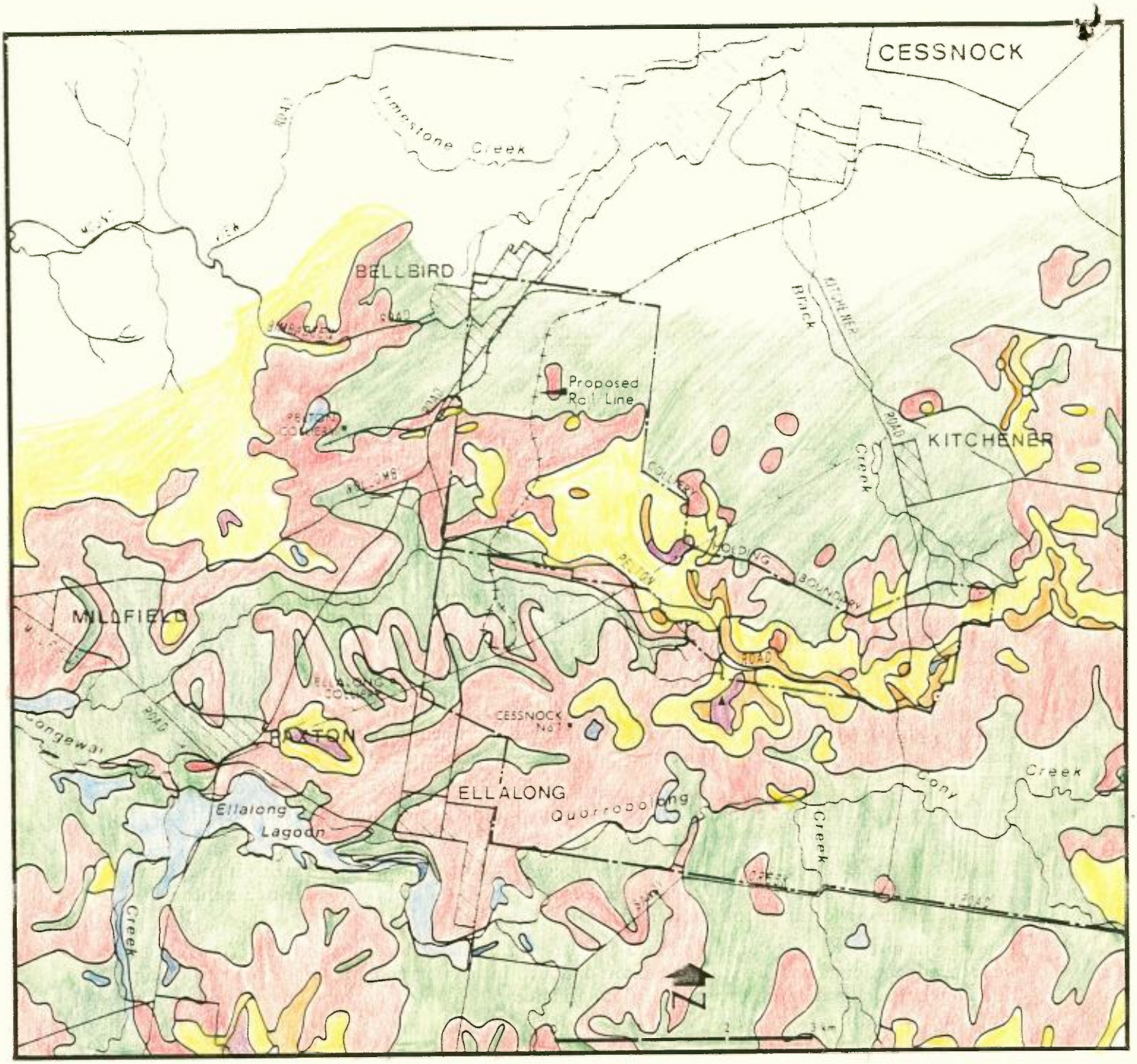
A soil survey was undertaken by Wayne Perry and Associates Pty Ltd over an area of approximately 74ha, which included the proposed surface facilities area and adjacent alternative reject disposal site. The area mapped is larger than the area likely to be considered, but accommodates all possible future options. Mapping was undertaken using aerial photographs with subsequent field checking.

The aim of the survey was to map and classify the soils according to the Northcote Classification (Northcote, 1979) and to assess the suitability of topsoil for stripping, stockpiling and topdressing purposes during subsequent revegetation.

Soil Profile Descriptions

Two groups of soils (duplex and uniform) were delineated within the area mapped, as shown on Figure 4.1.2. Typical soil profiles are shown in Figure 4.1.3. and a summary of soil survey data is presented in Table 4.1.1. Appendix 2 provides further data on these soil types.

Two duplex soils, one coarse and one fine, were identified. They are characterised by shallow, sandy-textured A horizons and sandy clay B horizons which vary in depth from 150mm to 800mm.



LEGEND

SLOPE CLASSES

- *0 - 1%*
- *1 - 5%*
- *5 - 10%*
- *10 - 20%*
- *20 - 30%*
- *> 30%*

Source : Hunter Region plan ; Sheet T10

▲ *Howard Horizontal Control Point*

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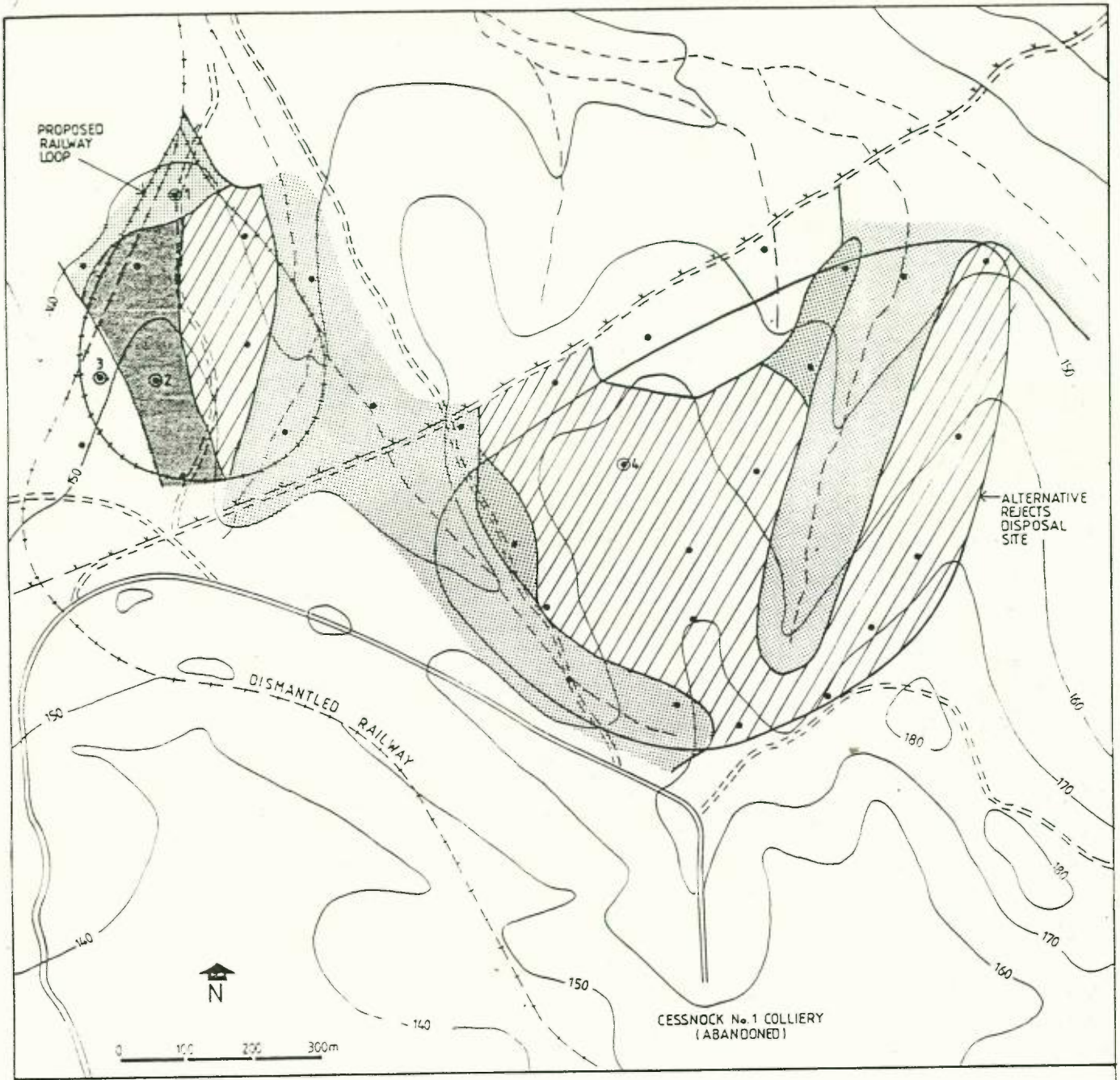
SLOPE ANALYSIS

FIGURE 4. 1. 1



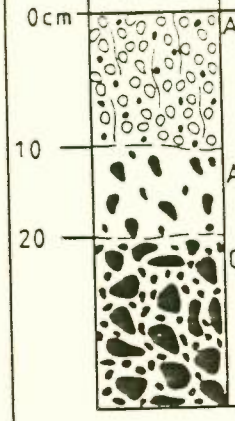
LEGEND

- Coarse duplex soils Dy 3.22
- Fine duplex soils Dr 3.42
- Shallow uniform soils Uc 4.13
- Medium depth uniform soils Uc 4.24
- Deep uniform soils Uc 4.21
- Survey site
- ◉3 Soil sampling site
- Existing contours
- Intermittent watercourses

SOIL DISTRIBUTION

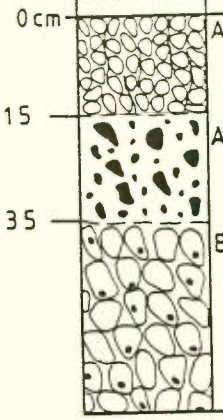
FIGURE 4. 1. 2.

UNIFORM SOILS
Shallow Uc 4.13



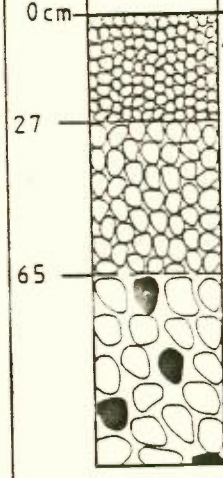
SOIL TYPE	TEXTURE, DESCRIPTION	TOPDRESSING SUITABILITY
A1	Yell.Red or Rdsh.Grey LS Earthy fabric.Weak pedality.Polyhedral 5 - 10 mm peds dispersed conglomerate.	Unsuitable for stripping except surface 5 - 10cm.
A2	Same as A1 except sandy fabric and apedal.	
C	Sub-rounded weakly weathered conglomerate. 5-50mm stone size.	

DUPLEX SOILS
Coarse Dy 3.22



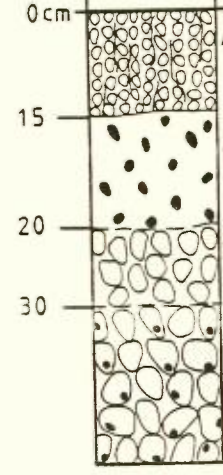
SOIL TYPE	TEXTURE, DESCRIPTION	TOPDRESSING SUITABILITY
A1	Rdsh.Br.LS. Weak pedality. Earthy fabric. 10 - 50 mm polyhedral peds.	Unsuitable for stripping except surface 5 - 10cm.
A2	Yell.Red LS. Weak pedality Sandy fabric Dispersed sub-rounded conglomerate.	
B	Yell.Red SC. Moderate pedality, rough faced 50 - 100 mm polyhedral peds. Dispersed conglomerate.	Suitable for stripping.

Medium Depth Uc 4.24



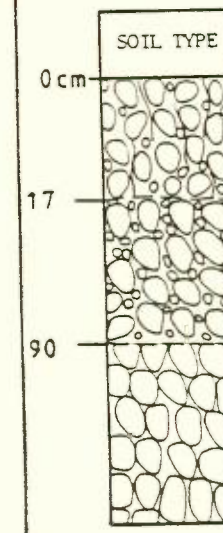
SOIL TYPE	TEXTURE, DESCRIPTION	TOPDRESSING SUITABILITY
A1	Rdsh.Br. CS Weak pedality. Earthy fabric 5 - 10 mm Round peds.	Unsuitable for stripping except surface 5 - 10 cm.
A2	Yell.Red CS Weak pedality. Sandy fabric. 5 - 20 mm Sub-angular blocky peds.	
B	Pale Yellow.LS.Weak pedality 20 - 50 mm prismatic peds. Dispersed conglomerate.	

Fine Dr 3.42



SOIL TYPE	TEXTURE, DESCRIPTION	TOPDRESSING SUITABILITY
A1	Rdsh.Br.LS. Weak pedality. Earthy fabric. 10 - 20 mm Polyhedral peds.	Unsuitable for stripping except surface 5 - 10 cm.
A2	Bleached CS. Apedal sandy fabric. Dispersed conglomerate.	
B1	Rdsh.Br.SC. Moderate pedality. Rough faced peds.	Suitable for stripping.
B2	Yell.Red Mottled HC. Strong pedality. 20 - 50 mm Prismatic peds. Dispersed conglomerate.	Suitable for stripping.

Deep Uc 4.21



SOIL TYPE	TEXTURE, DESCRIPTION	TOPDRESSING SUITABILITY
A1	Dk.Rdsh.Grey LS Weak Pedality. Earthy fabric. 10 - 30 mm Sub-angular blocky peds.	Unsuitable for stripping except surface 5 - 10 cm.
A2	Same as A1 except Yell.Red in colour.	
B	Sharp boundary. Yellow structureless sand.	

ABBREVIATIONS:

Rdsh. Br.	Reddish Brown
Yell.	Yellowish
Dk.	Dark
LS	Loamy sand
CS	Clayey sand
SC	Sandy clay
HC	Heavy clay

REPRESENTATIVE SOIL PROFILES

FIGURE 4. I. 3.

Three uniform soils were identified. These soils are characterised by shallow, sandy-textured A horizons with weak pedality and an earthy fabric. They are generally hard-setting and relatively stable. B horizons are sandy and are sometimes conglomeratic.

TABLE 4.1.1

SOIL SURVEY DATA

Mapping Unit	PPF*	No. of Described Sites	No. of Sites Sampled	Dominant GSG+	Estimated Area (ha)
Coarse Duplex	Dy 3.22	13	1	Red or yellow Podzolics	34.7
Fine Duplex	Dr 3.42	5	1	Red or yellow Podzolics	3.8
Shallow Uniform	Uc 4.13	3	1	Siliceous sand	4.6
Medium Depth Uniform	Uc 4.24	4	1	Siliceous sand	4.1
Deep Uniform	Uc 4.21	7		Siliceous sand	26.8
Total		32	4		74.0

*PPF Principal Profile Form (Northcote, 1979).
+GSG Great Soil Group (Stace et al, 1968).

Analytical Results

Four soil samples were tested for physical and chemical properties as recommended by the Soil Conservation Service (1985). The analytical results are summarised in Tables 4.1.2 and 4.1.3.[2]

The soil chemical analysis results indicate the following important features:

- All soils are low in calcium, phosphorus, nitrate-nitrogen, ammonium-nitrogen, potassium, zinc and molybdenum;
- The soils are very acid, ranging between pH 5.2 and pH 5.7;
- The cation exchange capacities (CEC) of the A horizons were very low;
- Potentially toxic levels of aluminium and iron are present in all the soils;
- Sodium domination of the CEC resulted in clay dispersion in sample 4; and
- Ca/Mg ratios were low for all samples.

These results indicate that the soils surveyed are of low fertility and possess acid induced effects.

[2]Physical testing – Soil Conservation Service, Scone
Chemical testing – Sydney Environmental and Soil Laboratory Pty Ltd

TABLE 4.1.2

RESULTS OF SOIL CHEMICAL ANALYSES

Parameter	Soil Samples Fine Duplex *(A1 Horizon)*	Shallow Uniform *(A1 Horizon)*	Medium Depth Uniform *(A2 Horizon)*	Coarse Duplex *(B Horizon)*
pH in water*	5.5	5.4	5.7	5.2
$EC_{1:2}$ (µS/cm)	0.17	0.05	0.04	0.24
Chlorides (ppm)	76	0	0	77
Soluble Cations (ppm)				
Na	37	0	0	69
K	11	9	5	9
Ca	1	0	0	0
Mg	14	7	10	8
Sol. + Exch.Cations (ppm)				
Na	92	0	0	230
K	55	43	23	55
Ca	40	20	20	20
Mg	146	122	122	854
Sum of Exch.Cations (ppm)	1.6	1.1	1.1	7.9
CEC (meq %)	3.1	3.8	2.1	12.6
Ca/Mg ratio	0.3	0.2	0.2	0
% Al	10	17	14	15
Nutrients (ppm)				
P	11	14	13	13
NH_4	4.2	1.4	0	0
NO_3	2	5.6	2.8	0.9
SO_4	16	9	9	18
Fe	16.1	138	157	75.9
Zn	4.7	4.9	0	3.1
Cu	4.9	4.6	4.8	4.2

* 1:2 soil to water solution
Exch = Exchangeable
CEC = Cation Exchange Capacity

To improve seed germination and pasture growth, both on topsoil stockpiles and on respread topdressing material, the following procedures will be adopted:

(i) Acid pH levels and low soil calcium indicate that the soils require lime. The A horizon material will be limed to 5t/ha and the B horizons 15t/ha of lime.

(ii) Phosphorus, molybdenum and zinc deficiencies will be ameliorated by the application of superphosphate with 0.02% Molybdenum and 2% zinc at rates between 300kg/ha and 500kg/ha.

(iii) Applications of muriate of potash at rates of 200kg/ha to 300kg/ha should redress potassium deficiencies.

(iv) Nitrogen will be applied in a starter fertilizer.

TABLE 4.1.3

RESULTS OF PHYSICAL AND MECHANICAL SOIL TESTS

Parameter	Soil Samples Fine Duplex *(A1 Horizon)*	Shallow Uniform *(A1 Horizon)*	Medium Depth Uniform *(A2 Horizon)*	Coarse Duplex *(B Horizon)*
Particle Size Analysis (%)				
Clay	6	7	8	47
Silt	8	6	6	7
Fine Sand	67	70	66	38
Coarse Sand	19	17	20	8
Emerson Aggregate Stability Class	3(1)	3(1)	3(1)	3(2)
Volume Expansion (%)	2	5	nd	10
Plastic Limit (%)	np	np	np	23
Liquid Limit (%)	16	17	na	50
Linear Shrinkage (%)	nd	nd	nd	13

nd = not determined
na = not applicable
np = not plastic

Physical and mechanical properties of the soils and their implications are as follows:

(i) Particle size analysis: The A horizon material has very high proportions of sand with low silt and clay and has a resultant low water holding capacity. The B horizon material contains high proportions of clay and fine sand.

(ii) Emerson Aggregate Test: The A horizon material has Class 3, Subclass 1 aggregates which are generally stable and suitable for soil conservation earthworks. The B horizon material has Class 3, Subclass 2 aggregates which have similar stability properties to the A horizon material.

(iii) Volume Expansion Test: All soil samples are categorised as having low volume expansion which is favourable for construction purposes.

(iv) Atterberg Limits: The liquid limit, plastic limit and plasticity index are used to determine the cohesiveness and compressibility of the soil. These properties are important in the construction of soil conservation earthworks. The A horizons have low liquid limits and are not plastic. This material is not cohesive. The B horizon material is cohesive and has a high compressibility.

(v) Linear Shrinkage: Linear shrinkage for A horizon material was not able to be determined. The B horizons will provide only moderate limitations to earthwork construction.

Suitability of soils for stripping, stockpiling and topdressing

An assessment of the suitability of soils for topdressing purposes was undertaken in accordance with the criteria presented in Elliot & Veness (1981). Soils suitable for topdressing have the following characteristics:

- neutral pH and low salinity;

- good water holding and infiltration characteristics; and
- high proportion of peds which will retain their structure when disturbed or wet.

The availability of topdressing material within the Rail Loop Site and the alternative reject disposal site is shown in Figure 4.1.4.

With the exception of the surface 50mm to 100mm thickness of soil, which should be retained for its source of native seed material, the remainder of the A horizons of each soil type are considered unsuitable for topdressing purposes. This unsuitability is as a result of the weak pedality, high sand content and the presence of conglomeratic material. When used for topdressing purposes, the surface material will need to be treated with lime and fertilizer due to its acidic and infertile nature.

The B horizons of the Uniform Soils are unsuitable for topdressing purposes due to their high sand content and weak pedality. Furthermore, the Medium Depth and Shallow Uniform Soils are limited by the presence of conglomerate in this horizon.

A summary of soils suitable for topdressing purposes is presented in Table 4.1.4.

TABLE 4.1.4

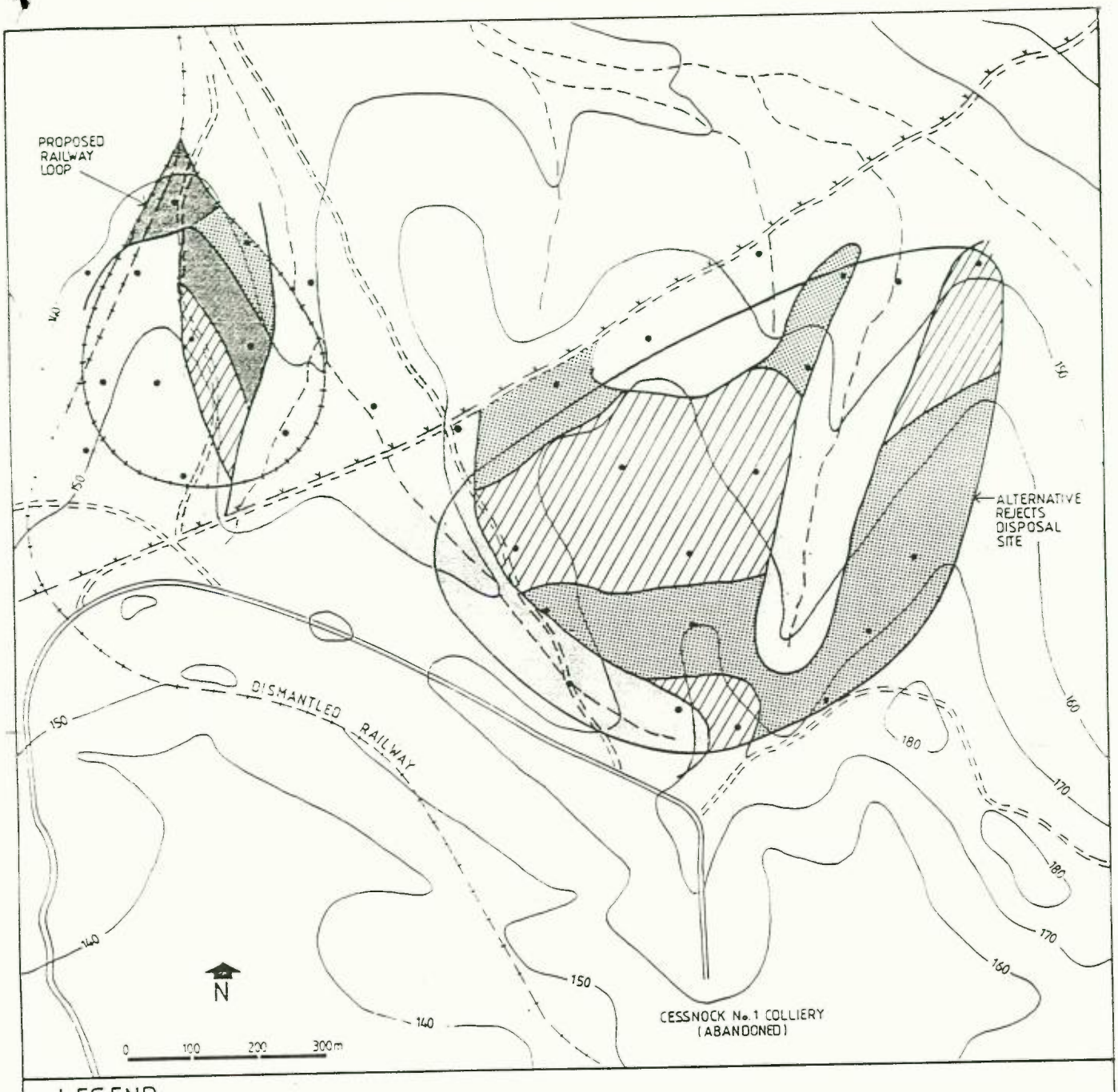
ESTIMATED VOLUME OF SOIL SUITABLE FOR TOPDRESSING

Depth (mm)	Rail Loop Site Area (ha)	Rail Loop Site Volume (m^3)	Rejects Disposal Area Area (ha)	Rejects Disposal Area Volume (m^3)
0 - 100	13.0	13,000	50.0	50,000
150 - 800	1.8	12,000	17.0	110,000
250 - 800	3.1	17,000	-	-
350 - 800	1.1	5,000	15.4	70,000
TOTAL		47,000		230,000

The following techniques will be adhered to for stripping and stockpiling of soil (Elliot and Veness 1981).

- If both A and B horizon are stripped, the material will be well blended.
- Stripping will preferably be undertaken when the soil is slightly moist, since moisture content affects the structural integrity of the soil material.
- Machinery movements will be minimised as excessive movement of machinery across the soil during stripping operations can destroy soil structures.
- Soil stockpiles will be 600mm (an optimum depth). Stockpiles will be sown with suitable seasonal cover crops to protect the surface and maintain root matter within the soil. Japanese Millet or Sorghum will be sown during spring and summer, and Wimmera Rye Grass or Oats will be sown during autumn and winter.

Within the Rail Loop Site, approximately 47,000m^3 of material suitable for topdressing purposes is available. This comprises the surface 50mm to 100mm of soil and the B horizons of the Duplex Soils to a depth of about 800mm. This amount can be respread over the area to a depth of approximately 350mm.



LEGEND

- 150–800mm
- 250–800mm
- 350–800mm
- Unsuitable
- Survey site
- Existing contours
- Intermittent watercourses

TOPDRESSING AVAILABILITY

FIGURE 4. 1. 4.

Within the alternative rejects disposal area, approximately 230,000m^3 of topdressing material comprising the surface 50 to 100mm of soil and B horizon material to a depth of 800mm is available. This is sufficient to be respread to a depth of 450mm over the site.

A reduction in the amount of topdressing material could result from variations in depth to bedrock or by the presence of increased amounts of conglomeratic material.

Existing Erosion

The extent of existing erosion was interpreted from aerial photographs and field checked. Over most of the area where the native forest has been left uncleared, erosion is minimal and the soil is stable. Some minor sheet erosion is evident in forested areas which have been affected by fire, but natural regeneration is occurring to counter this.

Moderate sheet and minor gully erosion are associated with tracks and where crossed by intermittent watercourses, moderate gully erosion generally results.

Erosion Hazard

Erosion hazard is determined by a combination of soil erodibility, topographic position and land use.

The current land use is causing only minimal erosion since the vast majority of the vegetation cover is left intact. The soils in the area, however, have very high inherent erodibilities and when disturbed, erosion is likely. This is largely a result of the coarse texture of the uniform soils and the inherent erodibility of duplex soils.

This is especially true in the intermittent watercourses and on steeper slopes where physiographic factors combine with soil erodibility to cause severe gullying.

The erosion hazard will be reduced significantly by incorporation of structural soil conservation measures to control run-off.

4.1.3 Impact Assessment - Physiography and Soils

Physiography

Land likely to be affected by surface subsidence, includes part of the Broken Back Range south-west of Kitchener and the alluvial flats of Quorrobolong and Cony Creeks. Alteration of drainage patterns within the alluvial flats as a result of surface subsidence, is expected to be minor but may increase the area subject to flooding and inundation, with subsequent effects on soil fertility and land capability.

Moderate change to the physiography of the surface facilities area will occur from cut and fill construction methods. The emplacement of rejects within the alternative on-site disposal area would affect approximately 30ha of undulating topography. The end result would be a higher landform with steeper gradients than the present 1 in 10 slopes and some alteration to the existing drainage patterns.

The disposal of reject within the Aberdare No. 7. final void, will result in the formation of a positive landform compatible with adjacent natural land surfaces.

Soils

Major cut and fill construction at the Rail Loop Site is likely to result in temporary soil erosion during the construction phase, due to the high erosion susceptibility of the site soils when disturbed. As described in Section 3.12, erosion will be minimised by the adoption of progressive revegetation of the site and the construction of soil conservation structures. The addition of lime and fertilizer and the correct storage of stripped soils will ensure that the soils will be suitable for revegetation purposes.

Similar procedures for soil conservation would be adopted for the alternative on-site reject disposal area, with soil being progressively stripped and re-used immediately on rehabilitation areas, where practicable.

Adequate soil is available for topdressing purposes at both the surface facility and alternative on-site reject disposal area. There is a deficiency of soil at the proposed reject disposal site at Aberdare No. 7 and hence the success of the current revegetation programme will be monitored to ensure that an optimal result is produced where a minimum of topsoil is available.

4.2 Hydrology and Water Quality

4.2.1 Hydrology

Surface Drainage Patterns

The Project is within the drainage catchment of the Hunter River. The site of the mine surface facilities, coal handling infrastructure and proposed coal preparation plant drains in a generally south-western direction. Much of the area above the proposed underground workings also drains in this direction.

The principal watercourse is Quorrobolong-Cony Creek which flows west before discharging into a fresh water wetland known as Ellalong Lagoon (see Figure 4.2.1). The catchment area upstream in the lagoon is approximately 87km^2 and consists of state forests and cleared farming land.

Near the village of Paxton, Quorrobolong Creek joins Congewai Creek. This is a slightly larger catchment of some 107km^2. The combined watercourse then flows to Wollombi Brook, one of the largest tributaries of the Hunter River. The Brook has some of the better quality water in the Hunter Valley and its lower reaches are used extensively for agricultural production.

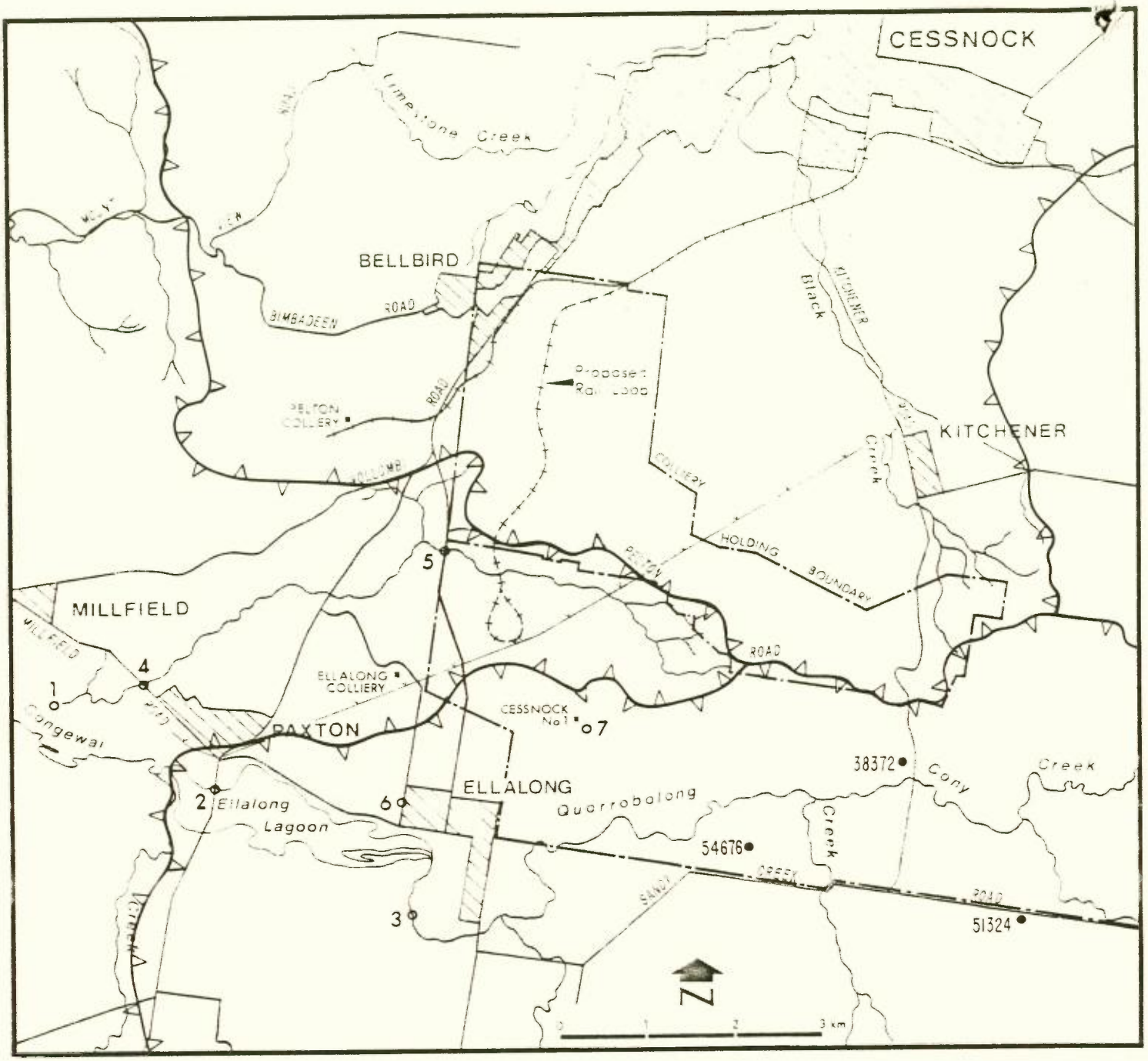
To the north of the proposed mine site, the Broken Back Range forms the watershed between Quorrobolong Creek and Black Creek. Black Creek flows north through the township of Cessnock to the Hunter River. Part of the underground workings pass under Broken Back Range and hence their northern extremity is beneath the catchment of Black Creek.

There are no river gauging stations on watercourses within the Project site. The nearest gauge is a discontinued station on Black Creek near Rothbury. Five years of data are available from the mid-1970's, permitting generation of the flow duration curve as shown on Figure 4.2.2. The gauge commanded a catchment of 220km^2, which is similar to the downstream confluence of Congewai and Quorrobolong Creeks. Other gauges include:

Gauge No.	Location
210026	Congewai Creek at Eglinford
210027	Congewai Creek at proposed dam site
210051	Congewai Creek at Hanging Rock

Existing Flooding

Flooding patterns in a section of Quorrobolong Creek will be affected by the proposed mining. Published topographic information is limited to a contour interval of 10m. This shows the bed of the creek has only a nominal gradient over the section above the mine. A more detailed longitudinal survey with cross-sections at 50m intervals was prepared as shown in Figure 4.2.3. The main waterway channel is an irregular trapezoidal shape in cross-section. Peak discharges and mid-stream depths of flow under various return periods were calculated as described in Australian Rainfall and Runoff (Institution of Engineers, Australia, 1977). The results are given in Table 4.2.1.



LEGEND

- ●38372 *Registered groundwater bores*
- o3 *Water monitoring station*
- *Quorrobolong Catchment*
- *Black Creek Catchment*
- *Congewai Creek Catchment*

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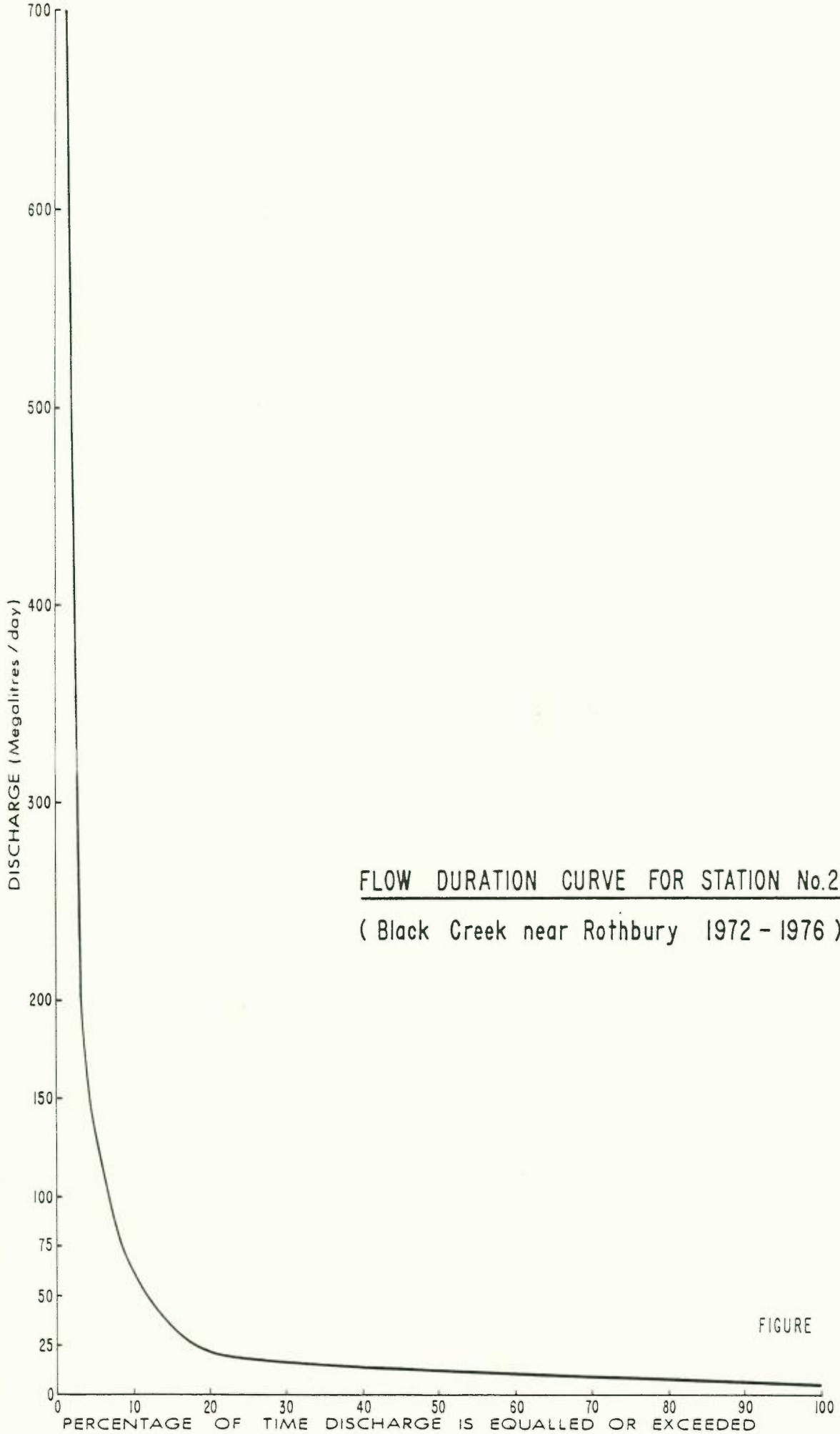
BELLBIRD SOUTH PROJECT

DRAINAGE CATCHMENTS

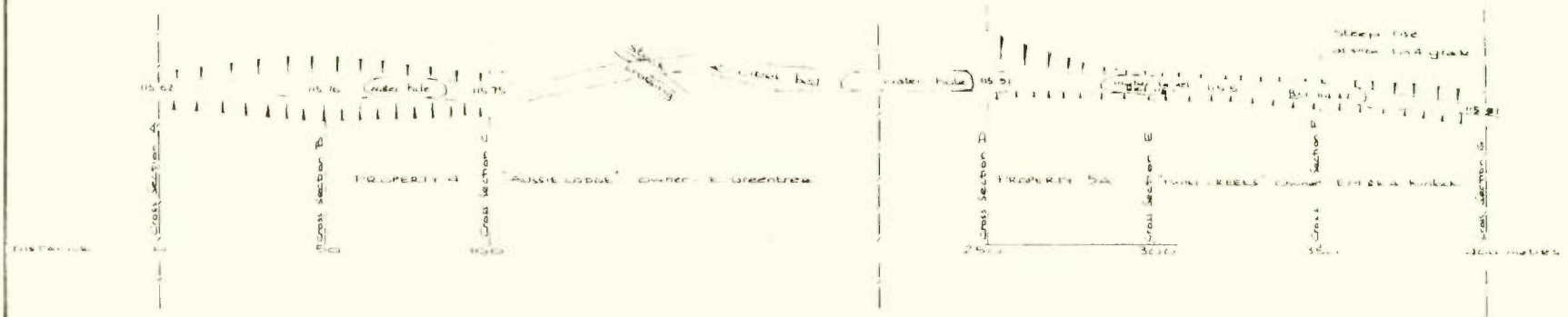
FIGURE 4. 2. 1.



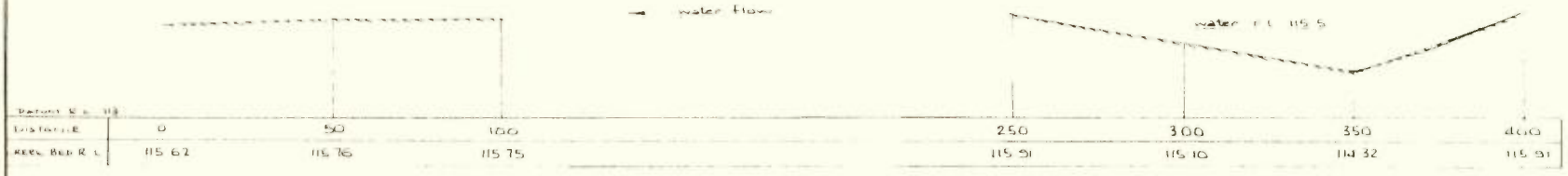
FLOW DURATION CURVE FOR STATION No.210089

(Black Creek near Rothbury 1972 - 1976)

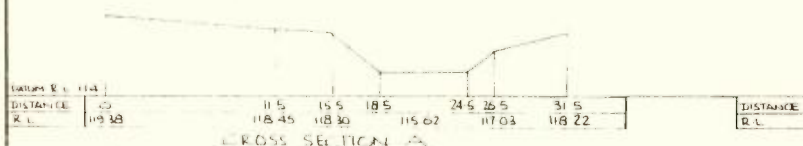
FIGURE 4. 2. 2.



PLAN SCALE - 1 1000

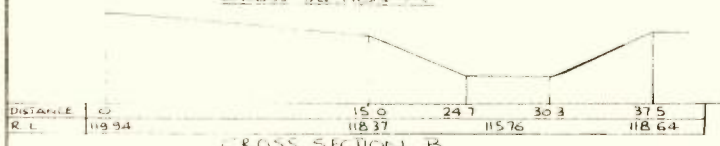


SECTION ALONG CREEK BED SCALES VERTICAL 1 100 HORIZONTAL - 1 1000

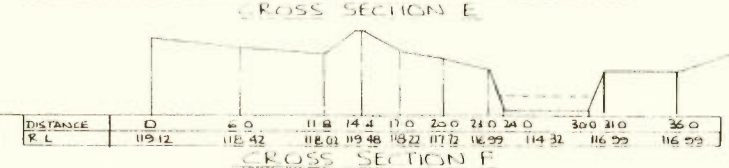


CROSS SECTION A

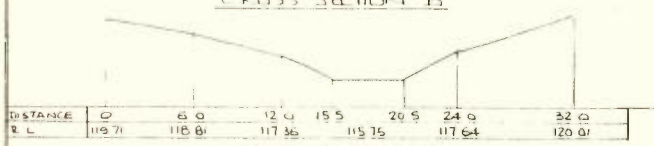
CROSS SECTION E



CROSS SECTION B



CROSS SECTION F



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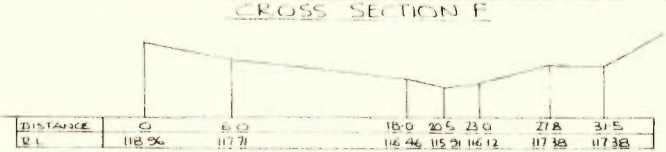

CROSS SECTION G

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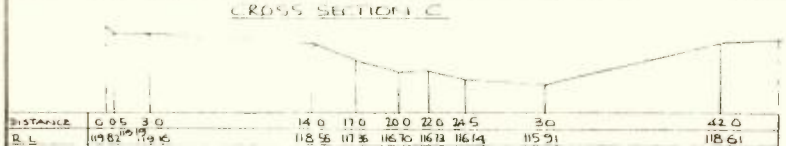

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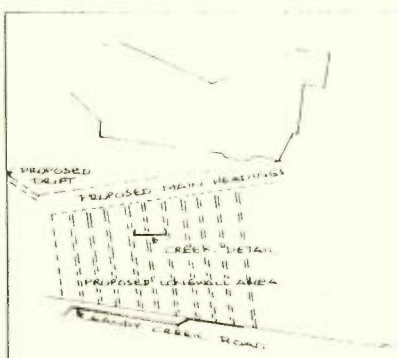

LOCATION PLAN

NOTE LEVEL DATUM ASSUMED A.H.D. FROM C.M.A. PLAN (COLLIERS)

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BELLBIRD SOUTH PROJECT

Creek Detail Over Proposed Longwall Area

FIGURE 4.23.

TABLE 4.2.1

FLOOD DISCHARGES

Annual Exceedance Probability %	Discharge (m^3/s)	Mid-Stream Depth (m)
10	71	3.3
1	126	5.8

Groundwater Usage

A search of Department of Water Resources' records was undertaken to determine the location of all registered groundwater bores (see Figure 4.2.1). All are shallow bores or wells intersecting surface alluvials in creek beds. The latter are separated from deep coal seam aquifers by intervening impermeable layers of overburden rock. While surface water bores are often of good quality, deep bores are invariably heavily contaminated by salinity from connate salts in the Permian coal seams. They are usually too saline for agricultural or urban water uses.

As the mine will be several hundred metres below the perched surface aquifers, with no direct hydraulic connection, it is unlikely that the mine will affect existing groundwater users.

Surface Water Availability: *Underground mining with shallow roof cover can lead to the development of full depth subsidence cracks.* If surface watercourses are undermined at shallow depth, it is possible for creek water to pass through these cracks and into the underground mine. In extreme cases, this can result in loss of low creek flows and can pose a hazard to safe mining.

The coal seam of interest at Bellbird South has between 400 and 500 metres of roof cover. At these depths, the risk of forming continuous cracks from the surface to the mine workings is negligible. The Mines Inspectorate Division of the Department of Industrial Relations (who oversee the safety of coal mines), would normally limit total extraction under standing water if the ratio of cover to seam thickness is less than 60. At Bellbird South, this ratio is between about 80 and 100, meaning water losses from Quorrobolong Creek to the mine will be negligible. *Mines in the lower Hunter routinely extract coal beneath Lake Macquarie and the Pacific Ocean, and as cover ratios exceed 60, little if any vertical inflow occurs.*

Lowering the creek bed by up to 2m will cause a localised ponding in the creek. It can be seen from Figure 4.2.3 that natural ponding already occurs in the creek. This will be extended as longwall panels are progressively extracted. The ponds will initially collect creek runoff, but once filled, will cease to reduce further surface runoff. The initial filling of a pond above each panel will only be a fraction of the annual yield from the Quorrobolong-Cony Creek catchment. *Minimal losses will therefore occur to downstream water uses and water supply to Ellalong Lagoon will not be disrupted. It is possible that subsidence ponds could be an advantage to local farmers in making available a larger quantity of water in the creek.*

Surface Watercourse Stability: It has not been possible to study geomorphological and sediment transport processes in Quorrobolong Creek. From field inspections of the current creek bed and Ellalong Lagoon, it does not appear that sediment loads are high. The formation of ponds through subsidence could possibly trap sediment bed load, thus causing sediment accretion above the workings and compensating river erosion further downstream. This does not appear to have occurred at the adjacent Ellalong Colliery, where the same coal seams

have been worked by longwall methods at comparable depths of cover. However, the Department of Water Resources has indicated that it will monitor the situation and if any erosion is attributable to mining, the Company will be required to remedy any damage.

4.2.2 Water Quality

Surface Water

A significant amount of water quality data has been collected over almost 2 decades in Black Creek and the Department of Mineral Resources has undertaken detailed investigations and prepared a number of reports.[3] It has also made available raw monitoring results of over 30 stations on the creek. Unpublished surveys have been carried out by the SPCC and Department of Water Resources.

Black Creek was the site of many of the oldest mines in the Cessnock/Greta Coalfield. In the late 19th century and an early part of the present century, there was no community expectation that mining would be undertaken in ways that would minimise environmental impacts. Unrehabilitated waste coal and chitter dumps were common occurrences along the banks of the creek and acid mine drainage could be seen at discrete locations. When combined with the high sulphur content of local coal seams in the Greta measures, this led to gross water pollution in the creek. Electrical conductivities of 4,000 to 8,000 micro Siemens and pH ranging from 2.0 to 3.0 are common along significant stretches of the watercourse. It is not possible to determine what proportion of salinity and acidity is due to natural surface and groundwater accessions, and what could be attributed to land use factors such as mining. However, monitoring results do point to the potential for significant impacts on water quality if adequate controls are not instigated.

The proposed mine will be drained by Quorrobolong and Congewai Creeks, not Black Creek. Almost no information is available on water qualities in these creeks, but they also drain the Ellalong Colliery. It is understood that due to a contribution of geological factors and contemporary pollution controls, the SPCC is satisfied that Ellalong Colliery complies with the Clean Waters Act.

To establish ambient water quality in these creeks, a water monitoring programme was set up in May 1987. Due to the very brief period available before completion of the EIS, sampling was conducted at weekly intervals. The programme will be continued on a monthly basis to gain a better appreciation of seasonal influences under a range of weather conditions.

Seven water monitoring stations were established, as shown in Figure 4.2.1. The stations are described further in Table 4.2.2.

The results of 5 weekly samples currently available are reproduced in Appendix 3. Due to dry weather conditions, samples were obtained from only 4 stations. Although these results may not be representative of longer term values, they indicate that all watercourses currently have very good quality water. Electrical conductivity and total dissolved solids are low. Congewai Creek appears slightly more saline than Quorrobolong Creek, with approximate salinities of 200mg/l and 100mg/l respectively. Chlorides predominate in Congewai Creek. Sodium is the most important positive ion. Anions in Quorrobolong Creek are more evenly distributed between chlorides, bicarbonates and sulphates. pH is slightly acidic, in the general range of 5.5 to 6.5.

There is no difference in water quality between the disused mine water dam at Cessnock No. 1 Colliery and the downstream watercourses, suggesting that the dam is being fed almost entirely by surface runoff.

[3]Fitzpatrick and Herbert, 1967, Heugh, 1972a; Heugh, 1972b; Corkery and McGlynn, 1974; Corkery, 1977; Toyer, 1983.

TABLE 4.2.2

SURFACE WATER MONITORING STATIONS

	Station No. and Location	Rationale
1.	Congewai Creek downstream of Ellalong Lagoon	Water quality below confluence of Congewai and Quorrobolong Creeks.
2.	Ellalong Lagoon	Water quality in lagoon.
3.	South Street, Ellalong	Water quality upstream of lagoon and downstream of area proposed for mining.
4.	Unnamed tributary between Paxton and Millfield	Water quality downstream of existing and proposed mining.
5.	Upstream of No. 4 station	Water quality downstream of proposed rail loop and rejects emplacement.
6.	Truro Street, Ellalong	Water quality from existing shafts area.
7.	Cessnock No. 1 Colliery	Existing disused mine water dam.

Groundwater

Groundwater from the Permian coal seams will be approximately equivalent in quality to mine water makes from the proposed underground workings.

All older workings in the area have been capped off and sealed, so direct access was not possible for testing purposes. However, two 1974 reports provide water quality data from the abandoned Cessnock No. 1 shafts and indicate that shaft water had a pH of 8.35 and total dissolved solids of 3,000mg/l.[4] Given the range of values in nearby shafts, it is suspected that sample dilution with fresh surface water occurred.

The Australian Gas Light Company is conducting a groundwater study of the area as part of a programme for utilising disused workings for gas storage. Unfortunately no water quality data are being collected, although regional water levels are being monitored. It appears that the regional water table still grades towards the workings, suggesting that they have not yet reached long-term equilibrium.

The most useful indication of future water quality comes from sampling results at Ellalong Colliery. A sample from an advancing heading had a pH of 9.5 and total dissolved solids of 11,815mg/l. The latter is consistent with regional values and is slightly higher than saturated leaching results given above. The trend of neutral to alkaline pH is significant, suggesting that the mine water may not be too undesirable.

4.2.3 Impact Assessment – Hydrology and Water Quality

Potential Subsidence Impacts

Extraction of coal in longwall panels will cause surface subsidence in overlying strata. It is expected that with a combination of available seam working heights, depth of cover, local geology and panel geometry, surface subsidence of up to 2m may occur. A series of longitudinal troughs will be progressively formed as shown in Figure 3.13.1.

The northern series of longwall panels will extract coal beneath Broken Back Range. Even a 2m subsidence in these areas would have no affect on surface flooding. The southern longwall panels extend beneath a length of Quorrobolong Creek. Subsidence may lower the bed of the creek in the adjacent floodplain, which may lead to more frequent and more

[4]Pollard, 1974; Sanders, 1974.

extensive local flooding. Due to inadequate topographical information, it is not possible to adequately delineate the area of land potentially affected. However, it appears that approximately 81ha could be involved as shown in Figure 3.13.2.

Losses of agricultural capability due to more frequent flood inundation do not appear to be directly covered by the Mine Subsidence Compensation Act. The Company has identified all properties potentially involved and is prepared to negotiate appropriate agreements with relevant landowners if subsidence monitoring confirms that losses to agricultural output could be caused by mine activities.

Disposal of Mine Water

If the access shafts are currently flooded, they will have to be pumped out and the base sealed before branching stone drifts are constructed. The exact volume of water which will have to be removed is not yet known. The head of water in the shafts was recently recorded at 15.25m. If this continues to be the case, just over 1Ml of water will be involved. In the worst situation where shafts are flooded to their full depths, some 22Ml of water will need to be pumped out.

There are several options to dispose of this water. Direct discharge is not believed to be appropriate given the high quality of water in Quorrobolong Creek. One option would be to draw down the disused mine water dam at Cessnock No. 1 Colliery and pump shaft water into it. It has been estimated that the dam has a capacity of approximately 98Ml and an average annual input of about 22Ml from surface runoff. If a larger volume is required to be disposed of, the permanent mine water pipeline should be constructed and utilised for dewatering.

Surface Water

Pit Top Site: The only potential water quality issue in the Pit Top area is the disposal of sewage. As this will be treated and the effluent disposed of by land irrigation, there will be no adverse impacts on downstream receiving waters.

Rail Loop Site: The main water quality issue at the rail infrastructure loop area is the impact of disposal of excess mine water, if a positive site water balance occurs. At the extreme, some 305Ml of saline mine water may require disposal. Any discharges could readily avoid Ellalong Lagoon by being directed to the unnamed creek that flows between the villages of Paxton and Millfield (see Figure 4.2.1). Given the range of known water quality in Congewai Creek and the flow regime depicted in Figure 4.2.2 direct discharge is not considered to be desirable. Flows only exceed 50Ml a day for about 10% of the time, so dilution is unreliable. The increase in salt load would also be of major concern. A natural annual salt load of approximately 2,900t would be more than doubled if direct discharge were permitted.

Treatment by desalination would be a possible option, but would be very expensive and would still require the disposal of saline brines. A more desirable option would be to return excess mine water to underground workings. One possibility would be the old Cessnock No. 1 workings, although these are very close to the proposed underground operations. It would appear preferable to pump north to the abandoned Bellbird Colliery workings. This would effectively mean the recycling of water within the deep underground aquifers which should help to maintain the existing groundwater regime. The feasibility of this option could only be confirmed with a more detailed analysis of the extent of underground workings and the characteristics of local groundwater flows. However it seems practical in principle and, if confirmed by more detailed investigations, will result in a flexible and environmentally sound management procedure.

4.3 Climate And Air Quality

4.3.1 Climate

The Hunter Valley Region lies in the transition zone between steady trade winds to the north and migratory anticyclones to the south. The climate is temperate maritime, with warm to hot summers and cool to mild winters. During summer, warm humid conditions associated with the easterly trade winds are experienced.

The anticyclone belt moves northward during autumn and winter, and hence the synoptic airflow is westerly. In spring the anticyclone belt returns to the south.

Data from 4 meteorological stations have been utilised in describing the climate of the area. Three of these stations are maintained by the Bureau of Meteorology, and the fourth station, providing rainfall data only, has been maintained by Newcastle Wallsend at the adjacent Pelton Colliery.

The locations of all 4 recording stations are shown in Figure 4.3.1.

Rainfall

Rainfall has been monitored at the Cessnock Post Office since 1903, at Cessnock Aerodrome since 1968, and in recent years at Pelton Colliery. Rainfall data are summarised in Table 4.3.1.

Summer is the wettest period and winter the driest. January has been the wettest month at Pelton, with 101mm average rainfall. February has been the wettest month at Cessnock's Post Office and Aerodrome, recording averages of 85 and 101mm respectively. Winter is the dry period with average rainfalls for the driest months of 11mm in July (Cessnock Aerodrome), 24mm in August (Pelton) and 43mm in both August and September (Cessnock Post Office).

The average annual rainfall recorded at the 3 stations ranges between 687/688mm at Pelton and the Aerodrome, and 746mm at the Cessnock Post Office.

Temperature, Humidity and Evaporation

These parameters have been recorded at Cessnock Post Office and Cessnock Aerodrome. January is the hottest month and July is the coldest. (See Table 4.3.2).

Humidity data recorded at Cessnock Post Office shows humidity at 9am ranges from 53% in November to 81% in May, and from 41% in November to 56% in June at 3pm. (Table 4.3.3). As is expected, humidity is usually higher in the morning (67% at 9am) than in the afternoon (47% at 3pm).

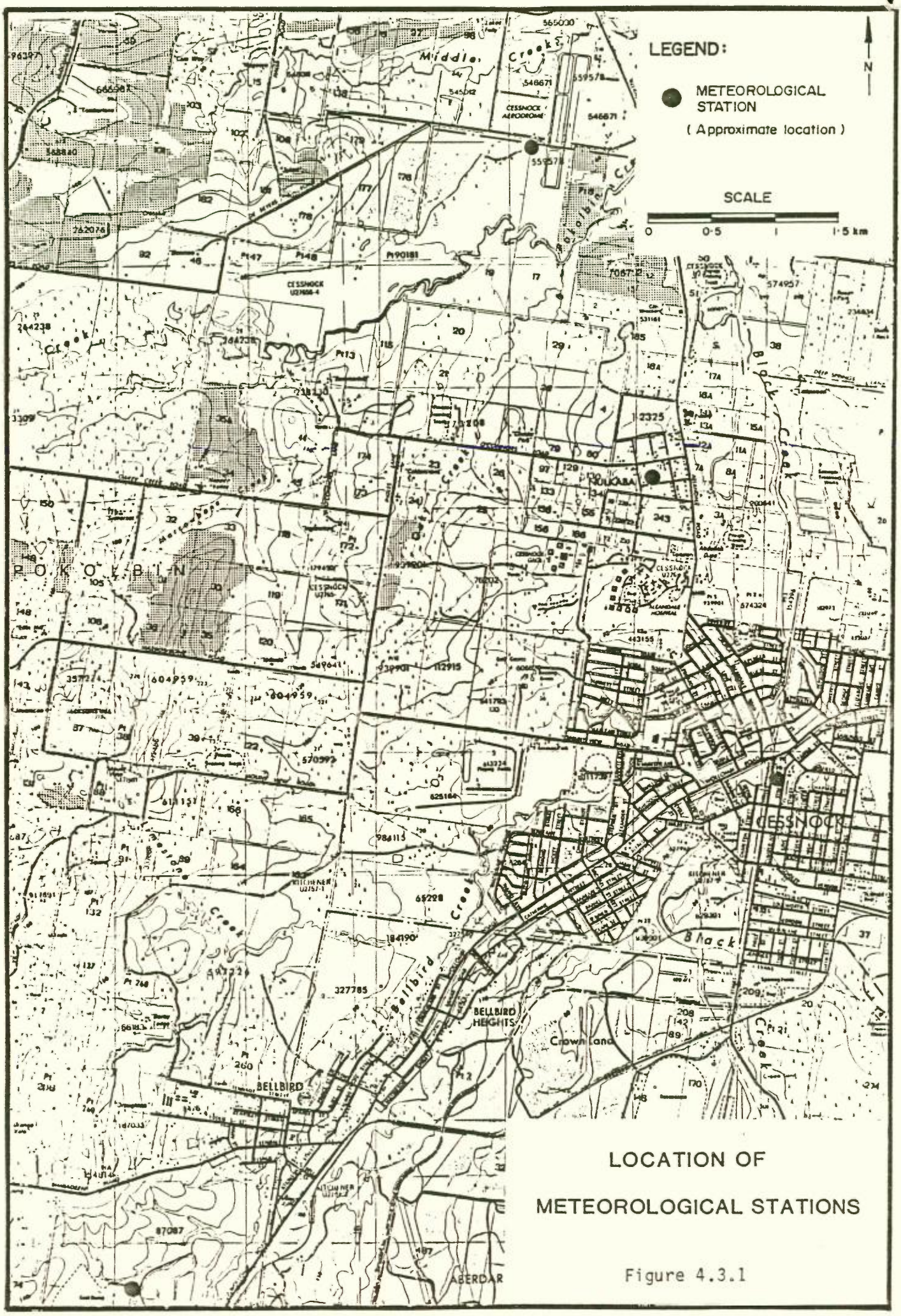
Evaporation monitored at Cessnock Post Office averaged over the period 1974 to 1984, is presented in Table 4.3.4.

Wind

Figures 4.3.2A and B show 9am and 3pm annual and seasonal wind roses derived from 13 years of data recorded at the (Nulkaba) station located approximately 8km north of the proposed mine site. The wind roses for summer include December to February data; autumn includes March to May; winter June to August and spring September to November.

The strong north-west – south-east alignment of the dominant winds is typical of many parts of the Hunter Valley. The same pattern has been noted previously at Glendell, Lochinvar and Jerry's Plains (Dames & Moore, Glendell EIS). In the morning, winds from the south-east predominate in summer, turning north-west during autumn, winter and spring.

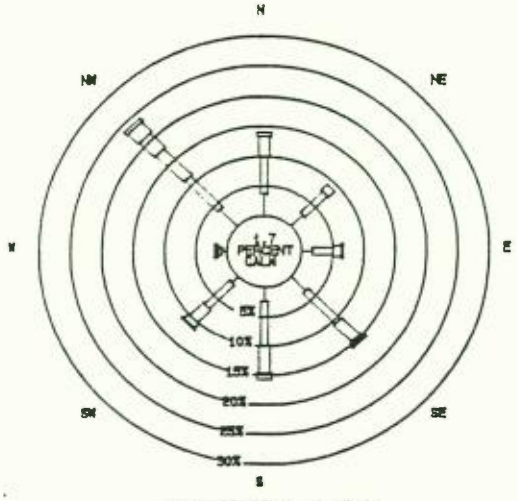
Data recorded at 3pm shows a similar pattern to that for the morning, except south-easterly winds are more common than north-westerly winds during autumn.



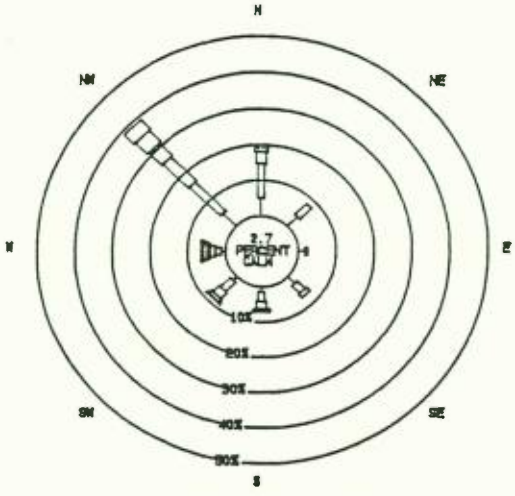
LOCATION OF

METEOROLOGICAL STATIONS

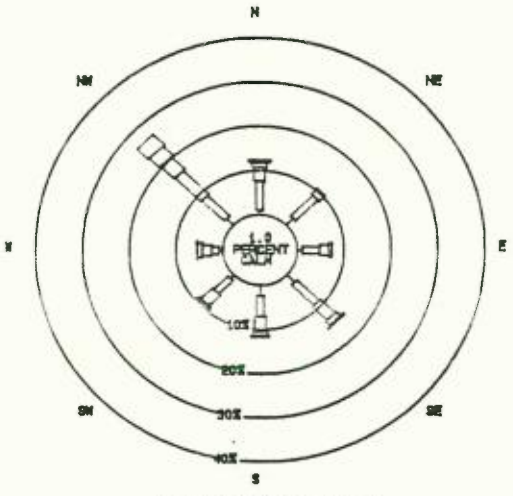
Figure 4.3.1



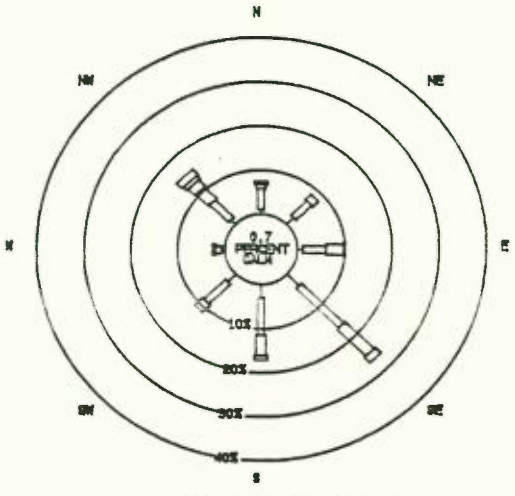
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
AUTUMN - 9AM



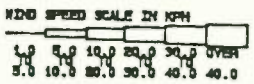
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
WINTER - 9AM

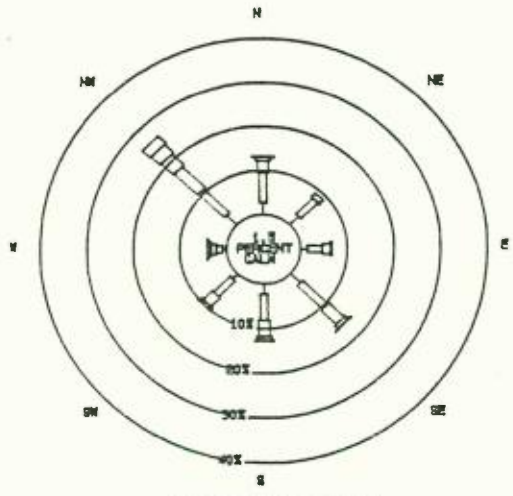


DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
SPRING - 9AM



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
SUMMER - 9AM





DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
ANNUAL - 9AM

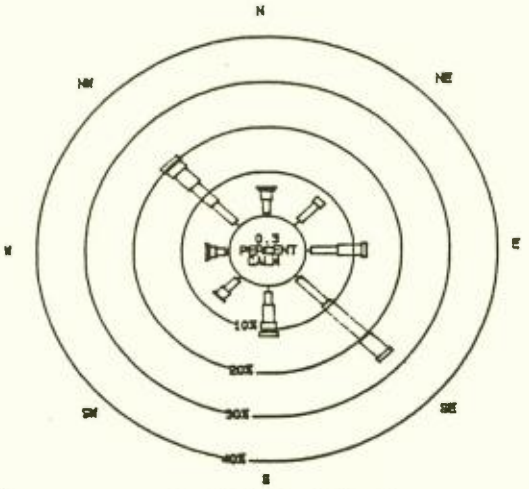
BELLBIRD

ANNUAL & SEASONAL

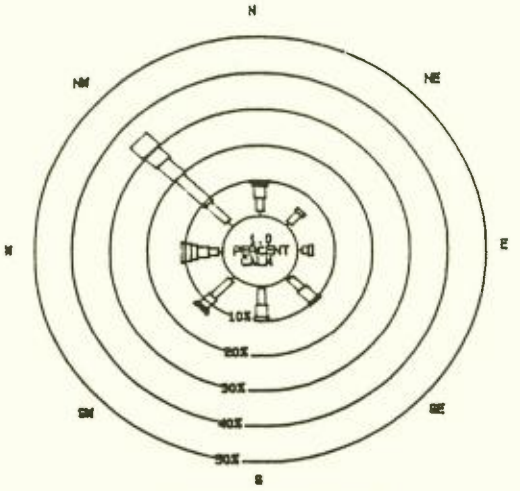
WIND ROSES

9AM

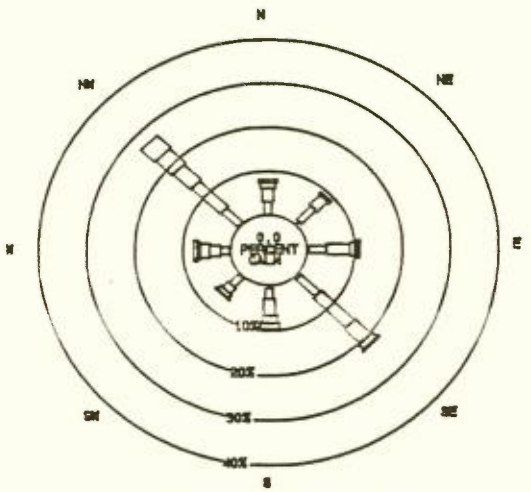
Figure 4.3.2A



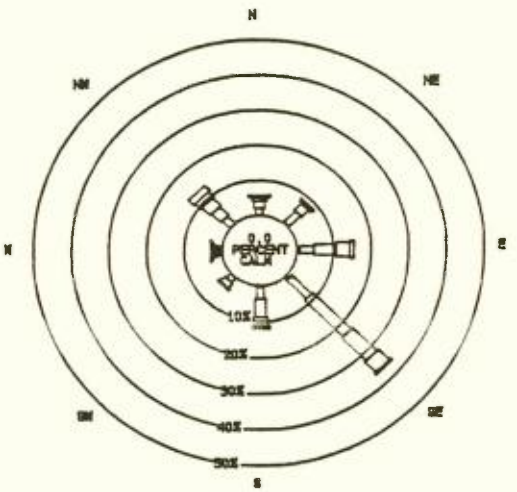
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
AUTUMN - 3PM



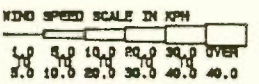
DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
WINTER - 3PM

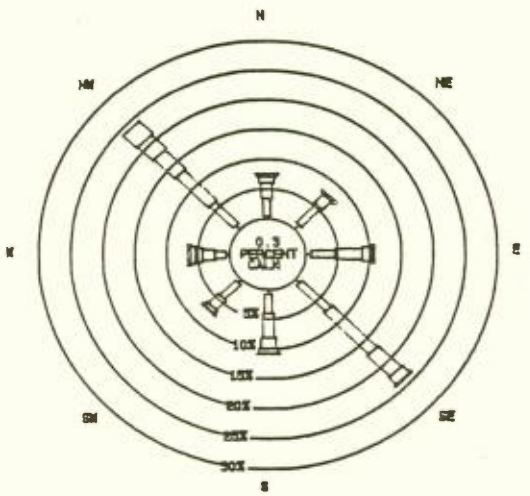


DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
SPRING - 3PM



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
SUMMER - 3PM





DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
ANNUAL - 3PM

BELLBIRD

ANNUAL & SEASONAL

WIND ROSES

3PM

Figure 4.3.2B

The annual wind roses indicate that throughout the year most winds occur from the north-west during the morning, and from both the north-west and the south-west during the afternoon.

On the whole, wind speeds recorded from the north-west tend to be higher than those from the south-east. The opposite is true during the summer months.

TABLE 4.3.1

RAINFALL (MM)

Mean Rainfall	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Year**
Cessnock Post Office	78	85	74	64	57	61	49	43	43	55	56	81	746
Cessnock Aerodrome	88	101	77	45	30	33	11	45	45	57	72	84	688
Site	101	41	85	58	37	27	35	24	40	77	123	40	687
No. of Raindays	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Year**
Cessnock Post Office	7	8	8	7	6	7	6	6	6	7	7	8	83
Cessnock Aerodrome	14	12	11	7	10	5	3	8	7	11	10	12	110

TABLE 4.3.2

TEMPERATURE (°C)

Post Office	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Mean Daily Temp	26.4	26.4	24.8	21.7	16.6	14.4	13.2	15.0	19.0	21.4	24.8	25.5
Mean Daily Min Temp	17.1	17.4	15.8	12.4	7.2	6.7	4.3	5.6	8.7	11.4	13.5	15.7
Mean Daily Max Temp	30.6	30.9	29.2	26.0	21.2	18.8	17.7	19.4	23.3	25.0	28.9	29.6
Average Range	13.5	13.5	13.4	13.6	14.0	12.1	13.4	13.8	14.6	13.6	15.4	13.9
Aerodrome	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Mean Daily Temp	26.2	24.8	23.8	20.9	16.6	13.5	12.8	15.7	17.1	21.2	22.4	24.5
Mean Daily Min Temp	15.7	15.7	12.4	9.3	6.9	4.2	1.9	5.1	5.7	9.1	12.1	13.3
Mean Daily Max Temp	29.7	28.0	27.5	24.3	20.3	17.9	17.4	19.4	21.3	25.4	25.5	29.1
Average Range	14.0	12.3	15.1	15.0	13.4	13.7	15.5	14.3	15.6	16.3	13.4	15.8

TABLE 4.3.3

HUMIDITY (%)

	J	F	M	A	M	J	J	A	S	O	N	D	Year
Relative Humidity													
9am	58	66	66	70	77	81	74	72	67	62	53	60	67
3pm	44	47	44	46	49	56	52	47	48	47	41	44	47

TABLE 4.3.4

EVAPORATION (MM)

J	F	M	A	M	J	J	A	S	O	N	D	Year
182.9	145.6	127.1	93.0	65.1	51.0	62.0	86.8	114.0	133.3	165.0	201.5	1,427.3

4.3.2 Air Quality

As the mine will be developed underground, air quality impact will be minor and the only environmentally significant sources of dust will be those associated with the surface facilities. Surface facilities will comprise conveyors, stockpiles, waste disposal area, coal preparation plant and rail loading facilities. For the purposes of impact assessment, attention has been focused on the impact associated with the final stage of development, that is, from Year 7 onwards. This is the period when dust generation will reflect maximum levels of coal production.

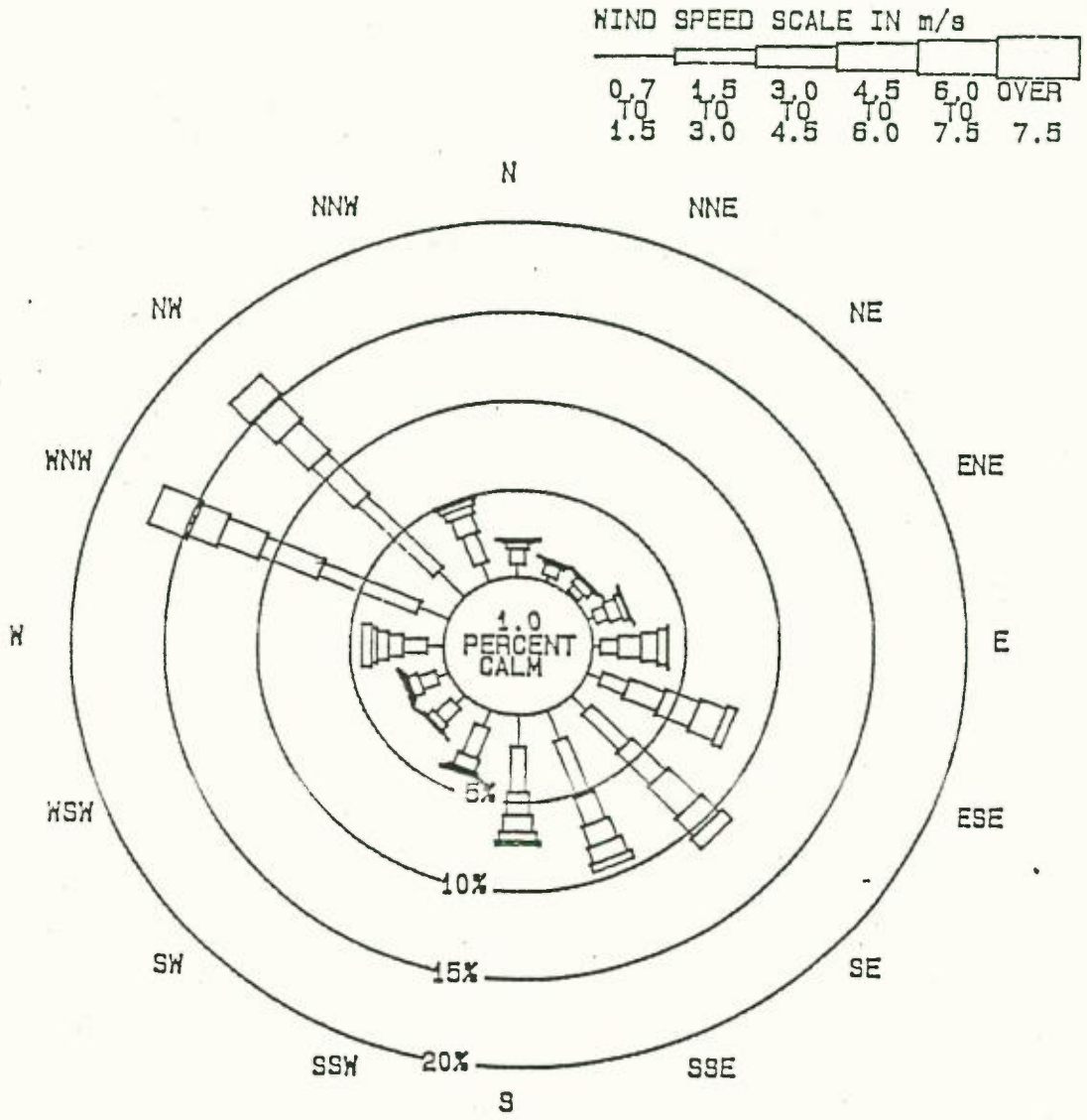
Meteorological data

To estimate the dispersion of dust from the area, information on hourly wind speed and direction is necessary. The Bureau of Meteorology data utilised in Figures 4.3.2 A and B is not suitable for this purpose as readings are only taken twice per day (9am and 3pm).

For this reason wind data from Lochinvar have been processed and converted to a form suitable for use as input to the dust dispersion model. Figure 4.3.3 is a windrose diagram for the Lochinvar data, showing the distribution of wind speed and direction. The patterns of winds which apply for the Lochinvar data set shows a predominance of north-westerly and south-easterly winds. This pattern is similar to that which applies for Nulkaba (Section 4.3.1).

Rainfall data, which are also required for estimating dust impacts, have been taken from the data collected at Cessnock Aerodrome (Section 4.3.1.).

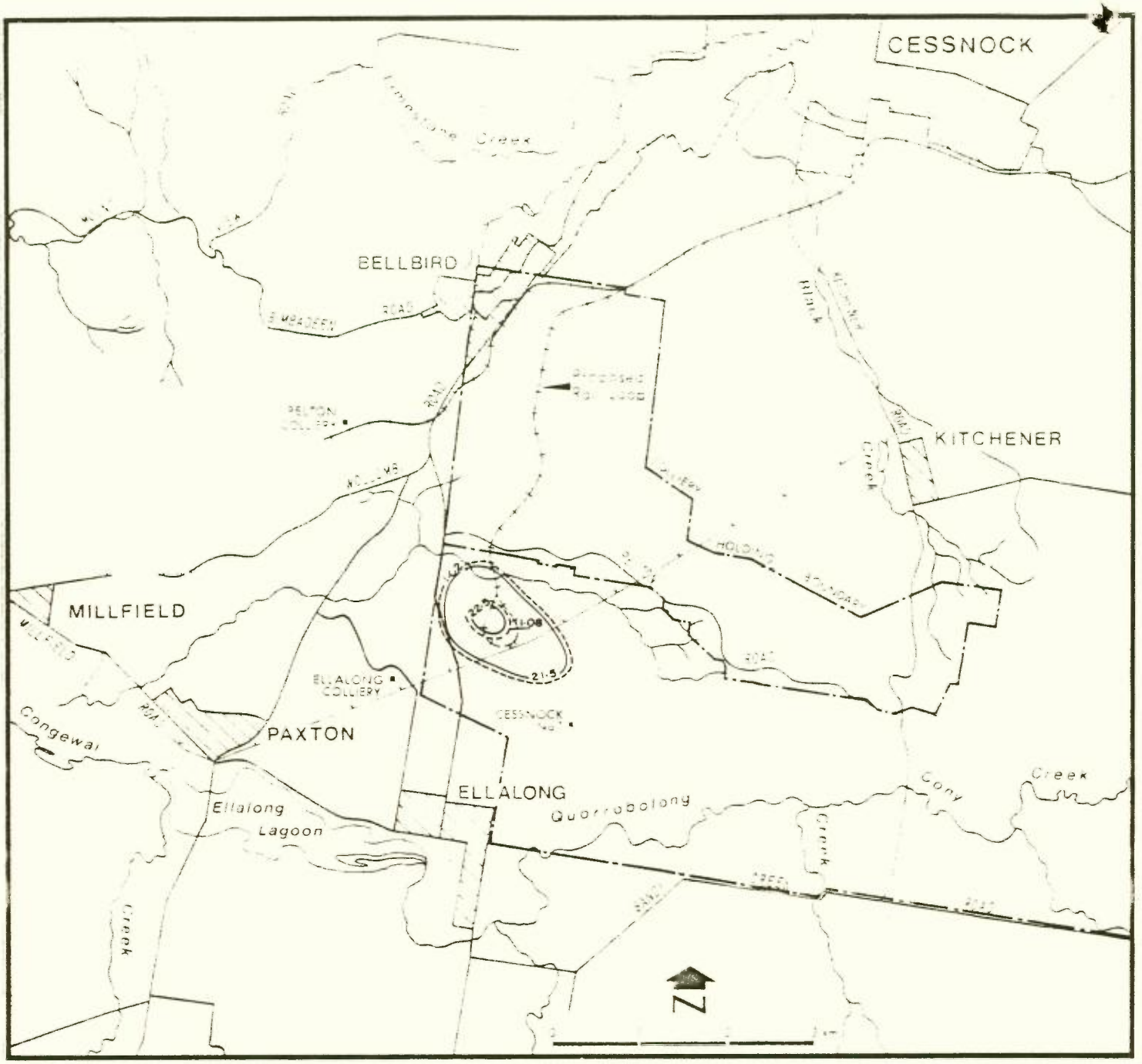
Local confirmation of meteorological data is to be monitored in an ongoing programme. To date only one sample from a single gauge is available (Figure 4.3.4). This result indicates that a background fallout level of approximately $1gm^{-2}month^{-1}$ applies for the area. While a single monthly measurement of dust fallout is of little value in determining representative fallout levels for the area, it is significant that a value of $1gm^{-2}month^{-1}$ is typical of background fallout levels which prevail in areas of the Hunter Valley which are remote from specific sources of dust, such as ploughed fields, unsealed roads or open cut mines. A value of $1gm^{-2}month^{-1}$ has been added to the predicted dust fallout levels to account for fallout from existing sources.



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
WIND DATA FOR LOCHINVAR 1980 (ALL HOURS)

WIND DATA FOR LOCHINVAR

Figure 4.3.3



LEGEND

_ _ _ _ _ _ _ PREDICTED ANNUAL AVERAGE DUST CONCENTRATION FOR YEAR 7 ONWARDS (ugm^{-3})

_____ PREDICTED ANNUAL AVERAGE DUST FALLOUT FOR YEAR 7 ONWARDS (gm^{-2} $month^{-1}$)

SOUTHLAND COAL PTY LIMITED

BELLBIRD SOUTH PROJECT

PREDICTED DUST CONCENTRATION AND DUST FALLOUT LEVELS

FIGURE 4. 3. 4.

TABLE 4.3.5

DUST EMISSIONS INVENTORY

BELLBIRD UNDERGROUND MINE YEAR-7

Source Description and Total Dust Emission per Year (after controls)	Emission Factor	Emission Factor Reference 1	Location Co-Ordinates 2 X	Y	Total Source Strength 3	Fine Particulates g/s	Inhalable Particulates g/s	Coarse Particulates g/s	Comments
ROM Storage pile Wind erosion and storage Pile Load-in 1.6t/yr	0.035 g/s/ha 0.5g/t	G.C. Howroyd	42,490 42,467	59,080 59,150	0.05	0.002	0.028	0.02	Estimated stockpile area = 0.684ha. 7% material silt content. 255 dry days per year. Frequency of occurrence of mean wind speed greater than 5.3m/s = 19%
Washed coal Storage pile Wind erosion and storage Pile load-in 2.2t/yr	0.035 g/s/ha 0.5g/t	G.C. Howroyd	42,597 42,570 42,550	59,040 59,120 59,200	0.072	0.0015	0.0447	0.0258	Estimated stockpile area = 1.539ha 7% material silt content. 255 dry days per year Frequency of occurrence of mean wind speeds greater than 5.3m/s = 19% Moisture content = 5%
Rail bin loading facility 0.2t/yr	0.5g/t	G.C. Howroyd	42,627	58,840	0.006	0.0002	0.003	0.0028	Estimates based on G.C. Howroyd's Overload Trestle Dumper
Reject storage pile Wind erosion 0.2t/yr	0.035 g/s/ha	G.C. Howroyd	42,550	58,880	0.006	0	0.004	0.002	Estimated stockpile area = 0.16ha. 7% material silt content. 255 dry days per year. Frequency of occurrence of mean wind speeds greater than 5.3m/s = 19% Moisture content = 5%.

1. G.C. Howroyd, (1984)
2. Grid: Australian Map Grid (U.T.N.) in 6° zones.
3. Dust control efficiency assumed to be 75% for all sources.

As dust concentrations in the area have not yet been consistemtly monitored, to account for existing background concentrations a level of 20μgm^{-3} has been assumed. Again this arbitrary figure is typical of areas in the Hunter Valley remote from specific sources.

Emissions Inventory

In order to estimate dust concentrations and fallout levels in the vicinity of the mine, it is necessary to estimate dust emission rates from specific operations and sources (eg. stockpiles) that are associated with the surface operations. This has been done by analysing the surface operations from Year 7 onwards. Year 7 has been selected because it represents the period of maximum development of the mine.

The calculated emissions inventory is presented in Table 4.3.5 which also lists references and provides explanatory comments describing how the emissions were estimated.

Criteria for Dust Fallout

Acceptable dust deposition levels are difficult to specify, and the level of dust deposition at which people begin to complain probably depends on objective factors (such as the nature of the dust and the deposition rate) which can be quantified, and on subjective factors (such as previous exposure to dust, attitude to the source of the dust and other psychological factors) which are more difficult to incorporate into an air quality criterion.

The SPCC (SPCC, 1983) provide a summary of current and past dust fallout standards in the United States. This summary is reproduced in Appendix 4.

Based on local Australian experience and the international criteria presented in Appendix 4 the SPCC has adopted as an interim criterion a fallout rate of 4$gm^{-2}month^{-1}$ (annual average), as the fallout rate for insoluble solids, above which it is considered that members of the public will begin to complain. The SPCC consider that amenity will probably have deteriorated to a totally unacceptable degree when the annual average fallout rate reaches 10$gm^{-2}month^{-1}$.

Criteria for Ambient Concentrations

Measures of particulate concentrations are also used as indicators of both health and nuisance effects.

The United States Environment Protection Agency presently suggest an annual average concentration of 75μgm^{-3} (geometric mean) as the primary standard to protect public health, and 60μgm^{-3} (geometric mean) as a secondary standard to protect public welfare (that is to protect the public against nuisance effects).

The Victorian Environment Protection Authority has adopted a 1 hour acceptable level which requires that visibility should not be less than 20km on more than 3 days per year. This is approximately equivalent to a concentration of 100μgm^{-3} for relative humidities of less than 70%.

The National Health and Medical Research Council of Australia recommend a maximum permissible annual average concentration of total suspended particulate (TSP) matter in urban environments of 90μgm^{-3}.

4.3.3 Impact Assessment – Air Quality

The predicted dust concentration based on the model described in Appendix 4 and the dust fallout levels for Year 7 are presented in Figure 4.3.4. The concentration predictions include an allowance of 20μgm^{-3} to account for existing dust from remote sources.

The predicted deposition levels have had 1$gm^{-2}month^{-1}$ added to them to account for background dust fallout.

It is clear from a comparison of the predicted concentrations and air quality criteria that no impacts due to dust concentration will occur at any residence in the neighbourhood of the mine.

It is also clear that no residential areas will experience dust fallout levels close to $4gm^2month^{-1}$. Thus no adverse impacts are expected as a result of dust emissions from the Project.

4.4 Acoustics

Richard Heggie Associates Pty Ltd conducted a study of the potential noise impact of the proposed operation on nearby premises, to determine the most practical and economical means of noise control.

Noise surveys were carried out in April 1987, to clearly establish the existing noise environment in the areas around the proposed operations. The details of these surveys, including instrumentation and procedures, are contained in Appendix 5.

The principal noise generators at the proposed mine will be the coal preparation plant and large mobile equipment. Both of these sources can be controlled and modified if necessary.

Closest residences are 760m from the operations and 160m from the proposed new rail line.

4.4.1 The Existing Acoustic Environment

Background Noise

Background noise monitoring positions representing individual residences or residential areas are labelled BG1, BG2, BG3 and BG4 on Figure 4.4.1.

Positions BG1 and BG2 are adjacent to the closest residences to the proposed operation, in Ellalong and Pelton respectively. Positions BG3 and BG4 are adjacent to individual residences in the direction from the Rail Loop Site, of Bellbird and Cessnock respectively.

The minimum noise levels measured during weekday day time (7am to 10pm) and night time (10pm to 7am) are listed in Table 4.4.1.

TABLE 4.4.1

BACKGROUND NOISE LEVEL

Monitoring Position	Background Noise Level (L90) Day	Night
BG1	29dBA	29dBA
BG2	32dBA	30dBA
BG3	31dBA	25dBA
BG4	24dBA	20dBA

For noise impact assessment purposes however, Chapter 19-2 of the SPCC Noise Manual states that "Where the existing background noise level at the receptor is less than 30dBA, as may occur in a quiet suburban or rural area, then 30dBA should be assumed to be the existing background noise level."

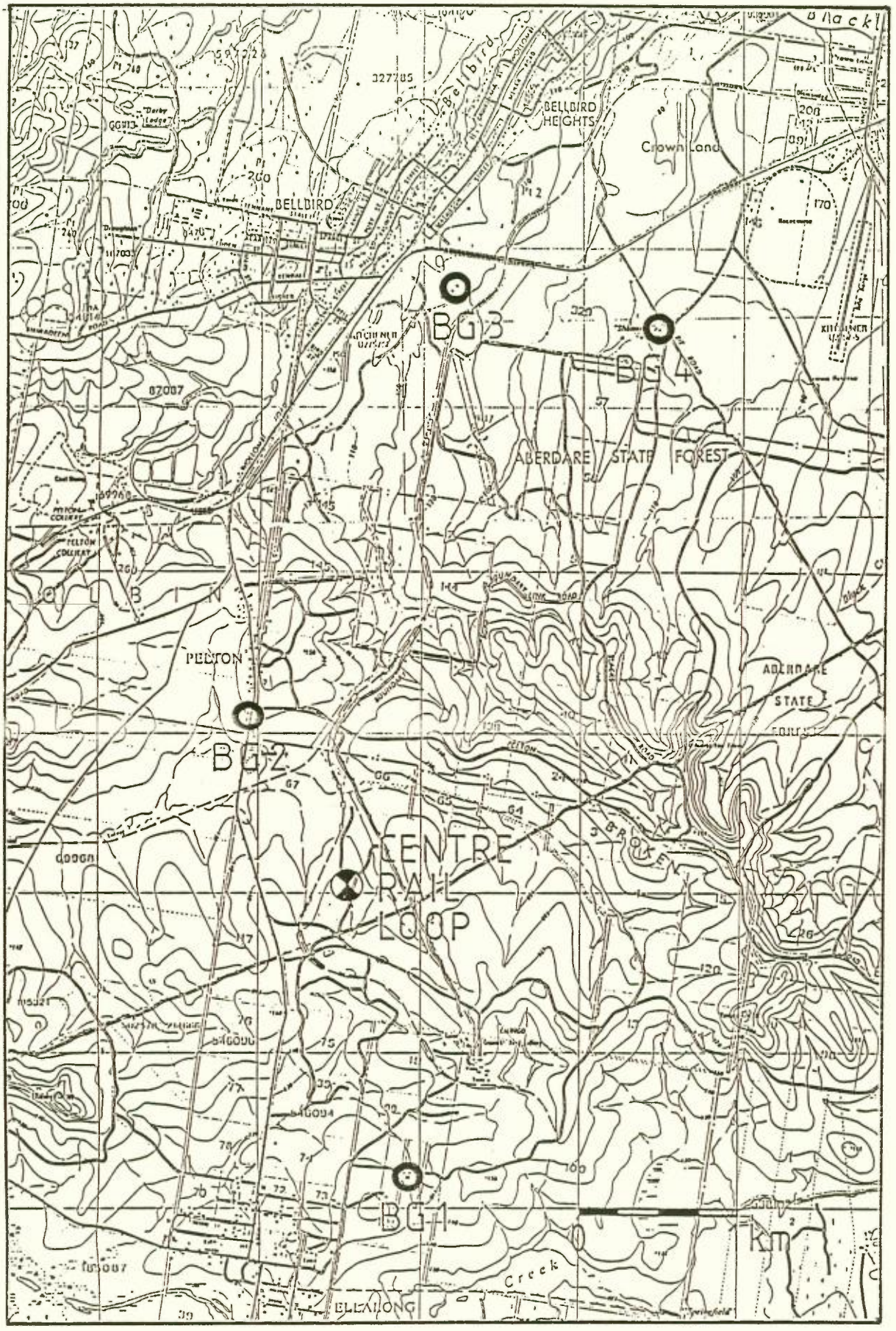


Figure 4.4.1 Acoustic Monitoring Stations

Major Noise Sources

A comprehensive survey was conducted of the noise emission levels from items similar to those proposed for the Bellbird South Project. The octave band and linear sound power levels of the major noise sources, monitored at Pelton and Ellalong Collieries are listed in Section 4 of Appendix 5.

The plant noise sources were considered as 5 distinct areas for assessment purposes.

- The Rail Loop Site (coal processing and handling);[5]
- The Pit Top Site (man access and ventilation);
- The drift portal (coal belt conveyor and trolley haulage);
- The rejects dump; and
- The coal train line.

4.4.2 Criteria for Acoustic Assessment

General Criteria

In implementing its environmental noise control policy, the SPCC has two broad objectives:

(i) that noise from any single source does not intrude greatly above the prevailing background noise level, and

(ii) that the background noise level does not exceed the level appropriate for the particular locality and land use.

In order to limit the potential offensiveness of noise from a specific source, any increase in the background noise level should generally not exceed 5dBA. For this purpose, the increase is determined as the difference between the L10 value at the receptor with the intrusive noise occurring and the L90 value determined in its absence.

The residences or residential areas around the proposed site potentially most affected by the noise of the proposed operations, are represented by monitoring positions BG1, BG2, B3 and BG4, as shown in the location map, Figure 4.4.1.

Criteria for Rural Areas

In relatively undeveloped rural areas, the existing background levels can be quite low. When development is permitted to proceed in such areas (for example, in view of its social worth or as a result of government decisions on resource use and infrastructure development), the land use designation may change, and there will often be a change in the noise climate.

To assist in balancing the individual and community effects and benefits arising from such situations, the SPCC has drafted a schedule of recommended background noise levels for various land use categories. An extract from the schedule relating to the two most stringent classifications appears below in Table 4.4.2.

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[5]The noise level from the combined coal processing and handling plant (Item 14, Section 4, Appendix 4) comprised contributions from the:

- enclosed coal pre-treatment plant (item 4)
- rotary breaker and scalping screen (item 5)
- new coal stacker and feed conveyor (item 7)
- preparation plant surge bin and vibrating feeder (item 9)
- rejects bin (item 12).

The noise level emitted from the combined coal processing and handling plant was measured during normal operations at Pelton Colliery. Similar plant is proposed for the Bellbird South Project.
Several items of coal processing and handling plant additional to those used at Pelton are also proposed for operations within the rail loop at Bellbird South. The noise emission from these items were individually added to the noise level predictions programme.
The combined processing plant noise level also includes the contribution from the coal washing plant as this operation is in close proximity to the measurement site.

TABLE 4.4.2

RECOMMENDED BACKGROUND LEVELS AT RESIDENCES

Zoning Description	Time Period (*)	Recommended Limit - L90 Acceptable	Maximum
Residences in Rural Areas	Day	45dBA	50dBA
	Night	35dBA	40dBA
Residences Near Industrial Areas	Day	50dBA	55dBA
	Night	40dBA	45dBA

(*) For Monday to Saturday, "day" is defined as 7.00am to 10.00pm

The average minimum background noise levels to be used for noise impact assessment purposes, based on lowest measured levels, are 30dBA at all receptors during night time operations, 30dBA at receptors BG1 and BG4 during day time operations, and 32dBA and 31dBA at receptors BG2 and BG3 respectively during day time operations. The "Acceptable Limits" recommended by the SPCC for Residences in Rural Areas for day time operation is 45dBA ("Maximum Limit" of 50dBA), and 35dBA for night time operation ("Maximum Limit" of 40dBA).

The SPCC's overall objective is for background noise levels not to exceed the specified "acceptable limit". Where the recommended "acceptable" level is not achievable (for technical or economic reasons), then the lowest level achievable may be permitted, provided the resultant noise levels at the receptors do not exceed the relevant "maximum" noise level limit.

Criteria for Rail Traffic

Noise criteria for measuring receptors at residences are recommended by the SPCC as a 24 hour L_{Aeq},T and as a maximum level, neither of which should be exceeded.

Planning Levels

L_{Aeq},24hr = 55dBA[6]
L_{Amax} = 80dBA

Maximum Levels

L_{Aeq},24hr = 60dBA
L_{Amax} = 85dBA

[6]The general formula for L_{Aeq},24hr becomes:

$$L_{Aeq,24hr} = L_{Aeq(T)} + 10 \log \frac{24 \times 60 \times 60 \text{ secs}}{T \text{ seconds}}$$

where T = measurement period of the train pass-by
and N = number of train pass-bys (inbound and outbound) in 24 hour period.

4.4.3 The Predicted Acoustic Environment

Coal Processing/Surface Handling Plant and Mobile Equipment

Calculations were performed to predict the noise level contributions at the potentially most affected residences and residential areas. Included in these calculations were the effects of distance attenuation and, where applicable, topographical barriers.

The source noise levels used in the prediction calculations were those associated with the plant for Stage 2 of the proposed operation. Consequently the predicted noise level contributions are the maximum levels and will not occur until Year 6 of the Project.

Topographical barriers affect the noise emission from the operations within the Rail Loop Site to the receptors represented by position BG1 and BG4. Barrier effects to BG1 only were included in the calculations, as the distance from the Rail Loop Site to BG4 is considerable.

Attenuation due to molecular absorption and ground effects were also included in the calculations. The attenuation rates used are shown in Table 4.4.3.

TABLE 4.4.3

ATTENTUATION RATES

Frequency (Hz)	Excess Attenuation (dB per 100m)
31	0.1
63	0.2
125	0.3
250	0.4
500	0.6
1,000	1.0
2,000	1.7
4,000	3.5
8,000	5.8

The sound power levels of the major noise sources within the proposed operations are listed in Section 4 of Appendix 5.

The major noise level contributions from all major noise sources (except the coal trains), with the associated octave band and A-weighted sound pressure levels at the receivers, are summarised in Tables 4.4.4 and 4.4.5.

TABLE 4.4.4

DAY TIME OPERATIONS

Receiver	Contributing noise sources at receivers (within 10dB of total noise level)	Hz	Received noise level 31	63	125	250	500	1k	2k	A
BG1	Exhaust fans – No. 2 shaft, bulldozer/ loader – reject dump	dB	52	53	47	36	29	20	2	35
BG2	Combined surface coal processing and handling plant, coal reject handling front-end loader, ROM coal reclaimer	dB	57	52	48	41	34	23	7	37
BG3	Combined surface coal processing and handling plant, bulldozer/loader – reject dump	dB	45	38	31	18	3	0	0	17
BG4	Combined surface coal processing and handling plant, bulldozer/loader – reject dump	dB	44	38	30	17	2	0	0	17

TABLE 4.4.5

NIGHT TIME OPERATIONS

Receiver	Contributing noise sources at receivers (within 10 dB of total noise level)	Hz	Received noise level 31	63	125	250	500	1k	2k	A
BG1	Exhaust fans – No. 2 shaft, ROM coal belt conveyor	dB	50	52	46	35	25	18	1	33
BG2	Combined surface coal processing and handling plant, ROM reclaimer	dB	56	51	47	39	32	22	6	36
BG3	Combined surface coal processing and handling plant	dB	44	36	28	16	0	0	0	15
BG4	Combined surface coal processing and handling plant, exhaust fans – No. 2 shaft dump	dB	43	36	27	15	0	0	0	15

Coal Transport

The maximum octave band and linear sound power level of a measured loaded coal train pass-by is given in Item 15, Section 4 of Appendix 5. The corresponding L_{Aeq} sound level over a 3 minute period was 54dBA.

The distances from the near points of the rail line to the closest residences are shown in Table 4.4.6.

TABLE 4.4.6

DISTANCE BETWEEN CLOSEST RESIDENCES AND RAIL LINE

Receiver	Distance to rail line
BG1	1,640m
BG2	510m
BG3	160m
BG4	550m

This study is based on a maximum of 2 coal trains, of maximum capacity 1,700t entering and leaving the proposed mine site at any one time.

Using the formula for L_{Aeq} (at the beginning of Section 4.4.4), the noise levels resulting from coal trains at the closest residences are shown in Table 4.4.7.

TABLE 4.4.7

NOISE LEVELS FROM COAL TRAINS AT CLOSEST RESIDENCES

Receiver	Noise Level	
	L_{eq}(24 hours)	L_A (max)
BG1	13dBA	43dBA
BG2	23dBA	53dBA
BG3	33dBA	63dBA
BG4	22dBA	52dBA

4.4.4 Impact Assessment – Acoustic Environment

The monitoring points and their distance from the closest sources of significant noise contribution, are presented in Table 4.4.8.

The proposed surface operations are shielded from sight in all directions by dense tree cover. Similarly the rail link cannot be seen from residences in Pelton or Ellalong.

There are also topographical barriers between the coal preparation/surface handling plant within the rail loop and positions BG1 and BG4, as shown in the topographical cross-sections of Figures 4.4.2 (A) and (B).

The noise level contributions during full capacity day time and night time operations of the proposed mine, are summarised in Table 4.4.9. Also shown are the corresponding design goal and background noise levels used for assessment purposes.

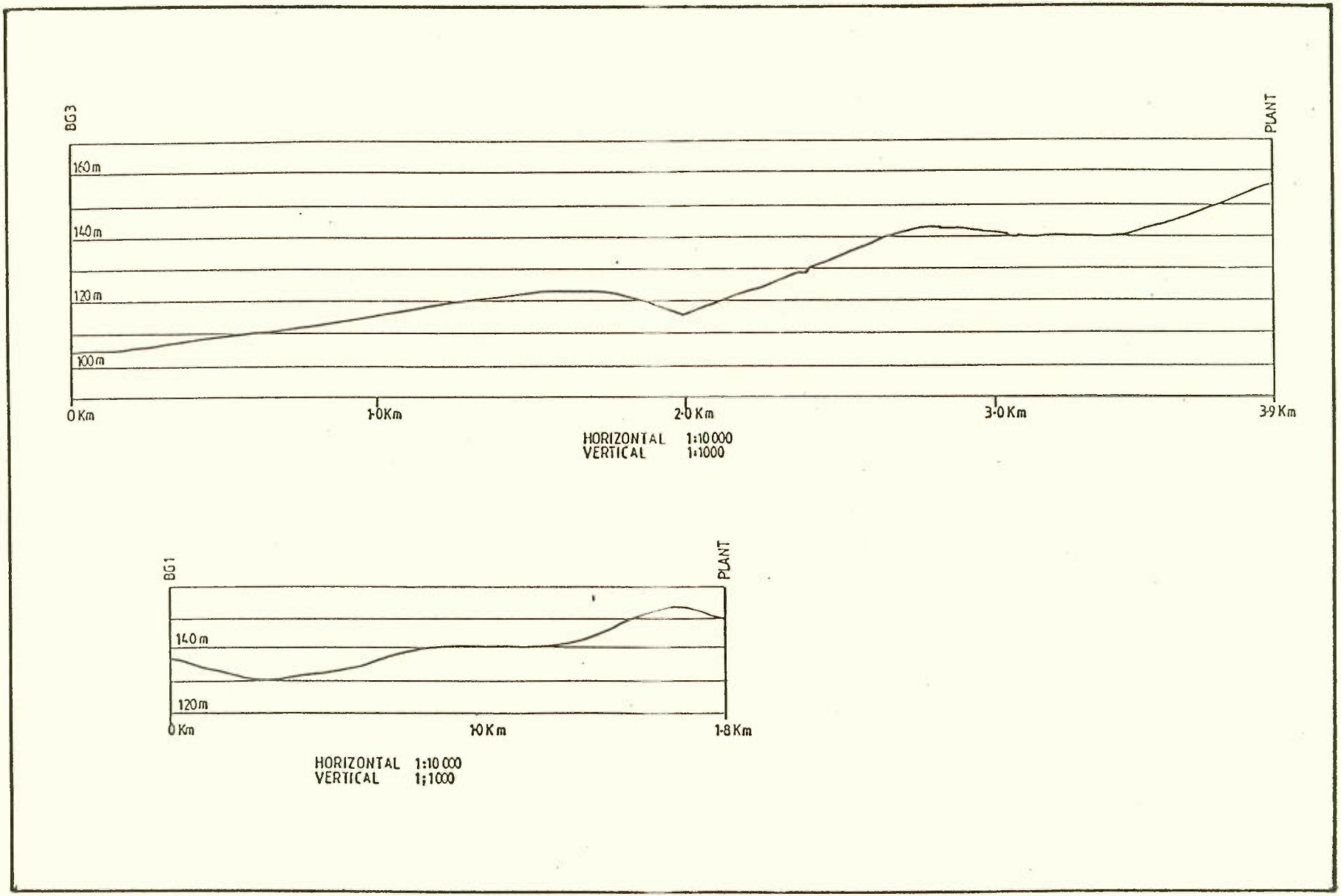


Figure 4.4.2A Topographical Cross-sections

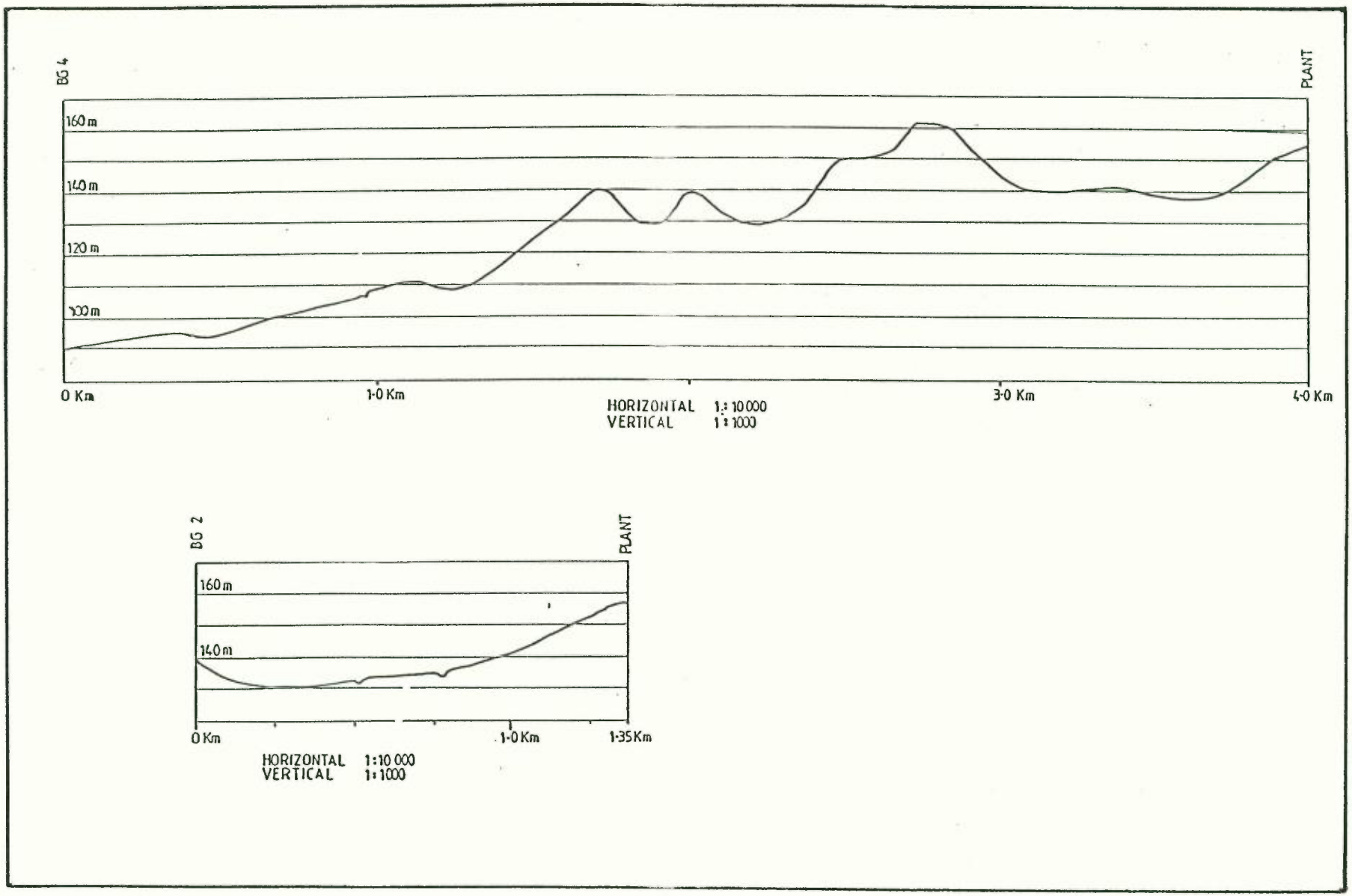


Figure 4.4.2B Topographical Cross-sections

TABLE 4.4.8

CLOSEST RESIDENCES TO THE PROPOSED OPERATIONS

Position	Operation	Distance
BG1	Mine Ventilation Fans	830m
BG1	Rail Loop – Coal Preparation and Surface Handling	1,860m
BG1	Man Access – Friction Winder	760m
BG2	Rail Loop – Coal Preparation and Surface Handling	1,180m
BG2	Coal Transport Rail Line (near point)	510m
BG3	Coal Transport Rail Line (near point)	160m
BG4	Coal Transport Rail Line (near point)	550m

TABLE 4.4.9

PREDICTED NOISE LEVELS

Receiver	Noise Source	Noise Level (dBA) Received Day	Received Night	Design Goal Day	Design Goal Night	Background Day	Background Night
BG1	Exhaust fans, mobile and fixed coal transport plant	35	33	45	35	30	30
BG2	Processing and surface handling plant, mobile equipment	37	36	45	35	32	30
BG3	Processing and surface handling plant, mobile equipment	17	15	45	35	31	30
BG4	Processing and surface handling plant, mobile equipment, exhaust fans	17	15	45	35	30	30

		Received Leq(24hrs)	Received LA(max)	Design Goal Leq(24hrs)	Design Goal LA(max)
BG1	Coal trains	13	43	55	80
BG2	Coal trains	23	53	55	80
BG3	Coal trains	33	63	55	80
BG4	Coal trains	22	52	55	80

The predicted noise level contributions from the proposed operations at all the nearby residences, except those represented by monitoring positions BG2, clearly comply with the noise level design goal.

The predicted night time noise level contribution from the processing and surface handling plant and mobile equipment at position BG2, on the Wollombi Road south of Pelton, is 36dBA. This exceeds the night time design goal by 1dBA.

Attenuation due to:

- the barrier effects of the stockpiles, and
- acoustical screening around the proposed site and alongside much of the rail transport lines by dense tree cover, were not accounted for in the received noise level predictions. It is anticipated that the extra attenuation provided by them is likely to reduce the predicted noise level contributions to below the design goals.

The nearby residences and township near the proposed Bellbird South Coal Project have been long associated with coal mining. Noise emitted by the proposed coal processing and handling operations will generally be inaudible at most locations. During periods of very low night time background noise levels and/or adverse weather conditions, noise from the operations may become audible. Even under these infrequent conditions, no adverse effects are anticipated on the acoustic amenity of the nearby residences from noise emitted from the proposed operations.

The coal transport trains will be audible at positions BG3 and BG4. Occurrences will be less frequent than the coal trains on the nearby existing Pelton lines, and noise emission levels clearly comply with the SPCC's guidelines.

The residence at monitoring position BG1 is the closest residence in Ellalong to the proposed operations. The predicted major noise level contributors to the background noise at this position are the exhaust fans and bulldozer/loader by day and the exhaust fans and coal belt conveyor by night.

Considering the variation in the winter day time and night time background noise level measured at BG1 it is unlikely that the operations will be audible above the existing nearby mining operations and traffic noise from Wollombi Road. The majority of the residences in Ellalong are closer to these existing sources. Consequently the noise level at these residences from the proposed operations will be effectively masked.

The township of Pelton is represented by the residence at position BG2. This is the nearpoint to the rail loop and to the coal processing and surface handling plant. The other residences within the township are located further from the contributing noise sources associated with the proposed operations, but are closer to Wollombi Road and Pelton Colliery to the north-west. The proposed operations will be inaudible to the majority of the residences, and possibly only faintly audible to the nearer residences.

The potential effects of the noise impact from the Project on the residences within Bellbird South and Bellbird Heights are represented by assessments made at the residences at monitoring positions BG3 and BG4. The centre of the township of Bellbird is only 500m from BG3 and BG4 and is centrally located between Bellbird and Kitchener Road, the main Cessnock road. The existing colliery at Pelton is closer to the residences at BG3 and BG4 and to the township of Pelton, than the proposed project.

The distances of these residences from the proposed operations (and, in the case of BG4, the topographical barrier effects) attenuate noise from the coal processing and handling plant to a much lower level than that already existing.

The proposed project's coal transport rail line is located close to the residence at positions BG3, to the south-east. Due east of this residence the line will branch eastwards to join the existing rail line from Pelton Colliery. Coal trains on this line transport all the coal from Ellalong and Pelton Colliery after processing and washing at Pelton. Coal transport trains on this existing line pass within 200m and 510m of the residences at BG3 and BG4 respectively.

The coal transport trains from the proposed project will be of the same capacity as those presently using the existing rail line from Pelton. The impact of the coal trains from the proposed project on residences BG3 and BG4, will be equivalent to those from existing coal trains from Pelton Colliery and these clearly comply with SPCC guidelines.

4.5 Vegetation

A vegetation survey of the Project site and surrounding area was carried out in autumn 1987 (see Bartrim and Martin Biological Studies (1987)). Figure 4.5.1 depicts significant features of the area including Ellalong Lagoon and other significant aquatic areas.

4.5.1 Vegetation Communities and their Distribution

108 plant species have been recorded for the area and are listed in Table 4.5.1. Characteristics of the vegetation communities are presented in Table 4.5.2. These communities were distinguished by the species present in the dominant stratum. Figure 4.5.2 shows the distribution of the 7 communities over the area studied.

Most of the study area is covered by Communities 1, 3 and 4, which have been modified substantially by such activities as logging, clearing for railway and easement development, previous mining activities, grazing, frequent firing and dumping of car bodies. Community 1, (Spotted Gum/Ironbark Open-forest) is the most common. Community 3 (Cabbage Gum/Forest Red Gum Woodland/Open-forest) is associated with shallow gullies and watercourses, such as Quorrobolong Creek. Community 4 (Grey Gum/Rough-barked Apple Woodland/Open-forest) forms a broad transitional zone between the former two communities.

A Grey Box Open-forest (Community 5) enters the area from the south and, like the above communities, has been highly disturbed by logging and grazing.

Very little bushland remains in the south except in patches along Quorrobolong Creek (Community 3) and surrounding Ellalong Lagoon. The swamp communities associated with Ellalong Lagoon are good examples of wetland habitats. The lagoon is a semi-permanent fresh swamp (Community 7) fringing open fresh water. There are a number of distinct vegetation zones within this community (see Figure 4.5.2). The dominant vegetation type is reed bed dominated by E. sphacelata. The smaller lagoon near Cessnock No. 1 Pit Top is partially covered and narrowly fringed by similar vegetation to Ellalong Lagoon. The edges are heavily grazed by cattle.

A Swamp Oak Open/Closed-forest (Community 6) forms a fringe around Ellalong Lagoon particularly on the southern side. This community has also been affected by grazing.

Only two small patches of Community 2 (a Yellow Bloodwood Open-forest) were found in the area. This is not common in the Hunter Region.

Three protected plant species have been recorded in the area studied (see Table 4.5.2). *Adiantum aethiopicum* and *Caladenia alba* are present in Communities 3 and 4 respectively, while *Boronia polygalifolia* is common to both.

TABLE 4.5.1

PLANT SPECIES RECORDED IN THE BELLBIRD SOUTH AREA

Scientific Name	Common Name	Status
Adiantaceae Pteridophyta		
Adiantum aethiopicum L.	Common Maidenhair Fern	P
Cheilanthes sp.		
Azolla filiculoides	Azolla	
Dennstaedtiaceae		
Pteridium esculentum (Forst.f) Cockayne	Bracken	

Scientific Name	Common Name	Status
Salviniaceae		
* Salvinia molesta D.S. Mitchell	Salvinia	
Angiospermae		
Monocotyledonae		
Alismataceae		
# Alisma plantago-aquatica L.	Water Plantain	
Cyperaceae		
? Baumea juncea (R.Br.) Palla		
# Bolboschoenus fluviatilis Bsp	Marsh Clubrush	
# Cyperus exaltatus Retz	Lofty Sedge	
# C. odoratus L.	Scented Sedge	
C. L. sp.		
Eleocharis sphacelata R.Br.		
? Schoenoplectus validus	River Clubrush	
Hydrocharitaceae		
Ottelia ovalifolia (R.Br.) Rich	Swamp Lily	
Juncaceae		
# Juncus polyanthemus Buchen s. str.	Many-flowered Rush	
J. usitatus L.A.S. Johnson	Common Rush	
Juncaginaceae		
Triglochin procera R.Br.	Water Ribbons	
Liliaceae		
Tricoryne elatior R.Br.		
Najadaceae		
# Najas tenufolia R. Br.	Water Nymph	
Orchidaceae		
Caladenia alba R.Br.		
Poaceae		P
Cymbopogon refractus (R.Br) A. Camus	Barbwire Grass	
Cynodon dactylon (L.) Pers	Couch	
Echinopogon Beauv. Sp.	A Hedgehog Grass	
Entolasia Stapf sp.		
Eragrostis brownii Nees ex steud		
Imperata cylindrica Beauv. var. major (Nees) C.E. Hubbard	Blady Grass	
Phragmites australis (Cav.) Trin. ex Steud	Common Reed	
Stipa L. sp.		
Themeda australis (R.Br) Stapf	Kangaroo Grass	
Potamogetonaceae		
# Potamogeton tricarinatus F. Muell & A. Benn ex A. Benn	Floating Pondweed	

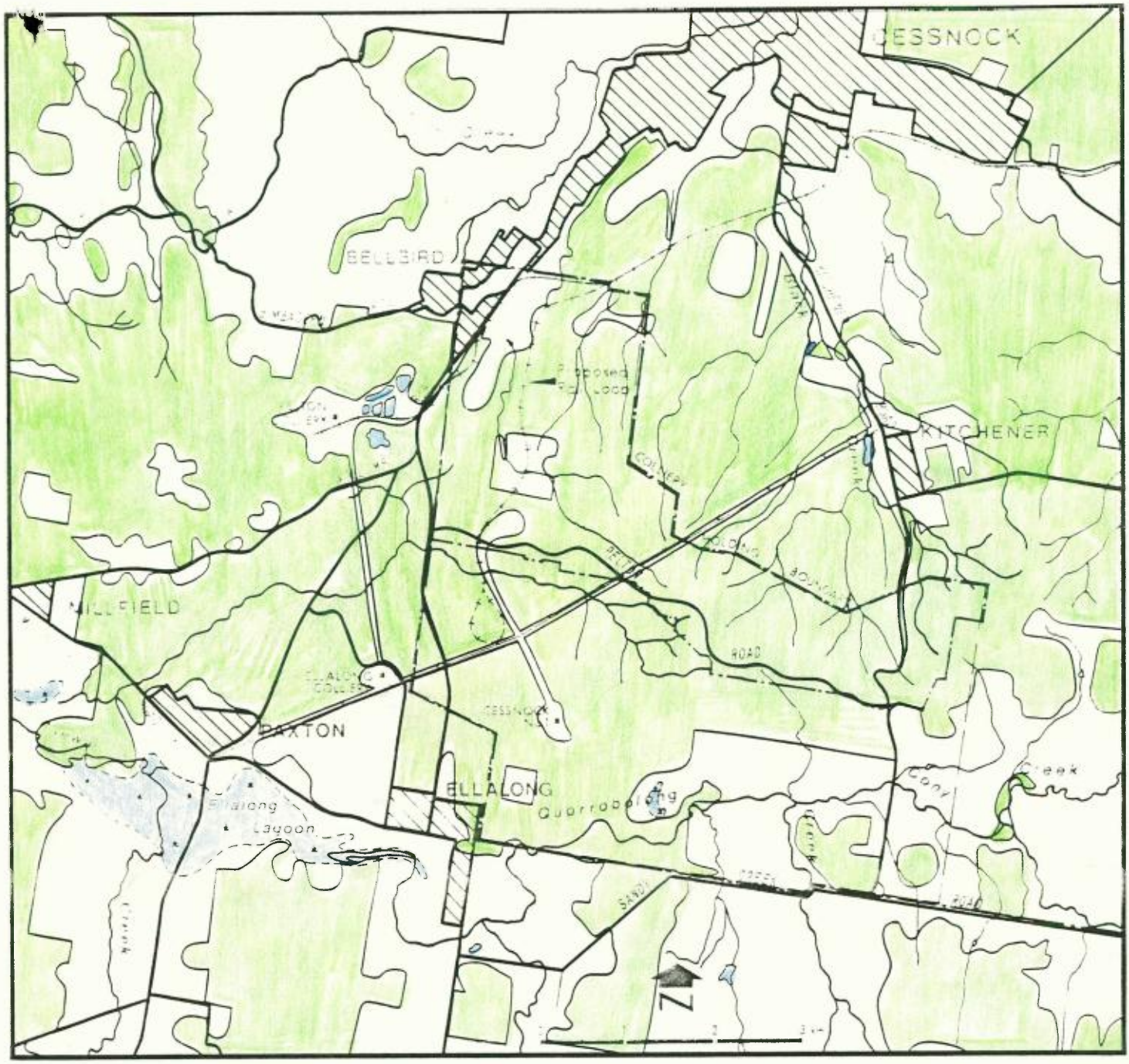
Scientific Name	Common Name	Status
Typhaceae		
# Typha orientalis C. Presl.	Broad-leaf Cumbungi	
Xanthorrhoeaceae		
Lomandra longifolia Labill		
Lomandra obliqua (Thunb.) Macbride		
Dicotyledonae		
Amaranthaceae		
Alternanthera denticulata R.Br.	Joyweed	
Aplaceae		
* Hydrocotyle bonariensis Lamk.		
Apocynaceae		
# Parsonsia straminea (R.Br.) F Muell	Common Silkpod	
Asteraceae		
Helichrysum apiculatum (Labill.) D. Don		
Helichrysum diosmifolium (Vent.) Sweet		
Olearia elliptica D.C.		
Senecio lautus Forst. f. ex Willd	Fireweed	
Celastraceae		
Maytenus silvestrus Lander & L.A.S. Johnson		
Campanulaceae		
Wahlenbergia Schrad. sp.		
Casuarinaceae		
Allocasuarina torulosa	Forest Oak	
Casuarina glauca Sieber ex Spreng	Swamp Oak	
Elatinaceae		
# Elatine gratioloides A. Cunn	Waterwort	
Epacridaceae		
Leucopogon R.Br. sp.		
Monotoca scoparia (Sm.) R.Br.		
Styphelia Soland ex Sm sp.		
Euphorbiaceae		
Phyllanthus thymoides Muell. Arg.		
Fabaceae		
Daviesia acicularis Sm. ulicifolia Andr.		
Desmodium Desv. sp.		
Dillwynia retorta (Wendl.) Druce	Eggs & Bacon	
Glycine clandestina Wendl.		
Hardenbergia violacea (Schneev.) Stearn		

Scientific Name	Common Name	Status
Indigofera australis Willd.	Native Indigo	
Jacksonia scopania R.Br	Dogwood	
Oxylobium ilicifolium (Andr.) Domin		
Pultenaea cunninghamii (Benth.) Williamson		
Hypericaceae		
Hypericum gramineum Forst. f.		
Lentibulariaceae		
# Utricularia exoleta R. Br.	Floating Bladderwort	
Lobeliaceae		
Pratia purpurascens (R.Br.) E. Wimmer		
Mimosaceae		
Acacia falcata Willd.		
Acacia myrtifolia (Sm.) Willd.		
Acacia parvipinnula Tindale		
Acacia terminalis (Salisb.) Macbride	Sunshine Wattle	
Acacia ulicifolia (Salisb.) Court	Prickly Moses	
Acacia Willd. sp.		
Myrtaceae		
Angophora floribunda (Sm.) Sweet	Rough-barked Apple	
? Callistemon linearis DC		
? Eucalyptus amplifolia Noudin	Cabbage Gum	
? Eucalyptus capitellata Sm.	Brown Stringybark	
Eucalyptus crebra F. Muell.	Narrow-leaved Ironbark	
Eucalyptus eximia Schauer	Yellow Bloodwood	
Eucalyptus fibrosa F. Muell.	Broad-leaved Ironbark	
Eucalyptus maculata Hook	Spotted Gum	
Eucalyptus moluccana Roxb	Grey Box	
Eucalyptus punctata DC	Grey Gum	
Eucalyptus tereticornis Sm.	Forest Red Gum	
Leptospermum attenuatum Sm.		
Leptospermum flavescens Sm. s. lat.	Common Tea Tree	
Leptospermum juniperinum Sm.		
* Melaleuca decora (Salisb) Britten		
Melaleuca linariifolia Sm.	Snow-in-summer	
Melaleuca nodosa (Soland ex Gaertn.) Sm.	Ball Honey-myrtle	
Melaleuca thymifolia Sm.		
Melaleuca L. sp.		
Syncarpia glomulifera (Sm.)Nied	Turpentine	
Onagraceae		
# Ludwigia peploides (Kunth) Raven	Water Primrose	

Scientific Name	Common Name	Status
Pittosporaceae		
Billardiera scandens Sm	Dumplings	
Bursaria spinosa Cav.	Blackthorn	
# Polygonum decipiens R.Br	Slender Knotweed	
# P. hydropiper L.	Water Pepper	
P. lapathifolium L.	Pale Knotweed	
# P. orientale L.	Prince's Feather	
# P. strigosum R.Br.	Spotted Knotweed	
Proteaceae		
Banksia spinulosa Sm	Hairpin Banksia	
Grevillea montana R. Br.		
Hakea sericea Schrad		
Isopogon anemonifolius (Salisb.) Knight	Drumsticks	
Persoonia linearis Andr.		
Ranunculaceae		
Clematis aristata R. Br. ex DC		
Ranunculus inundatus R. Br. ex DC		
* R. scleratus L.	Celery-leaf Buttercup	
Rosaceae		
* Rubus L sp	Blackberry	
Rubiaceae		
Pomax umbellata (Gaertn) Soland ex A. Rich		
Rutaceae		
Boronia polygalifolia Sm.		P
Santalaceae		
Exocarpus cupressiformis Labill.	Native Cherry	
Thymelaeaceae		
Pimelea linifolia Sm.	Rice Flower	
Verbenaceae		
* Lantana camara L.	Lantana	
Violaceae		
Viola hederacea Labill.	Ivy-leaved Violet	

NOTE: Nomenclature according to Jacobs and Pickard (1981) and Beadle et al (1982).

* Indicates an introduced species.
? Indicates a tentative identification.
Listed by Hunter Wetlands Trust (1987) &/or National Trust of Australia (1984)
Status: P – Protected species under National Parks & Wildlife Act (1974), Schedule 13.



LEGEND

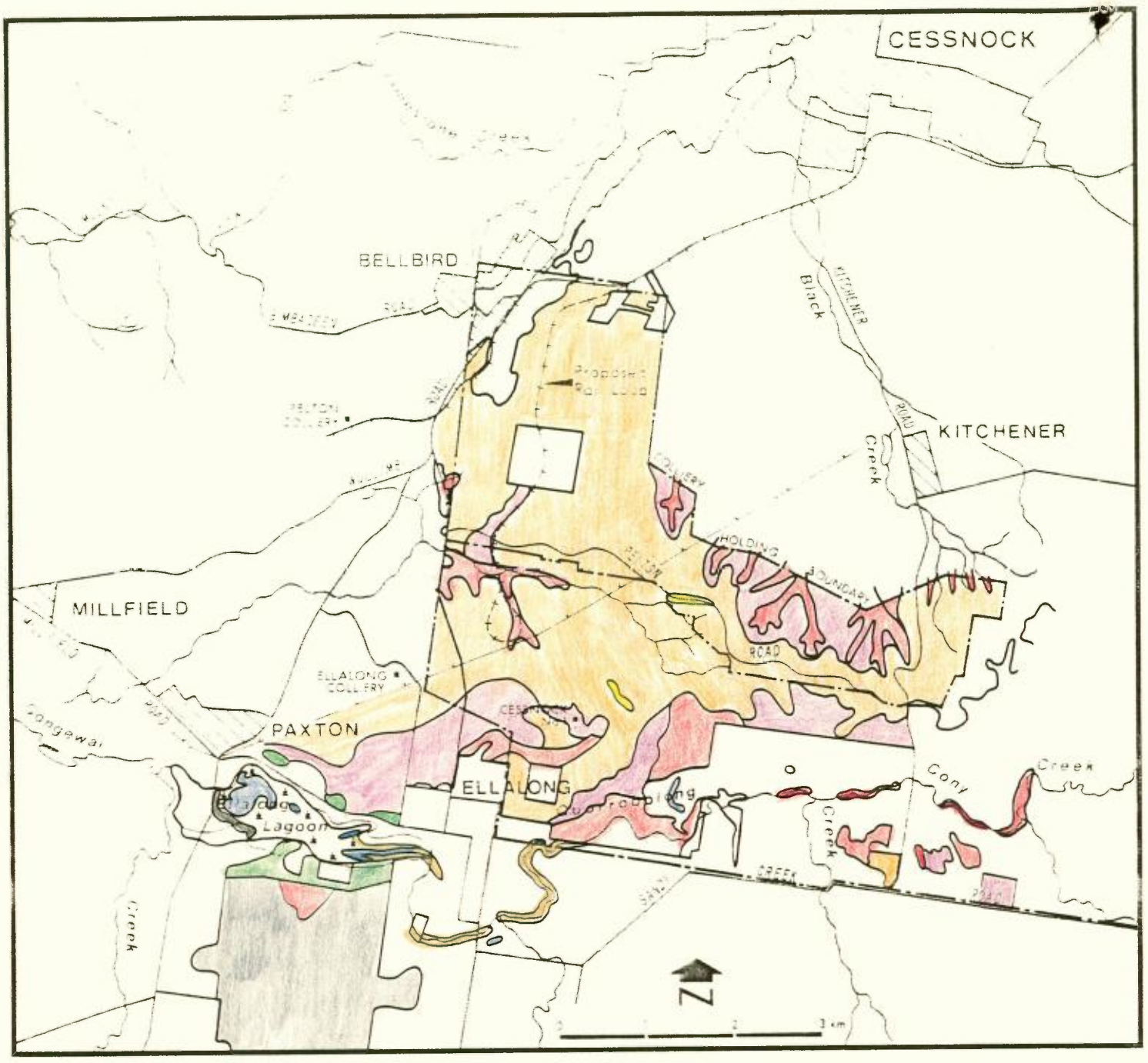
- Urban Area
- Forest Area
- Roads
- Drainage Course
- Lagoons / Dams
- Swampy Areas
- Site Boundary

SOUTHLAND COAL PTY LIMITED

BELLBIRD SOUTH PROJECT

BIOLOGICAL FEATURES OF THE STUDY AREA ENVIRONS

FIGURE 4 5. 1.



LEGEND

- Cleared Land
- Spotted Gum / Iron bark Open-forest
- Yellow Bloodwood Open-forest
- Cabbage Gum / Forest Red Gum Woodland / Open forest
- Grey Gum / Rough-barked Apple Woodland / Open forest
- Grey Box Open-forest
- Swamp Oak Open / Closed-forest
- Semi Permanent Freshwater Swamp
- Water Bodies
- Eleocharis-dominated Reed Beds
- Juncus Swamp
- Fresh Meadow / Pastureland

SOUTHLAND COAL PTY LIMITED

BELLBIRD SOUTH PROJECT

VEGETATION COMMUNITIES OCCURRING IN THE STUDY AREA

FIGURE 4. 5. 2.

TABLE 4.5.2 – VEGETATION COMMUNITIES IN THE BELLBIRD SOUTH AREA

Community	Habitat Type	Trees			Tall Shrubs/Small Trees			Low Shrubs			Herbs & Ground Cover			Comments
		Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	
1. Spotted Gum/ Ironbark Open-forest	Dry Sclerophyll Forest	Eucalyptus maculata E. fibrosa, Variable occurrence of E. capitellata, E crebra, E. punctata and Syncarpia glomulifera	13-20	50-80	Acacia falcata, A. parvipinnula, A. sp., Allocasuarina torulosa, Callistemon linearis, Helichrysum diosmifolium, Leptospermum attenuatum, Juvenile tree spp. Persoonia linearis In some gullies: Melaleuca nodosa, Melaleuca sieberi, A. parvipinnula	2-13 8 3-5	0-70 40 100	Acacia myrtifolia, A. ulicifolia, Daviesia ulicifolia Grevillea montana Hakea sericea, Persoonia linearis, Pimelea linifolia	1-2	10-80	Billardiera scandens, Cheilanthes sp., Clematis aristata, Entolasia sp., Eragrostis brownii Glycine clandestina, Hardenbergia violacea, Hibbertia vestita, Hypericum gramineum, Imperata cylindrica, Lepidosperma sp., Pomax umbellata, Tricoryne elatior, Wahlenbergia gracilis	<0.5	20	Highly disturbed over all parts of study area investigated
2. Yellow Bloodwood Open-forest		Eucalyptus eximia, Ironbark sp. E. punctata, Stringybark sp.	10-13	40	Acacia terminalis, Daviesia ulicifolia, Persoonia linearis, Juvenile tree spp.	≤3	20	Banksia spinulosa, Bossiaea, rhombifolia, Daviesia Dillwynia acicularis retorta, Grevillea montana, Hakea sericea, Isopogon anemonifolius, Monotoca scoparia, Oxylobium ilicifolium	0.5-1.5	10-60	Entolasia sp., Lomandra obliqua, Pomax umbellata, Xanthorrhoea sp.	<0.5	<10	On very rocky hillsides with skeletal soil

H – height
C – cover

Community	Habitat Type	Trees			Tall Shrubs/Small Trees			Low Shrubs			Herbs & Ground Cover			Comments
		Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	
3. Cabbage Gum/ Forest Red Gum Woodland/ Open-forest	Shallow gully/ Watercourse Vegetation	Eucalyptus amplifolia, (?) Angophora floribunda, Occasional Stringybark sp. E. punctata, Casuarina glauca In some sectors E. tereticornis appears to replace E. amplifolia.	<25	20-50	Casuarina glauca, Melaleuca linariifolia In some areas clumps of Acacia parvipinnula, Leptospermum attenuatum and Melaleuca nodosa occur with little tree stratum development Dense stands, of M. decora may be associated with the occurrence of E. tereticornis	10-15	20-60	Variable – may comprise: Melaleuca nodosa or Callistemon linearis, Jacksonia scoparia, Melaleuca thymifolia M.spp. or along Quorrobolong Creek: Acacia spp., Bursaria spinosa, Indigofera australis, Leptospermum flavescens, Rubus sp.	1-2 1-1.5 1-4	<5 <5 30-50	Boronia polygalifolia Cheilanthes sp., Desmodium sp., Entolasia sp., Helichrysum apiculatum, Pteridium esculentum, Stipa sp., Along Quorrobolong Creek: Adiantium aethiopicum, Lomandra longifolia and Viola hederacea are common. In sections of Quorrobolong Creek retaining water at the time of survey, species such as Potamageton tricarinatus, Ranunculus validus Triglochin procera were present	<1	50-90	

Community	Habitat Type	Trees			Tall Shrubs/Small Trees			Low Shrubs			Herbs & Ground Cover			Comments
		Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	
4. Grey Gum/ Rough-barked Apple, Woodland/ Open-forest	Dry Sclerophyll Forest (Transitional)	Eucalyptus punctata, Angophora floribunda Variable Occurrence of E. moluccana, E. amplifolia? Syncarpia glomulifera, and E. capitellata	17-25	20-70	Acacia parvipinnula, A.sp. Bursaria spinosa, Exocarpus cupressiformis, Leptospermum attenuatum, Melaleuca linariifolia, M. nodosa, Persoonia linearis	2-10	30-70	Acacia sp. A. ulicifolia, Banksia spinulosa, Bursaria spinosa, Grevillea montana, Hakea servicea, Leptospermum attenuatum, Melaleuca nodosa, Styphelia sp.	0-5-2	10-50	Billardiera scandens, Boronia polygalifolia, Caladenia alba, Cheilanthes sp. Desmodium sp., Helichrysum apiculatum, Pomax umbellata, Pratia purpurascens	<1	10-80	Great variation in under-storey speciation and cover indicative of transitional nature of community
5. Grey Box Open-forest		Eucalyptus moluccana, E. sp. Occasional E. punctata	<25	50	Acacia falcata A sp., Bursaria spinosa Juvenile eucalypts Occasional Melaleuca decora?	2-4 <10	10-50	Grevillea montana Helichrysum diosmifolium Leucopogon sp., Juvenile eucalypts	0.5-1.5	10	Cymbopogon refractus, Echinopogon sp., Eragrostis brownii Pomax umbellata, Pratia purpurascens, Stipa sp.	<0.5	40-50	Has been logged and grazed - little shrub understorey development
6. Swamp Oak Open/Closed-forest		Casuarina glauca, Melaleuca decora? Occasional Eucalyptus amplifolia? tereticornis	10-18	30-80	Melaleuca nodosa (in clumps) Casuarina glauca Occasional Bursaria spinosa	2-7	30-80				Cynodon dactylon other grass spp, Casuarina cladodes	<1	80	Regrowth of juvenile Casuarinas evident around edges grazed Forms fringe around Ellalong Lagoon predominantly on southern side

Community	Habitat Type	Trees			Tall Shrubs/Small Trees			Low Shrubs			Herbs & Ground Cover			Comments
		Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	Common Species	H (m)	C %	
7. Semi-permanent Freshwater Swamp	Semi-permanent Freshwater Swamp/Open Water	**1. Ellalong Swamp Lagoon**						Large expanses of Eleocharis sphacelata with patches of Phragmites australis, Typha orientalis	1.5 -2	50-70	In very damp but drying sectors around lagoon edges, the following species were present: Salvinia molesta (wettest areas), Alisma plantago-aquatica? Ranunculus scleratus Triglochin procera. Extending outward from this, was bare mud (c.1-3m wide), Juncus Swamp with J. usitatus and Polygonum lapath: folium and in some areas a final zone of pastureland/fresh meadow with Polygonum lapathifolium, Alternanthera denticulata and other 'weed' species	<0.5	100	Large body of water in centre covered with Salvinia molesta at time of survey. To east, along entrance channel to lagoon, water free of weed and channel lined by reeds. Swamp very dry at time of survey and weeds starting to colonise drying mud. Dieback of Eleocharis reed beds evident along eastern channel.
		2. Swamp SE of Kalingo Pit Top Some clumps of Melaleuca sp. on north/north-eastern edge						Similar species as 1. but predominantly Eleocheris sphacelata	2	50	Similar to 1. but very narrow zone around edge			Waterweed present but not totally covering water. Edge patches of reeds heavily grazed by cattle.

4.5.2 Status of Vegetation

Virtually all of the vegetation has been disturbed by human activity. These disturbances have altered the natural distribution and concentration of some species. The resultant plant communities are in a very degraded condition and generally cannot be considered to have conservation significance. Furthermore, the plant species and vegetation units are typical of the locality and are better represented elsewhere in the Hunter Region.

Communities 2 and 7 are exceptions. The former, the Yellow Bloodwood community is not common to the Hunter Valley, being more typical of the sandstone country to the west and south-west.

Wetland habitats (Community 7) are a limited resource, hence the size and permanent nature of Ellalong Lagoon and its associated system gives this swamp a high conservation status. Recent assessment by the National Trust has lent support to the concept of Ellalong Lagoon as a Nature Reserve (National Trust of Australia, 1984).

The smaller lagoon in the lease area, would also be rated as medium to high conservation status, being of a semi-permanent nature and providing suitable habitat for a number of waterbird species. However, the number of species would be much less than that supported by Ellalong Lagoon, which is considered an important breeding and drought refuge.

4.5.3 Impact Assessment – Vegetation

The impact of the Project on vegetation would be considered of minor significance since clearing operations will be restricted to the immediate vicinity of the proposed Rail Loop Site and access route.

The main communities to be disturbed would be Community 1 and small portions of 3 and 4. Communities 2, 5, 6 and 7 are outside the area of direct impact. Communities 3 and 4 contain some protected species. There is however, potential for impact on Community 7 if subsidence occurs beneath the smaller lagoon or under Quorrobolong Creek. Subsidence beneath the lagoon is unlikely to cause it to drain and is more likely to result in an extension of the swamp area. Either result could lead to some modification of the present community. Subsidence in the vicinity of the creek could ultimately affect Ellalong Lagoon as well as the creek itself, if drainage was interrupted and flows decreased.

However, experience at Ellalong Colliery of the effects of subsidence on watercourses (with a very similar mining programme being conducted) indicate that only very minor modifications, if any, are likely to occur.

The Department of Water Resources provide an additional safeguard in requiring the Company to construct whatever works are required to maintain the existing flow regime of the watercourses.

4.6 Fauna

4.6.1 Avifauna

Within the Project site locality 145 bird species have been recorded, of which 57 were observed during fauna surveys undertaken in autumn, 1987 (see Table 4.6.1).

The degraded state of most of the forest habitat suggests that population numbers would not be high in these areas. Greatest concentrations of birds would be expected along the gullies and watercourses, particularly the vegetated sectors of Quorrobolong Creek.

All the recorded forest species would be expected to occur on the Project site at some time. However, some forest species are very restricted in distribution. For example, only two colonies of the Bell Miner were located in the autumn surveys, one along Quorrobolong Creek and one within the proposed Rail Loop Site. Two forest species, the Gang-gang Cockatoo and Glossy Black Cockatoo, which are considered to be of special concern in NSW, have been recorded on the Project site.

High concentrations of waterbirds occur at times on Ellalong Lagoon (an important breeding and drought refuge) and, to a lesser extent, on the smaller lagoon. 105 of the 145 species recorded in Table 4.6.1 are only associated with the wetland habitats and therefore are not usually found elsewhere in the area.

A number of species of conservation significance have been recorded in the Ellalong Lagoon area, including the Peregrine Falcon, Freckled Duck, White-bellied Sea-eagle and Grey Plover.

4.6.2 Mammals

Only 6 native species have been recorded in the area (see Table 4.6.2). Four of these are found within the area of disturbance: the Eastern Grey Kangaroo, the two Possums, and the Short-beaked Echidna. It is likely that the poor ground stratum is unsuitable for small ground mammals resulting in only scattered distributions.

4.6.3 Reptiles

Five species are known to occur, the most common being the Red-bellied Black Snake (see Table 4.6.3).

The poor condition of most of the forest habitat would suggest that the total number of forest birds, mammals and reptiles would be low. Hunting by man and predation by feral animals would have further depleted the numbers of forest mammals and reptiles.

4.6.4 Status of Fauna Species and Habitats

Fauna species of conservation significance occur only amongst the avifauna, and are noted in Table 4.6.1.

A number of species of significance have been recorded around the area since 1975, mostly associated with the wetland habitats. The Gang-gang Cockatoo, which is listed as Vulnerable to Rare, was however recorded in the forest/woodland habitat during the autumn survey, the species typically being a winter visitor to the Hunter Valley. As the forest/woodland habitat is well represented in the Hunter Valley, the Bellbird South Project would not have a significant impact on this species.

Fauna habitats in the area are generally considered of low conservation value, the exceptions being the wetland habitats of Ellalong Lagoon and the smaller lagoon, and the vegetated sectors of Quorrobolong Creek. The former would be rated highly and the latter rated of medium value.

4.6.5 Impact Assessment – Fauna

Direct impacts on fauna species will be restricted to those individuals inhabiting or utilising the proposed Rail Loop Site and access areas. The resultant loss of a small number of individuals is considered an unavoidable impact of the proposal.

The Vulnerable/Rare Gang-gang Cockatoo would not be significantly affected by the Project, the species being only a visitor to the area.

A potential wider impact on waterbirds could occur if subsidence affects the drainage flows feeding the swamp systems. This impact is more likely to be positive than negative, but will be dependent on the extent of extra ponding and therefore habitat that could eventuate. Any degradation of Ellalong Lagoon however, would affect large numbers of avifauna species. Changes affecting the smaller lagoon would have a similar impact.

A more minor impact on some fauna species utilising Quorrobolong Creek may also occur if drainage flows are interrupted or altered.

TABLE 4.6.1

AVIFAUNA SPECIES IN THE BELLBIRD SOUTH AREA

Common Name	Scientific Name	Habitat	Source of Record	Status In NSW
Australian Pelican	Pelecanus conspicillatus	ES	H	C-MC
Darter	Anhinga Melanogaster	ES	*,P,	MC
Great Cormorant	Phalacrocorax carbo	ES	*,P,	C
Pied Cormorant	P. varius	ES	H	MC
Little Black Cormorant	P. Sulcirostris	ES	H,P,	A
Little Pied Cormorant	P. melanoleucos	S,ES	H,*	A
Australian Little Grebe	Podiceps novaehollandiae	S,ES	*,P,	A
Pacific Heron	Ardea pacifica	ES	*,P,	C
White-faced Heron	Ardea novaehollandiae	ES	*,P	A
Cattle Egret	Ardeola ibis	ES	H	MC
Great Egret	Egretta alba	ES	*,P	C
Little Egret	E. garzetta	ES	P,	MC
Intermediate Egret	E. intermedia	ES	H	MC
Little Bittern	Ixobrychus minutus	ES	P	U
Australasian Bittern	Botaurus poiciloptilus	ES	P	MC-U
Sacred Ibis	Threskiornis molucca	ES	H,*,P	A
Straw-necked Ibis	T. spinicollis	ES	H,*	A
Royal Spoonbill	Platalea regia	ES	P	MC
Yellow-billed Spoonbill	P. flavipes	ES	H	MC
Plumed Whistling Duck	Dendrocygna cytoni	ES	P	MC
Black Swan	Cygnus atratus	ES	*,P	C
Freckled Duck	Stictonetta naevosa	ES	H	C
Pacific Black Duck	Anas superciliosa	ES	P	A
Grey Teal	A. gibberifrons	ES	H,P	A
Chestnut Teal	A. castanea	ES	H,P	MC
Australian Shoveler	A. rhynchotis	ES	H,P	MC
Hardhead	Aythya australis		P	C
Maned Duck	Chenonetta jubata	ES	H,P	A
Musk Duck	Biziura lobata	ES	H	MC
Black-shouldered Kite	Elanus notatus	ES	P	C-MC
Whistling Kite	Haliastur sphenurus	ES	P	MC
Brown Goshawk	Accipiter fasciatus	ES	H,P	MC
Collared Sparrow Hawk	A. cirrhocephalus	ES	P	MC
Wedge-tailed Eagle	Aquila audax	Cl	*R	MC
White-bellied Sea-eagle	Haliaeetus leucogaster	ES	H,P	U(SC)
Marsh Harrier	Circus aeruginosus	ES	H,P	MC
Peregrine Falcon	Falco peregrinus	ES	P	U(V)
Australian Hobby	F. longpipennis	ES,F	*,P	MC
Australian Kestral	F. cenchroides	ES	H,*,P	C
Brown Falcon	Falco berigora	ES,F	H,*,P	MC
Quail sp.	Coturnix sp.	F.	*	
Crake	Porzana pusilla	ES	Pa	C-MC

Common Name	Scientific Name	Habitat	Source of Record	Status In NSW
Spotted Crake	P. fluminea	ES	P,	MC
Dusky Moorhen	Gallinula tenebrosa	ES	H,*,P	A
Purple Swamphen	Porphyrio porphyrio	S,ES	H,*,P	A
Eurasian Coot	Fulica atra	ES	H,P	A
Masked Lapwing	Vanellus miles	S,ES	H,*,P	A
Red-kneed Plover	Erythrogonys cinctus	ES	H	MC
Black-fronted Plover	Charadrius melanops	ES	H	C
Grey Plover	Pluvialis squatarola	ES	H	R(SC)
Greenshank	Tringa nebularia	ES	W	C
Japanese Snipe	Gallinago hardwickii	ES	P	MC
Sharp-tailed Sandpiper	Calidris acuminata	ES	H,P	C(SC)
Black-winged Stilt	Himantopus himantopus	ES	H,P	C
Spotted Turtledove	Streptopelia chinensis	ES	H	I
Peaceful Dove	Geopelia placida	ES,F	H,*	A
Common Bronzewing	Phaps chalcoptera	E,F	H,*	A
Brush Bronzewing	P. elegans	F	*	MC
Crested Pigeon	Ocyphaps lophotes	ES	H	A
Wonga Pigeon	Leucosarcia melanoleuca	ES	H	MC
Little Lorikeet	Glossopsitta pusilla	ES,F	*,P	C
Funereal Cockatoo	Calyptoryhnchus funereus	ES,Cl/F	H,*(Heard)	MC
Glossy Black Cockatoo	C. lathami	Cl/F	*,R,P	MC(SC)
Gang-gang Cockatoo	Callocephalon fimbriatum	F	*	MC(V)
Galah	Cacatua roseicapilla	ES	P	A
Australian King Parrot	Alisterus scapularis	E	H	C
Crimson Rosella	Platycercus elegans	F	P	A
Eastern Rosella	Platycercus eximius	ES,F,Cl	H,*	A
Pallid Cuckoo	Cuculus pallidus	ES	H	C
Brush Cuckoo	C. variolosus	ES	H	MC
Fan-tailed Cuckoo	C. pyrrhophanus	ES,F	*,P	C
Shining Bronze Cuckoo	Chrosococcyx lucidus	E,S	H	S
Tawny Frogmouth	Podargus strigoides	F(Road kill)	*	A
Azure Kingfisher	Ceyx azureus	ES	H	MC
Laughing Kookaburra	Dacelo novaeguinea	ES,F	*,P	A
Sacred Kingfisher	Halcyon sancta	ES	H,P	A
Rainbow Bee-eater	Merops ornatus	ES	H	A(SC)
Welcome Swallow	Hirundo neoxena	ES,F	H,*,P	A
Tree-martin	Cecropis nigricans	ES	H,P	A
Fairy Martin	C. ariel	ES	H,P	A
Australian Pipit	Anthus novaeseelandiae	ES	H,P	A
Black-faced Cuckoo-shrike	Coracina novaehollandiae	ES,F	H,*,P	A
Grey-crowned Babbler	Pomatostomus temporalis	Cl(Road kill)	*,P	A(SC)
Golden-headed Cisticola	Cisticola exilis	ES	H,P	A
Little Grassbird	Megalurus gramineus	ES	H,P	A
Clamorous Reed-warbler	Acrocephalus stentoreus	ES	H,P	A
Superb Fairy-wren	Malurus cyaneus	ES,F,(Ck)	H,*,P	A

Common Name	Scientific Name	Habitat	Source of Record	Status In NSW
White-throated Warbler	Gerygone olivacea	ES	H	A
Weebill	Smicrornis brevirostris	E	H	A
Striated Thornbill	Acanthiza lineata	ES	P	A
Yellow Thornbill	A. nana	ES	P	A
Brown Thornbill	A. pusilla	ES	P	A
Buff-rumped Thornbill	A. reguloides	E	H	A
Yellow-rumped Thornbill	A. chrysorrhoa	ES	H	A
White-browed Scrubwren	Sericornis frontalis	ES	P	A
Speckled Warbler	Chthonicola sagittata	E	H	C
Jacky Winter	Microeca leucophaea	ES	P	A
Scarlet Robin	Petrocia multicolor	ES	H	C
Rose Robin	P. rosea	ES	H	C
Eastern Yellow Robin	Eopsaltria australis	ES,F	*,P	A
Grey Fantail	Rhipidura fuliginosa	ES,F	H,*,P	A
Willie Wagtail	R. leucophrys	ES,Cl	H,*,P	A
Leaden Flycatcher	Myiagra rubecula	ES	H	C
Restless Flycatcher	M. inquieta	ES	H	A
Golden Whistler	Pachycephala pectoralis	ES	H	A
Rufous Whistler	P. rufiventris	ES,F	*,P	A
Grey Shrike-thrush	Colluricincla harmonica	ES,F	H,*,P	A
Shrike-tit	Falcunculus frontatus	E	H	C(SC)
Eastern Whipbird	Psophodes olivaceus	ES,F	*	A
Sittella	Neositta chrysoptera	E	H	C
Brown Tree Creeper	Climacteris picumnus	ES	P	A
White-throated Tree-creeper	C. leucophaea	E	H	A
Mistletoe bird	Dicaeum hirundinaceum	ES	P	A
Spotted Pardalote	Pardalotus sp.	ES	P	A
Yellow-tipped Pardalote	P. striatus	ES	P	MC
Silvereye	Zosterops lateralis	ES	H,P	A
Lewin's Honeyeater	Meliphaga lewinii	E	H	A
Fuscous Honeyeater	Lichenostomus fuscus	ES	P	A
Yellow-faced Honeyeater	L. chrysops	ES,F	P	A
White-plumed Honeyeater	L. penicillatus	ES	P	A
White-eared Honeyeater	Lichenostomus leucotis	E	H	A
Yellow-tufted Honeyeater	L. melanops	ES,F	H,*	A
White-naped Honeyeater	M. Lunatus	ES,E	H,P	A
Noisy Friarbird	Philemon corniculatus	ES,F	H,*	A
White-cheeked Honeyeater	Phylidonyris nigra	E	H	A
Striped Honeyeater	Plectorhyncha lanceolata	ES	H	A
Eastern Spinebill	Acanthorhynchus tenuirostris	E	H	A
Bell Miner	Manorina melanophrys	F(Ck)	*	C
Noisy Miner	M. melanocephala	ES,F	*	A
Red Wattlebird	Anthochaera carunculata	E	H	A
Red-browed Firetail	Emblema temporalis	ES	H	A
Double-barred Finch	Poephila bichenovii	ES	H	A

Common Name	Scientific Name	Habitat	Source of Record	Status In NSW
House Sparrow	Passer domesticus	ES	H	I
Common Starling	Sturnis vulgaris	ES	H	I
Brown-headed Honeyeater	Melithreptus brevirostris	ES	H	A
Olive-backed Oriole	Oriolus sagittatus	ES	H	C
Magpie-lark	Grallina cyanoleuca	ES,Cl	H,*	A
White-winged Chough	Corcorax melanorhamphos	E,F	H,*	C
Dusky Woodswallow	Artamus cyanopterus	ES,F	H,*	A
Pied Currawong	Strepera graculina	ES,F,Cl	H,*	A
Pied Butcherbird	Cracticus nigrogularis	ES,F	H,*	A
Grey Butcherbird	C. torquatus	ES,F,Cl	H,*	A
Australian Magpie	Gymnorhina tibicen	ES,F,Cl	H,*	A
Satin Bowerbird	Ptilonorhynchus violaceus	E	H	C
Australian Raven	Corvus coronoides	ES,F	H,*	A

Nomenclature according to Morris et al, (1981)

KEY

HABITAT

ES – Ellalong Lagoon
S – Small lagoon within study area
E – Ellalong Area
F – Forested Areas/Woodland
Cl – Cleared Areas/Grazing Land
Ck – Creek

SOURCE OF RECORD

H – Outings by Hunter Bird Observers Group or Newcastle Flora and Fauna Protection Society
* – Recorded during autumn, 1987 by Bartrim & Martin Biological Studies.
*R – Observed by local resident.
P – Recorded by F.W.C. Van Gessel, 1975 in Pelton area.
WT – Listed in Waterhouse (1987).

STATUS IN NSW

R – Rare
U – Uncommon
C – Common
MC – Moderately Common
A – Abundant
(SC) – Of special concern
(V) – Rare/vulnerable
(National Parks & Wildlife (Amendment) Act, 1983.)
(Morris et al, 1981)

TABLE 4.6.2

MAMMAL SPECIES IN THE BELLBIRD SOUTH AREA

Common Name	Scientific Name	Source of Record
Short-beaked Echidna	Tachyglossus aculeatus	R
Common Wombat	Vombatus ursinus	R
Common Ringtail Possum	Pseudocheirus peregrinus	S
Common Brushtail Possum	Trichosurus vulpecula	R
Eastern Grey Kangaroo	Macropus giganteus	R
Wallaroo	M. robustus	E
Rabbit	Oryctolagus cuniculus	S
Horse	Equus caballus	O
Domestic Cow	Bos tarus	O

Nomenclature from Strahan (Ed) 1983

KEY

R – Reported by local resident
S – Signs of animal observed during surveys
O – Observed during surveys
E – Observed by company personnel

TABLE 4.6.3

REPTILES IN THE BELLBIRD SOUTH AREA

Common Name	Scientific Name	Source of Record
Bearded Dragon	Amphibolurus barbatus	C
Lace Monitor	Varanus varius	R,E
Fence Skink	Cryptoblepharus sp.	O
Copper-tailed Skink	Ctenotus taeniolatus	O
Red-bellied Black Snake	Pseudechis porphyriacus	R

Nomenclature from Cogger, (1975)

KEY

C – Captured during field surveys
R – Reported by local residents
E – Observed by company personnel
O – Observed during surveys

4.7 Historical Background

4.7.1 Archaeology

An archaeological survey was conducted by Brayshaw McDonald Pty Ltd in March 1987.

The areas investigated are shown in Figure 4.7.1. One archaeological site and one isolated artefact were found during the survey, both in potential subsidence areas. No archaeological relics were located within areas to be directly impacted by the development.

The archaeological site, Quorrobolong 1, (Figure 4.7.1) was located on a south-eastern spur of Broken Back Range in the Quorrobolong Creek catchment. It consisted of 7 artefacts in an 80 x 25m area.

The isolated artefact was located on the Pelton Road 1.6km north-west of Quorrobolong 1. It consisted of a silcrete core 30 x 24 x 12mm (longest flake scar 20/23mm multi-platformed).

4.7.2 Local History

Historical Background to Coal Mining in the Cessnock Area.

The initial phase of coal mine development occured during the period 1900 to 1912 when approximately 12 mines were opened. Shafts were sunk at Aberdare, Abermain, Hebburn, Pelaw Main and Stanford Merthyr. During this period the present railway system linking Cessnock with the Coalfields was established. Cessnock and Kurri Kurri grew rapidly as townships to service the mining industry.

During the second phase of expansion between 1912 and 1924, caused by an upward trend in the price of coal, a further 12 collieries commenced operations. This brought to 24 the total number of collieries which were operating during the first quarter of the 20th century. This development occurred along the entire length of the Greta Seam between East Greta and Ellalong.

The area remained a significant producer of coal until the early 1950's, after which successive mine closures occurred. Today there remains only 2 operating collieries on the Coalfields.

Bellbird and Cessnock No. 1 Collieries

The Bellbird Colliery, formerly known as the Hetton Extended Colliery, commenced operations in 1908. The Colliery was subsequently renamed the Bellbird Colliery in 1911 and continued mining by both underground and open cut means until 1977.

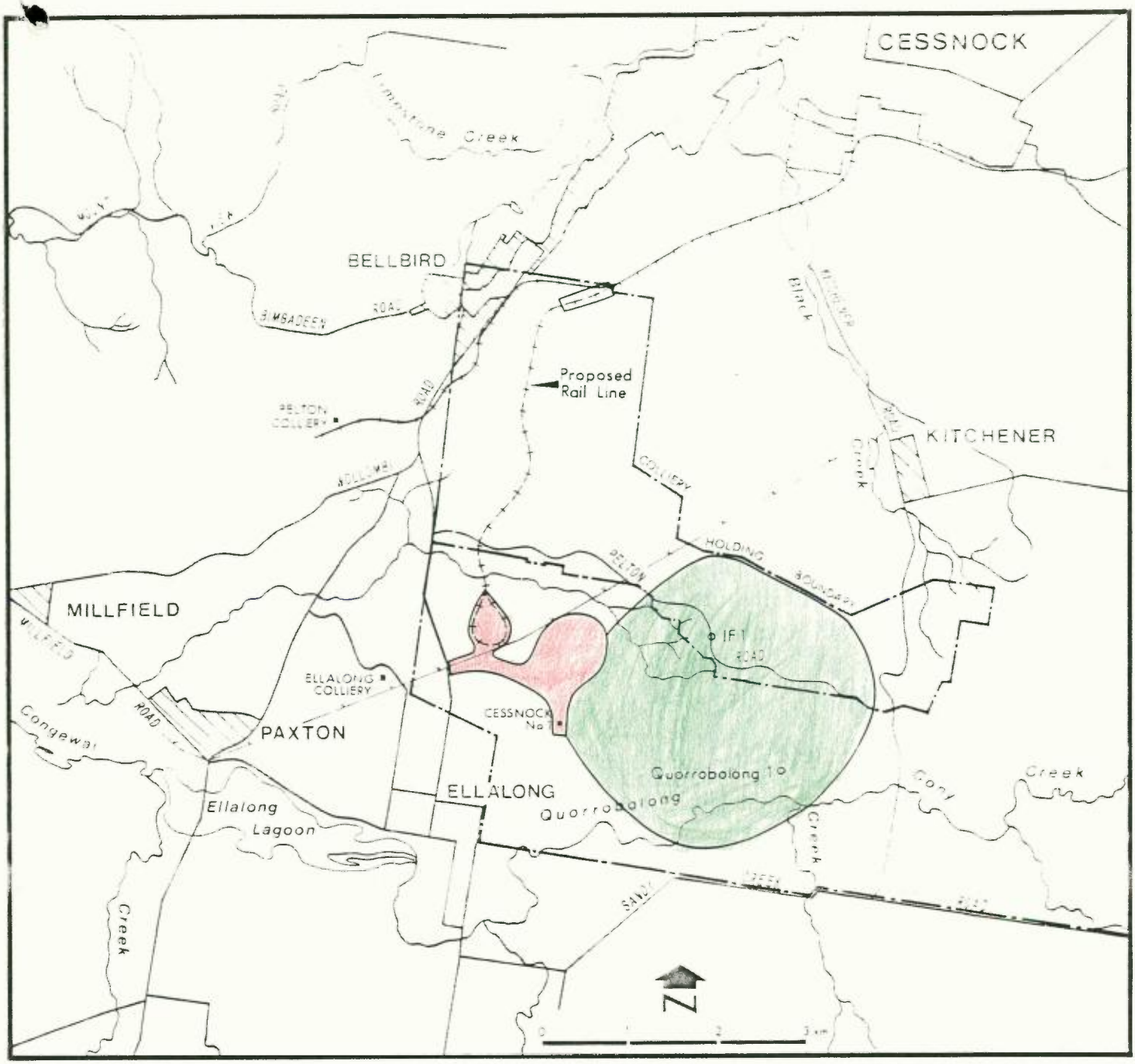
The Cessnock No. 1 Colliery, also known as the Kalingo Colliery, commenced operations as the Great Northern Colliery in 1921. It was developed by the Wickham and Bullock Island Coal Company Ltd. The Colliery was closed between 1929 and 1936 and in 1937 was renamed the Cessnock No. 1 Colliery, which operated until 1961. When work ceased the mine was incorporated into the Aberdare North Colliery Holding.

For further details of mining history in the district see Section 3.2.

The Cessnock No. 1 Colliery Surface Facilities

A site survey has identified the structures and remains of structures on the site (see Figure 4.7.2). These are detailed in Wayne Perry and Associates (1987).

Site Setting: The Colliery surface facilities are located on a cleared site of approximately 7ha which is surrounded by dense vegetation. It is a relatively remote site, being approximately 1.5km from the Cessnock-Ellalong road. It is not visible from any public roads.



LEGEND

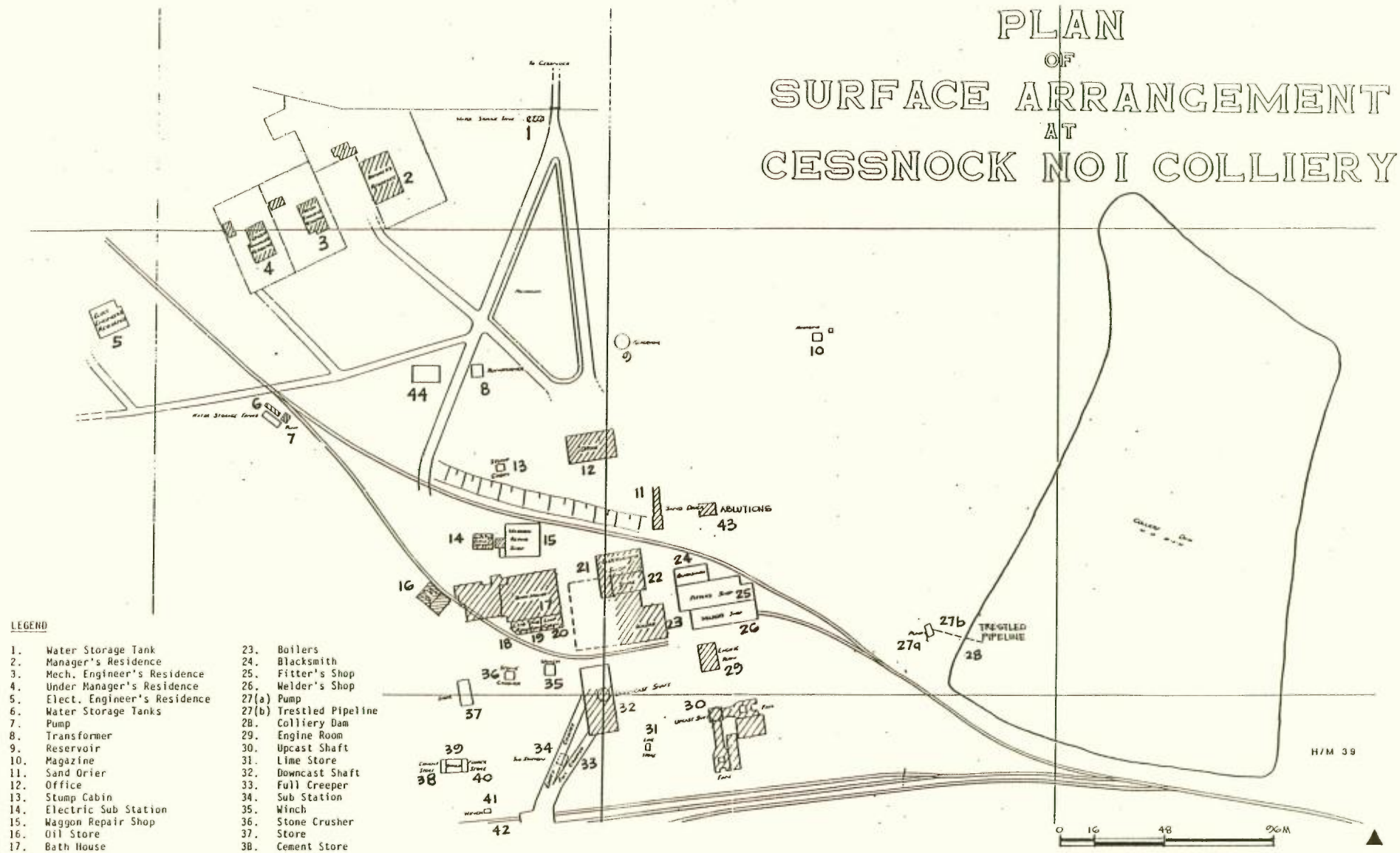
Surface Developments

Subsidence Areas

ARCHAEOLOGICAL SITES

- Quorrobolong 1 ____ *Open site*
- IF 1 ____ *Isolated artefacts*

SOUTHLAND COAL PTY LIMITED
BELLBIRD SOUTH PROJECT
ARCHAEOLOGICAL SITES
FIGURE 4. 7. 1.



LEGEND

1. Water Storage Tank
2. Manager's Residence
3. Mech. Engineer's Residence
4. Under Manager's Residence
5. Elect. Engineer's Residence
6. Water Storage Tanks
7. Pump
8. Transformer
9. Reservoir
10. Magazine
11. Sand Drier
12. Office
13. Stump Cabin
14. Electric Sub Station
15. Waggon Repair Shop
16. Oil Store
17. Bath House
18. Crib Room
19. Amb. Room
20. Lamp Cabin
21. Electrician's Shop
22. Store
23. Boilers
24. Blacksmith
25. Fitter's Shop
26. Welder's Shop
27(a) Pump
27(b) Trestled Pipeline
28. Colliery Dam
29. Engine Room
30. Upcast Shaft
31. Lime Store
32. Downcast Shaft
33. Full Creeper
34. Sub Station
35. Winch
36. Stone Crusher
37. Store
38. Cement Store
39. Bicycles
40. Fodder Store
41. Winch
42. Railway Line
43. ABLUTIONS
44.

15 SURVEY NUMBER

BUILDING OR STRUCTURE PRESENT ON SITE

SOURCE COAL & ALLIED OPERATIONS PTY LTD

BELLBIRD SOUTH EIS
HERITAGE SURVEY

JULY 1987

Figure 4.7.2

Recent Use of the Site: Since closure of the mine in 1961, use of the site has been restricted to cattle grazing and residential occupancy of the three remaining houses. Much of the equipment, head frames and other re-usable items have been removed to other colliery sites.

Condition of the Site and Structures: The grounds and road system within the site have been maintained in relatively good condition. Figure 4.7.2 shows the extent of the 44 buildings and structures which were originally constructed on the site and the proportion of these which remain.

Nine main buildings are present on-site, comprising the office, bathhouse, electricians shop and store, boiler housing, engine/winder room, the fan control building and the three residences.

Six minor buildings, comprising the pump housing, stump cabin, electrical sub-station, wagon repair shop annexure, oil store and office toilet block remain on-site.

Existing structures include the 2 water storage tanks, the sand drier, the downcast shaft base and carrier entries, the upcast shaft and associated fan structures.

The majority of the buildings are of brick construction. The condition of each building and structure varies and brief descriptions are provided in the site survey report (Wayne Perry and Associates (1987)). The varying range of bricks used and different architectural detailing, indicates that construction, alteration and extension of the buildings occurred over an extended time period.

Evidence is present (varying from foundations to timber posts and superstructures), to verify that the majority of the buildings and structures which are shown on Figure 4.7.2 no longer exist. The Colliery dam and railway formwork, which includes cuttings and embankments and limited lengths of railway line and sleepers still remain.

Comparison with other Collieries and Heritage Value of the Site: The site is one of 13 collieries within the South Maitland Coalfields which provide evidence of their former mining use.

The site does not provide a complete record of an early 1920's colliery which for example, is evident at the Pelaw Main, Richmond Main and Stanford Main No. 2 Collieries. It does not portray a consistent use of material and architectural style as occurs with these 3 collieries. This is largely a result of continued development and modernisation on the site and is also due to different ownership from the 3 collieries formerly owned by J & A Brown.

The site does however, contain in excess of 40 buildings and structures and evidence of the railway system and is therefore more intact than the Bellbird, Aberdare Central, Aberdare South, Aberdare East, Aberdare and Hebburn Colliery remains. The site has been listed in the Hunter Regional Heritage Study as being less complete than 17 other collieries but with sufficient of the complex surviving to warrant further investigation and recording.

The main value of the site is considered to be the ability to trace technological change between 1921 and 1961, which was undertaken by the Colliery to enable it to be one of the most technologically advanced underground operations at the time of closure.

Proposals for Future Use of the Site: It is the Company's intention to retain as many of the brick buildings which are in a reasonable state of repair, consistent with their heritage value and adaptability, for future use as part of the modern colliery surface facilities.

Plate 1 (front piece) represents an artist's impression illustrating the extent of existing buildings to be retained and proposed new buildings and structures. Figure 3.4.4 depicts the proposed surface arrangements in detail.

It is proposed to retain and renovate the office building and bath-house and re-use these according to their previous use. The existing stump cabin, switch room and winder room will be retained and repaired, with the winder room being used possibly as a safety and training

facility. The existing upcast shaft is to be re-used and equipped with modern twin fans. Similarly, the downcast shaft is to be re-used and equipped with an enclosed headframe to serve as a man-riding shaft. The access shaft will be connected to the bath-house by a covered walkway.

Renovation of buildings to be re-used, will be undertaken in a sympathetic manner with attention given to the matching of materials and consistent architectural detailing. The new structures, which include the superstructure to the 2 shafts and the covered walkway, will be constructed using coloured, profiled steel sheeting. These will be similar in appearance to equivalent structures at the nearby Ellalong Colliery.

It is proposed to remove derelict structures from the site as part of the site clean-up and integrate the proposed additions with the existing structures, by a continuation of the present landscape theme (see Section 3.2.1).

The Colliery dam will be retained for re-use and the railway formwork will be re-used for a considerable proportion of its existing length.

4.7.3 Impact Assessment – Historical Background

Neither the archaeological site nor the isolated artefact are likely to be affected by the proposed development. The isolated artefact, being situated on the road, is already out of its archaeological context. The Quorrobolong 1 site will not be affected by predicted subsidence.

4.8 Land Use, Capability, Tenure and Zoning

4.8.1 Land Use

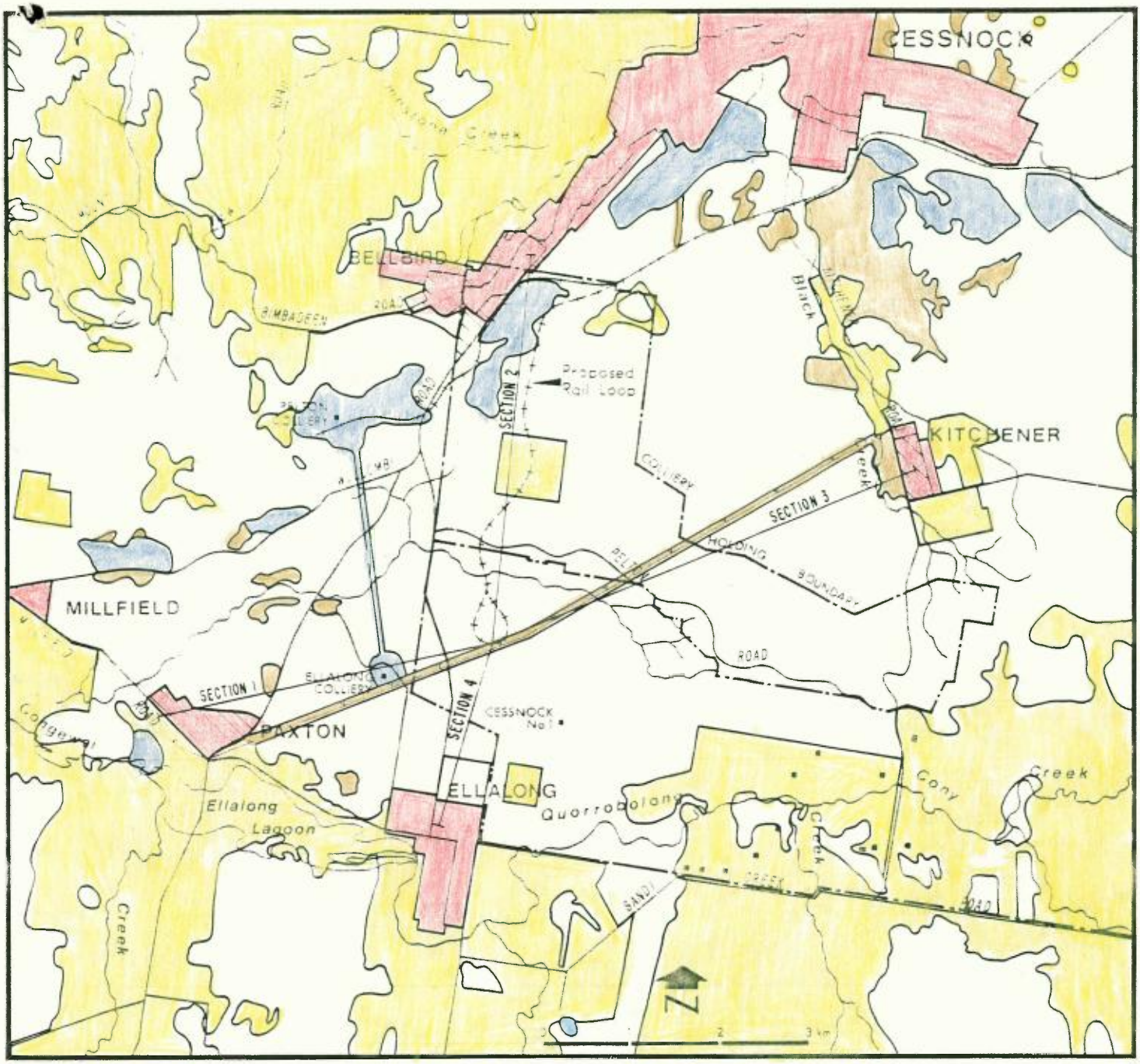
Delineation of land use was undertaken by Wayne Perry and Associates within an area of approximately 140km^2. The Project itself covers an area of approximately 20km^2.

The study comprised the Colliery Holding and adjacent areas of urban development, as shown in Figure 4.8.1 and summarised in Table 4.8.1. More detailed field mapping, including the location of residences, was undertaken for the area likely to be subjected to longwall mining.

TABLE 4.8.1

LAND USE DISTRIBUTION

Land Use	Area (ha)	Percentage
Urban	890	6.5
Vineyards	10	<1
Grazing	4,080	29.6
Forestry	8,270	59.9
Mine/Mine Associated	320	2.3
Disturbed	230	1.7
Total	13,800	100



LEGEND

- Urban areas
- Mining
- Grazing
- Forest
- Disturbed land
- Residences within area of proposed underground workings
- Poultry Sheds

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BELLBIRD SOUTH PROJECT

LAND USE

FIGURE 4.8.1.

Urban

The Colliery Holding is situated close to a relatively large urban population comprising Cessnock, some 6km directly to the north and the villages of Bellbird, Paxton, Pelton, Millfield, Ellalong and Kitchener. The development of Cessnock and these villages was primarily related to the continued mining of coal from the South Maitland Coalfield since 1887. The closest village to the proposed Pit Top development is Ellalong, some 1.5km distant.

The villages, and Cessnock to a large extent, comprise development which reached its peak in the 1920's and is predominantly a timber and galvanised iron architecture typical of mining towns throughout the State. Infilling of the village structure with modern brick veneer homes and the southern extension of urban Cessnock to Bellbird Heights, is evidence of an increasing number of commuters taking advantage of low land prices and existing infrastructure.

Table 4.8.2 shows population distribution in the urban centres surrounding the proposal.

TABLE 4.8.2

POPULATION OF URBAN CENTRES

Town/Village	Population+
Cessnock*	17,695
Kitchener	231
Ellalong	416
Paxton	580
Millfield	327
Pelton	75
Total	19,324

* Includes Nulkaba, Aberdare, Bellbird and Mountview.

\+ Based on 1981 data with 1987 adjustments according to occupancy rates and dwelling approvals.

Source: Cessnock City Council.

Mining

This land use accounts for approximately 2.3% of the area studied and includes current and abandoned mines and associated mining uses. The Pelton and Ellalong Collieries, operated by the Newcastle Wallsend Coal Company and located north-west and south respectively, of the Project, represent the only operating collieries within the area. A number of ventilation shafts and an overland conveyor are associated with these 2 collieries.

Abandoned colliery sites are a characteristic of the area and range from those which have been completely rehabilitated, to others which have been partially rehabilitated and which include reject disposal areas, tailing ponds and surface infrastructure.

Within the study area, the following collieries have worked the Greta Seam since the late 1880's: Millfield North, Millfield, Maitland Main, Stanford Main No. 2, Kalingo or Cessnock No. 1, Hilldale Open Cut, Bellbird, Aberdare No. 7 Open Cut, Cessnock No. 2, Aberdare Extended, Aberdare East, Aberdare and Aberdare Central.

Currently, reject from the Pelton Colliery is being disposed of within the final void of the Aberdare No. 7 Open Cut.

Rural

Grazing of cattle and horses accounts for approximately 30% of the land use in the area. Smaller areas are used for limited goat raising and poultry farming. The area is not renowned as a high quality rural area.

More dense rural settlement occurs in the south-east portion of the area defined in Figure 4.8.1, where a number of the smaller blocks are occupied by hobby farmers. The size of these blocks render them uneconomic in providing a sole rural based income. The effect of these rural subdivisions is to increase the general rural rate levied by Council.

Ten residences exist within this area and approximately 40 ha of the alluvial flats are used for cropping. Crops include fodder production for animals, citrus trees and limited vegetables.

Forestry

On an areal basis, forestry is the most significant land use, occupying approximately 60% of the area defined in Figure 4.8.1. The Aberdare State Forest extends eastwards from Pelton to the east of Abernethy. It comprises good quality mine timber stands together with fencing, poles and sawlogs. The forest is harvested every 5 to 10 years with timber stand improvement being undertaken at the time of harvesting. The major management problem is the high number of deliberately lit fires.

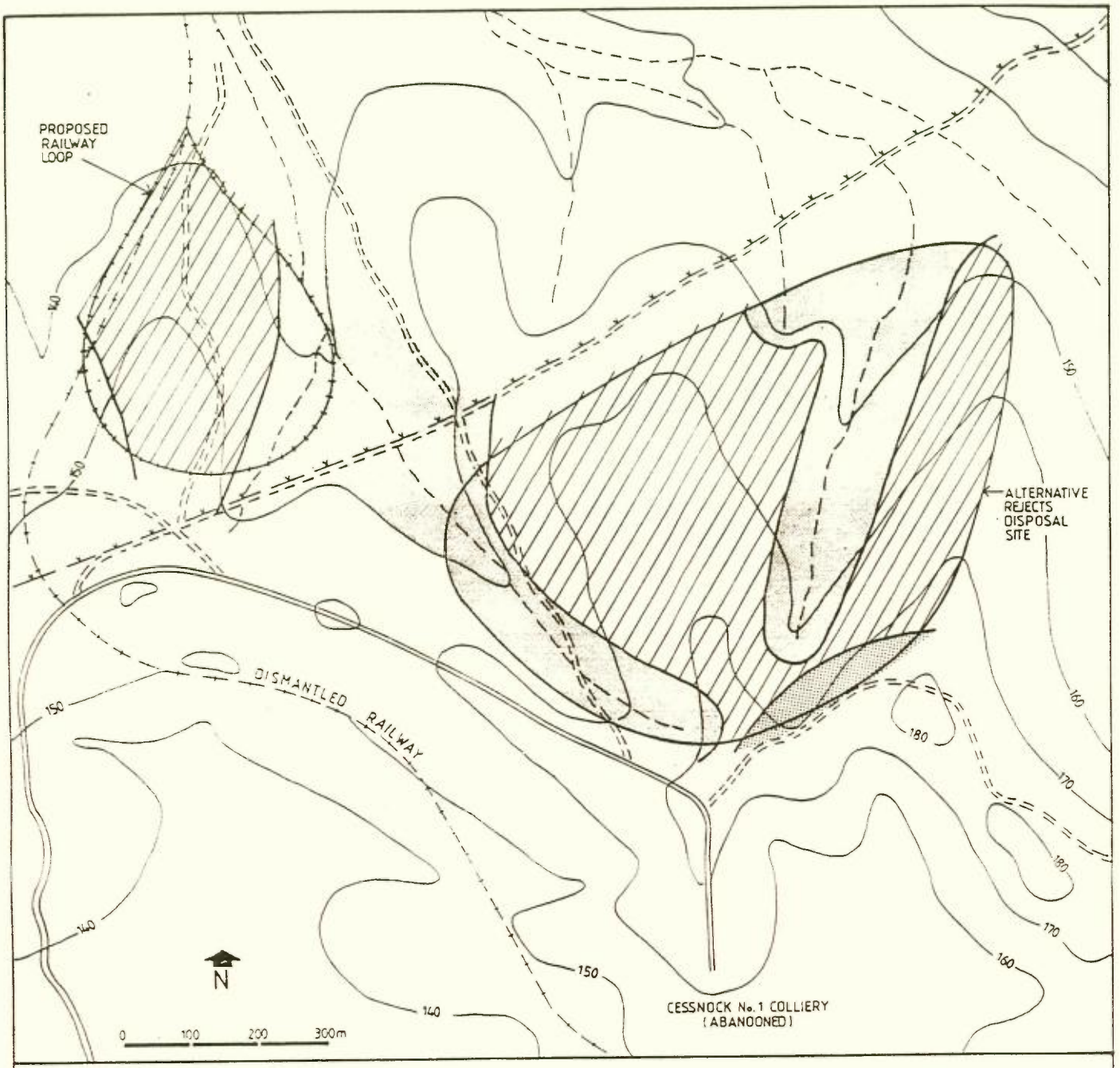
The remainder of the forested area is a combination of privately-owned and Crown land. The major land owner within the study area, Coal & Allied Operations Pty Limited, manage their timbered properties according to timber management plans. Timber is used for pit props and other mining related uses.

4.8.2 Land Capability

A rural land capability assessment was completed for the area shown in Figure 4.8.2. Details of the natural features of the general area, including surrounding areas of forest, are shown in Figure 4.5.1. This assessment indicates the agricultural potential of the area independent of land use.

Land capability classifications were based on the 8 class system devised by Emery (1985) and used by the Soil Conservation Service of NSW. It relies upon an assessment of the biophysical characteristics of land, the extent to which these will limit a particular type of land use and the current technology that is available for the management of land. The majority of the area can be broadly classified as being suitable for grazing comprising Class VI land with lesser areas of Class VII and VIII. The Class VII areas are best protected by retention of timber cover whilst the Class VIII land has severe limitations rendering it unsuitable for agricultural production. Table 4.8.3 provides a summary of the area of each rural land capability class.

The Project area is unsuitable for cultivation, has a very low productivity and requires soil conservation practices if the existing vegetative cover is removed.



LEGEND

- Class VI
- Class VII
- Class VIII
- Existing contours
- Intermittent watercourses

RURAL LAND CAPABILITY

Figure 4.8.2

TABLE 4.8.3

RURAL LAND CAPABILITY CLASSES

Class	Area (ha)	Percentage of Area Mapped
VI	43.0	58.4
VII	29.5	39.7
VIII	1.5	1.9
Total	74.0	100.0

4.8.3 Land Tenure

The Project is located within the County of Northumberland, Parishes of Cessnock, Ellalong and Quorrobolong. Figure 4.8.3 shows land ownership blocks covering the area of interest. Ownership of land is summarised as follows:

Block	Owner	Portion Numbers	Parish
27	Southland Coal Pty Ltd	32	Cessnock
30A	Coal & Allied Industries Limited	2, 3, 4, 19, 35, 64, 65, 66, 67, 75, 99, Pt 100, 125	Ellalong
30B	Coal & Allied Industries Limited	Various	Ellalong Quorrobolong
1, 2, 3, 4, 5A, 5B, 5C, 6A, 6B, 7, 8, 9, 10, 11A, 11B,11C, 12, 13, 22, 24A, 24B, 24C, 28, 29,	Individual Private Owners	Various	Quorrobolong
31A, 31B	Crown Land	Various	Cessnock

Block 30A covers all the land which is under purchase option by Southland Coal from Coal & Allied.

4.8.4 Zoning

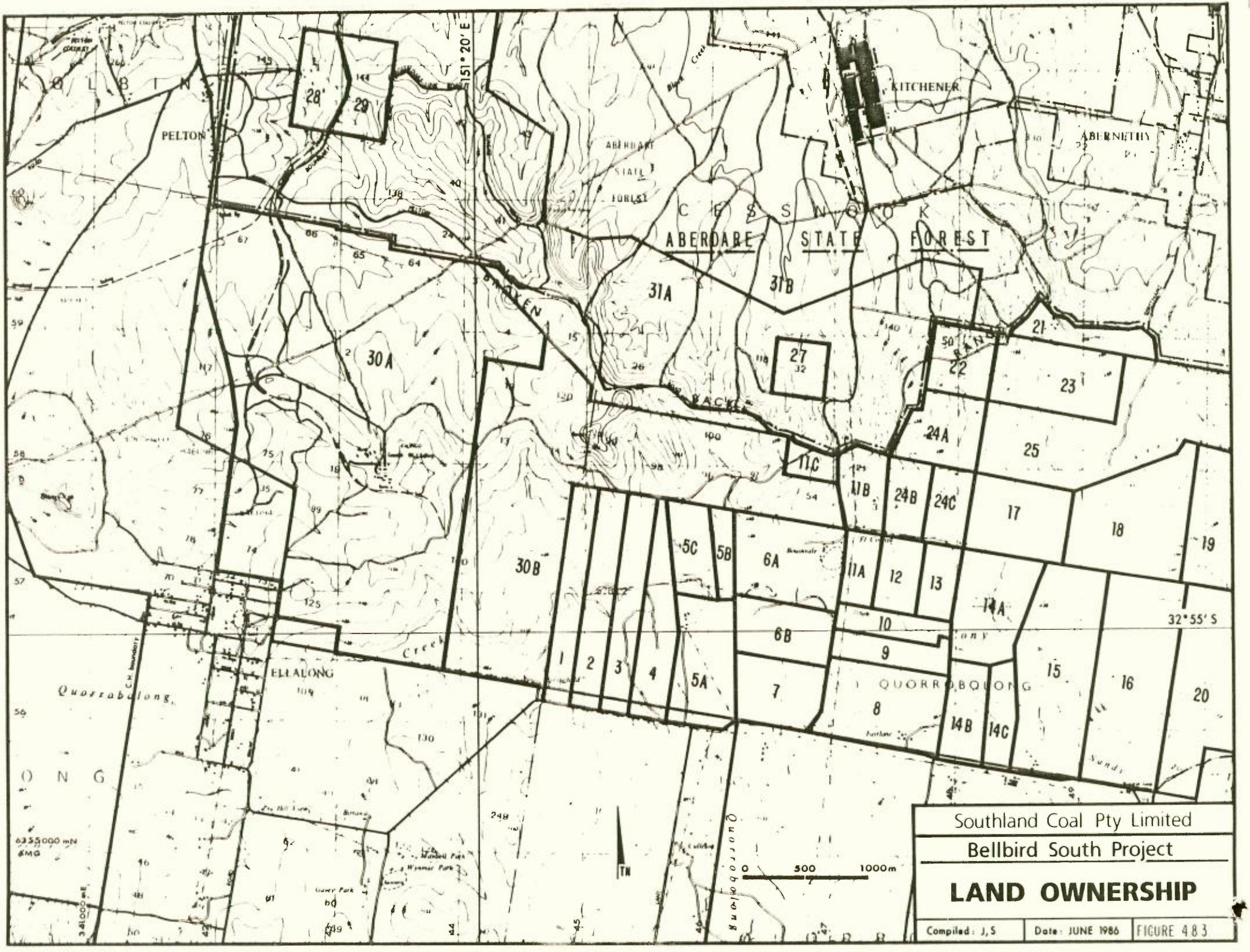
The site of the Bellbird South Project is zoned non-urban "A" under the Northumberland Planning Scheme ordinance, where coal mining is a permissible use with Council consent.

As coal mining is a designated development, the proposal is subject to the provisions of Part IV of the Environmental Planning and Assessment Act, 1979.

4.8.5 Impact Assessment - Land Use and Capability

Land Use

The Bellbird South Project is not expected to significantly affect existing urban, mining and forestry land uses within the Project area.


PELTON
KITCHENER
ABERNETHY
ABERDARE STATE FOREST
ABERDARE STATE FOREST
31A
31B
30A
30B
27
32
28
29
22
23
24A
25
11C
11B
24B
24C
17
18
19
5C
5B
6A
11A
12
13
14A
6B
10
9
1
2
3
4
5A
7
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15
16
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TN
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Southland Coal Pty Limited
Bellbird South Project
LAND OWNERSHIP
Compiled: J, S
Date: JUNE 1986
FIGURE 4.8.3

Surface subsidence resulting from longwall extraction of coal beneath the more settled rural subdivision area fronting Sandy Creek Road, may affect the productivity of the alluvial flats used for cropping and grazing. This would result from an increase in the area subject to flooding and to more frequent inundation thereby extending the area of semi-permanent wetland. It is not expected that vibration from underground blasting within this area during construction would affect any landowners.

Land Capability

Correct management of the soils as described in Section 4.1.2, will ensure that present land capability can be maintained at the Rail Loop Site and the alternative on-site reject disposal site. Upon abandonment of the sites, these areas would be suitable for rough grazing and the management of green timber.

The effects of surface subsidence on the alluvial flats (see Section 4.1) may affect the land capability of these areas. Should an increase in the area subject to flooding and inundation occur, a decrease in soil fertility levels and a downgrading of areas currently suitable for cropping may result. The quality of this pasture land may also decline. The area would on the other hand provide an increase in the wetland area available to wildlife.

4.9 Aesthetics

4.9.1 Subregional Landscape Status

The region studied (defined in Figure 4.9.1) contains two areas of scenic significance:

- Ellalong Lagoon, a swamp covering an area of approximately 250ha and located to the south-west of the Project area. The National Trust of Australia (NSW) has proposed that it be declared a nature reserve; and
- Pokolbin rural landscape to the north-west which extends as far south as Bellbird.

As a general principle, the National Trust proposes that rural landscape areas be subject to land management controls in order to preserve their scenic integrity.

4.9.2 Landscape Character Types

Five landscape character types were identified within the region, based upon variations in landform, vegetation and land use.

Forested Ridgelines and Lower Slopes: This unit comprises the Broken Back Range and shallower sloping lands to the north and south. It is characterised by elevated and predominantly steep to moderately sloping landforms, covered by Open Eucalypt-forest varying in height from 10 to 15m.

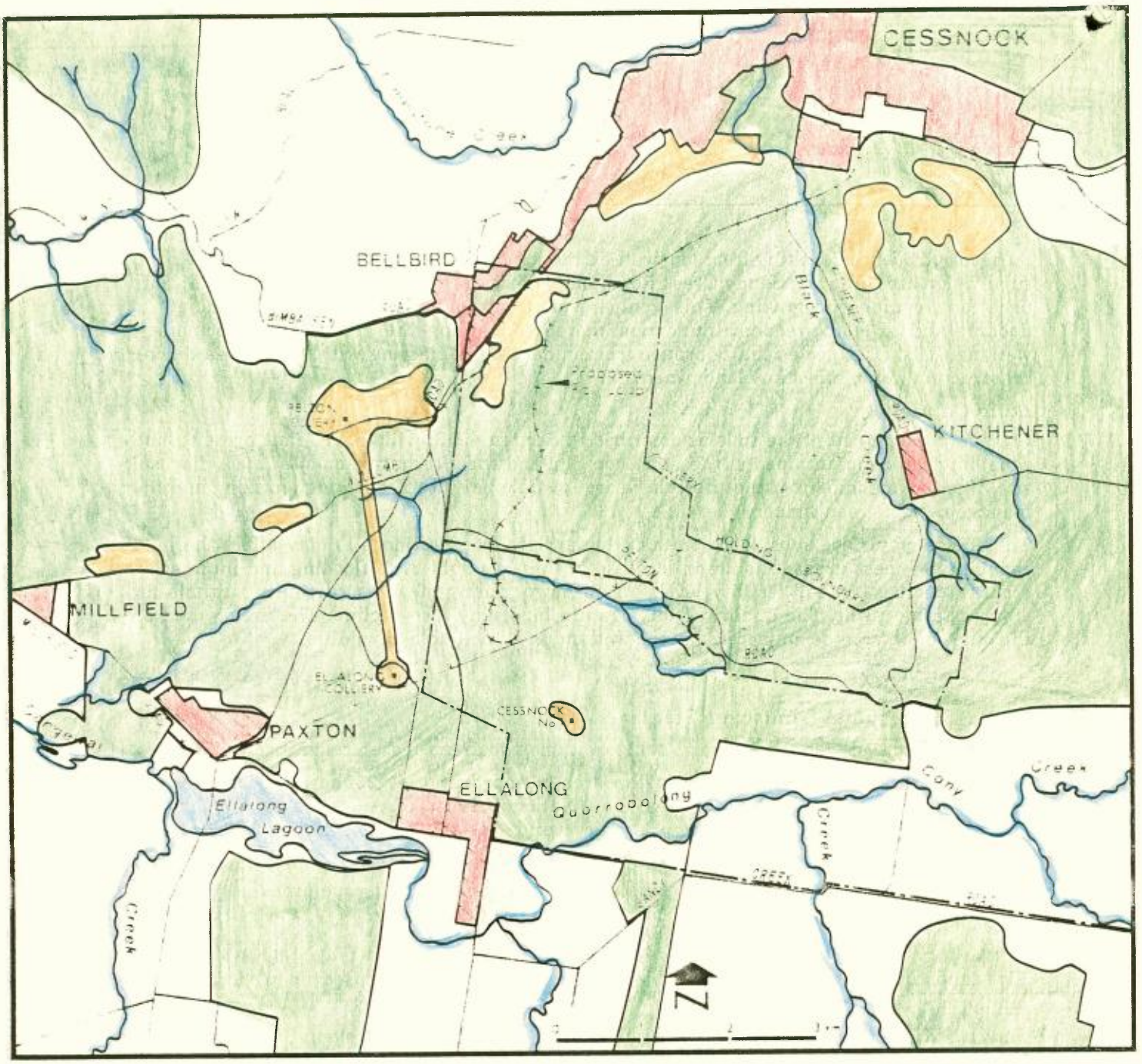
Cleared Valleys and Lower Slopes: This unit which generally occupies north-western and southern portions of the study area is characterised by cleared, shallow sloping land and alluvial flats which are used largely for rural activities.

Water Bodies: Ellalong Lagoon, Congewai Creek, Quorrobolong Creek and Cony Creek represent the main water bodies which are recognisable as landscape units.

The creeks are characterised by numerous ponds resulting from impeded drainage and are lined with riverine vegetation. Ellalong Lagoon is a relatively wide expanse of water, surrounded by and containing swamp vegetation.

Urban: This unit comprises the large settlement of Cessnock and the smaller, confined villages of Millfield, Paxton, Ellalong and Kitchener. The settlements are characterised by low scale, predominantly 'timber and tin' architecture and the lack of significant vegetation.

Extractive: Characteristics of this unit include disturbed land; surface facilities structures; coal and reject stockpiles.



LEGEND

- Forested Ridge Lines and Lower Slopes
- Cleared Valleys and Lower Slopes
- Water Bodies
- Urban
- Extractive

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DISTRIBUTION OF LANDSCAPE CHARACTER TYPES

FIGURE 4. 9. 1.

4.9.3 Scenic Quality and Site Visibility

The relative scenic quality of landscape character units is based upon an assessment of the variety or diversity which exists within each unit. Units with the most variety or diversity are normally assigned a higher scenic quality rating.

Based upon this criteria the *water bodies* unit has been rated as being of high scenic quality whilst the *forested ridgelines and lower slopes*, and the *cleared valleys and lower slopes* units are considered to be of moderate scenic quality. The *urban* and the *extractive* landscape units have been rated as having a relatively low scenic status.

The proposed Rail Loop Site and the adjacent alternative reject disposal site are located within *the forested ridgeline and lower slopes* landscape unit. The reject disposal site at Aberdare No. 7 is situated within the *extractive* landscape unit.

The Rail Loop Site is relatively remote from the public, being approximately 350m at the closest point from the Cessnock-Ellalong Road and in excess of 1.5km from Ellalong and 2km from Paxton. The Cessnock-Ellalong Road is classified as a minor road, which carries small volumes of traffic to local destinations. Because of the relatively dense forest cover, the site cannot be seen from either nearby villages or adjacent roads.

4.9.4 Impact Assessment – Aesthetics

Visual impact assessment was undertaken by field inspection and the use of line of sight sections. Due to the screening by vegetation and topographical effects, of both the Rail Loop Site and the Pit Top Site, it is only the taller structures at both sites that may be visible from selected vantage points.

As shown in Figure 4.9.2, only the upper portion of taller structures, which include the rail loading bin and coal preparation plant (25m height) at the Rail Loop Site and the man riding shaft superstructure (25m height) at the Pit Top Site, may be visible from certain parts of Ellalong. From all other viewing positions the structures are not expected to be seen.

The impact of these structures when viewed from Ellalong is expected to be marginal due to the distances involved and the use of dark coloured cladding and structural steel members. The Pit Top Site is 1.5km, and the Rail Loop Site is 2km, from Ellalong. The extent of visibility of these structures from Ellalong will depend also on the position of scattered vegetation located closer to the village and not shown on Section 4, Figure 4.9.2.

4.10 Socio-Economics

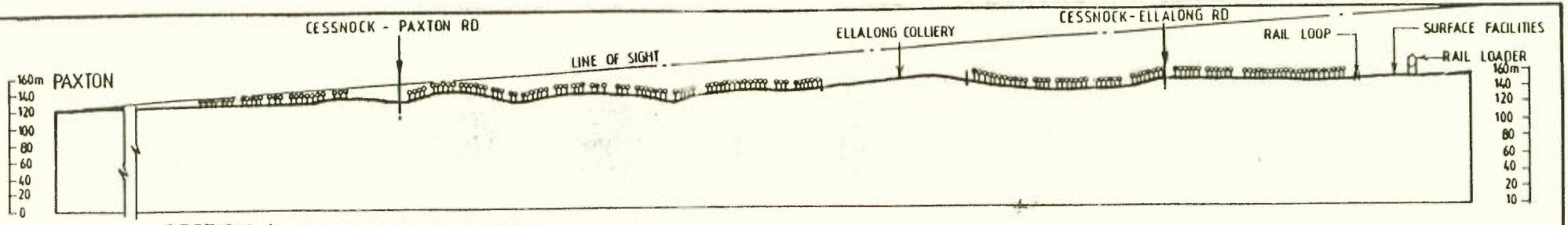
4.10.1 Introduction

The production of coal from the Bellbird South Project will create substantial new employment opportunities and will have a beneficial socio-economic effect within the Cessnock district.

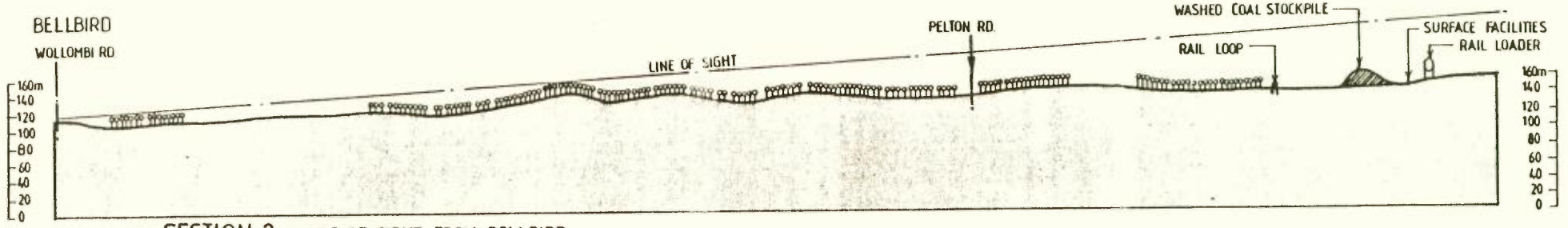
The estimated maximum workforce of 340 will largely be drawn from the local pool of skilled workers. Direct socio-economic effects will be concentrated within the Cessnock Local Government Area, which is an established coal mining community. Mining activity in the South Maitland District (including all mines in the vicinity of Cessnock) has been declining steadily over a long period, and the proposed development will partially offset this trend.

In assessing the impact of the proposed development (see Fallding, M., (1987)) a number of issues have been considered:

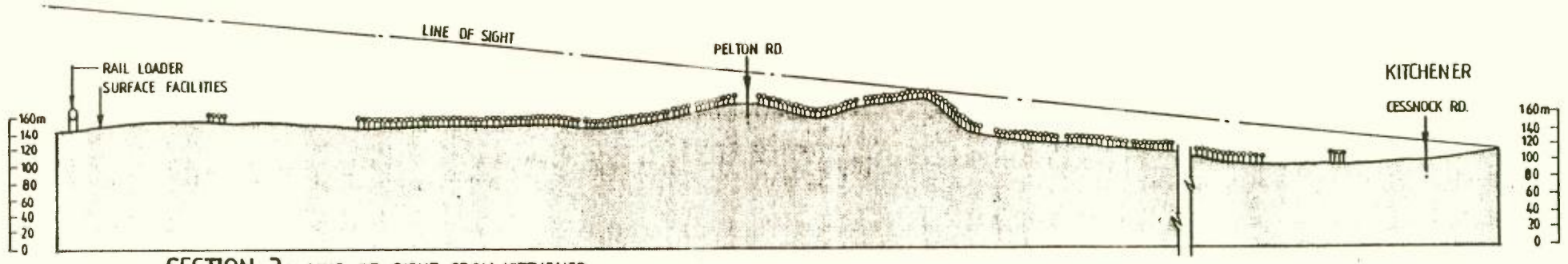
- employment situation;
- demographic characteristics;
- economic impact;
- accommodation and housing; and
- community services and facilities.



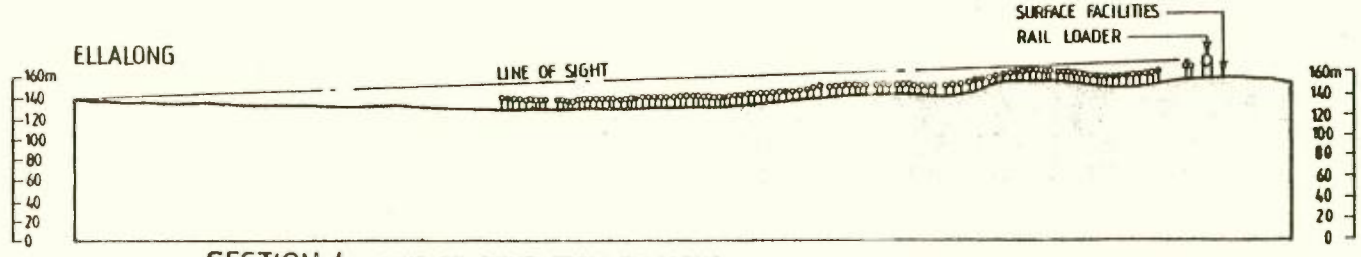
SECTION 1 - LINE OF SIGHT FROM PAXTON



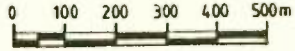
SECTION 2 - LINE OF SIGHT FROM BELLBIRD



SECTION 3 - LINE OF SIGHT FROM KITCHENER



SECTION 4 - LINE OF SIGHT FROM ELLALONG



VERTICAL TO HORIZONTAL EXAGGERATION= 2:1

LOCATION OF SECTIONS SHOWN ON FIGURE 4.8.1.

SITE VISIBILITY ASSESSMENT

FIGURE 4.9.2.

For this assessment, statistical information is based on the Cessnock Local Government Area. Mining statistics are based on the South Maitland District, as identified by the Joint Coal Board.

4.10.2 Employment Characteristics

Existing Situation

There are two underground coal mines currently operating in the South Maitland District, both located near Cessnock. There has been a steady decline in employment in mines in the district, from 3254 persons in 1960 to 578 persons in 1985. (Joint Coal Board, 1985). Without the opening of new mines the trend is expected to continue, largely due to the depletion of available coal reserves in existing mines.

The employment classification by industry and occupation for the Cessnock Local Government Area is shown in Tables 4.10.1 and 4.10.2. The major employers are in the mining and manufacturing sectors. The majority of the workforce residing in Cessnock and the surrounding villages are employed at locations outside the Local Government Area, including Maitland, Newcastle, Singleton and the Central Coast.

TABLE 4.10.1

COMPARISON OF EMPLOYMENT BY INDUSTRY CATEGORIES

Industry Category	Employed Population of Cessnock				Hunter Region	NSW
	Male	Female	Total	%	%	%
Agriculture	281	125	406	2.8	4.8	4.9
Mining	2,602	27	2,629	18.1	5.2	1.4
Manufacturing	2,455	1,028	3,483	23.9	20.9	18.6
Electricity Water/Gas	248	24	272	1.9	3.2	2.1
Construction	740	59	799	5.5	7.8	6.2
Wholesale/Retail	862	870	1,732	11.9	15.3	17.3
Transport/Storage	390	60	450	3.1	5.2	5.5
Communication	135	28	163	1.1	1.4	2.0
Finance/Property	258	278	536	3.7	6.3	9.6
Public Admin/Defence	305	108	413	2.8	4.0	5.1
Community Services	749	1,216	1,965	13.5	13.4	13.9
Recreation/Entertainment	241	374	615	4.2	5.0	5.6
Not Stated	559	533	1,092	7.5	8.0	7.8
Total	9,825	4,730	14,555	100.0	100.0	100.0

Source: ABS 1981 Census

TABLE 4.10.2

EMPLOYMENT BY OCCUPATION FOR CESSNOCK LOCAL GOVERNMENT AREA

Occupation	Male	Female	Total	%
Tradesmen	4,671	888	5,559	38.2
Miners/Quarrymen	1,722	-	1,722	11.8
Service/Sport & Recreation	488	867	1,355	9.3
Clerical	349	941	1,290	8.9
Professional/Technical	615	669	1,284	8.8
Sales	347	624	976	6.7
Transport/Communication	537	45	582	4.0
Farmers/Fishermen	354	133	487	3.3
Administration	297	49	346	2.4
Armed Services	15	2	17	0.1
Inadequately described/NS	428	505	933	6.5
Total	9,823	4,728	14,551	100.0%

The workforce participation rate in the Cessnock Local Government Area is 53.4% for males and 26.5% for females, being slightly lower than that for the Hunter Region (ABS 1981 Census).

The number of unemployed registered at the Cessnock Commonwealth Employment Service (CES) in December, 1986 was a total of 2,776 persons comprising 1,748 males and 1,028 females. The highest levels of unemployment are in the 15-19 years age group and the 25-44 years age group. The rate of unemployment is approximately 15% and is higher than the national average (Cessnock CES, 1987). The categories of unemployed are shown in Table 4.10.3.

Unemployment among skilled mining workers living in the Cessnock area is currently low, although the majority of these workers are employed outside the area, often commuting long distances. It is estimated for example, that up to 35% of the workforce at some mines in the Singleton area commute daily from Cessnock.

Effect of the Proposed Development

The proposed development will directly employ up to 100 construction workers required during the estimated 3½ year construction period and require 340 people at full production.

Although construction contractors may bring employees from outside the region for limited periods, it is estimated that over 70% of construction workers will be drawn from the Cessnock and Lower Hunter Region.

The permanent workforce at the Bellbird South Mine is expected to be largely resident in the Cessnock area. Many mine workers will undoubtedly transfer from more distant mines to work locally. A surplus of skilled labour is expected due to reductions in the workforce at existing district mines.

TABLE 4.10.3

REGISTERED UNEMPLOYED AT CESSNOCK COMMONWEALTH EMPLOYMENT SERVICE, DECEMBER 1986

Occupation	Number
Managerial/Administrative	26
Natural Science/Technology	87
Artistic/Literary/Sport	15
Clerical/Sales/Service	1,079
Primary Production (including Mining)	223
Manufacturing/Construction	715
Transport/Materials	231
Basic Manual Workers	396
All other	4
Total	2,776

Source: Cessnock CES

The workforce is expected to be distributed evenly throughout the Cessnock Local Government Area. There may be some minor relocation of miners from the Western and Southern Coalfields, depending on mining activities in those areas. Trade union practices will have some influence on the actual employment statistics at the time of commencement of the development. A small number of professional positions will probably be filled from outside the region.

In summary, the proposed development will increase the employment opportunities of local residents within the Cessnock area and is unlikely to create any labour shortages in the district.

4.10.3 Demographic Characteristics

Compared to the rest of the Hunter Region, the Cessnock Local Government Area has higher proportions of its residents in the childhood age groups, the group aged 25 to 34 years and the group aged over 70 years. The age structure is shown in Table 4.10.4.

Within the Local Government Area, the population is distributed widely between the major towns of Cessnock and Kurri Kurri, rural villages, and rural areas. The location of population is shown in Table 4.10.5.

The population of Cessnock has varied significantly from a peak population in 1954 of 38,729 to a population low of 34,521 in 1966. These changes are directly related to changes in the mining and manufacturing industries.

During the period 1976-1981 the average annual rate of population growth was 1.22% per annum compared with the state average of 1.09% per annum. Approximately 60% of the population growth can be attributed to net migration, the remainder being natural increase (ABS Census 1981).

The projected population of the Local Government Area in 1991 is a total of 43,000, based on expectations of continuing steady population growth (Cessnock City Council, 1987; Department of Environment and Planning, 1984).

The anticipated employment pattern and the time taken to develop the proposed mine to full production, indicate that the contribution of the Bellbird South Project to overall population growth and change, will be of minor significance.

TABLE 4.10.4

AGE STRUCTURE OF CESSNOCK LOCAL GOVERNMENT AREA

Age Groups	Males	Females	Total	% of City Population
0-4	1,660	1,481	3,141	8.1
5-9	1,786	1,786	3,572	9.2
10-14	1,795	1,657	3,452	8.9
15-19	1,551	1,481	3,032	7.8
20-24	1,575	1,463	3,038	7.8
25-29	1,581	1,531	3,112	8.0
30-34	1,571	1,474	3,045	7.9
35-39	1,260	1,178	2,438	6.3
40-44	957	921	1,878	4.8
45-49	936	895	1,831	4.7
50-54	1,022	1,024	2,046	5.3
55-59	965	1,009	1,974	5.1
60-64	824	913	1,737	4.5
65-69	661	847	1,508	3.9
70-74	549	719	1,268	3.3
75+	606	1,046	1,652	4.2
Total	19,299	19,425	38,724	100.0

Source: ABS 1981 Census

TABLE 4.10.5

POPULATION OF CESSNOCK LOCAL GOVERNMENT AREA BY LOCALITY

Locality	Population 1976	Population 1981	Change 1976-1981
City of Cessnock (LGA)	36,199	38,724	+2,525
Cessnock Urban Area	16,256	16,916	+660
Kurri Kurri Urban Area	12,143	12,795	+652
Branxton/Greta	2,485	2,849	+364
Rural Villages	1,828	1,922	+94
Rural Areas	3,487	4,242	+775

Source: Cessnock City Council

4.10.4 Impact Assessment – Socio-economic

Economic

The large initial capital investment ($100m) and ongoing expenditure, will contribute to the substantial economic impact of coal mining in the Hunter Region. The impacts will be both direct and indirect and will be spread widely throughout the economy.

The economic impact can be divided into a number of component parts:

(a) Initial capital expenditure during construction. Construction expenditure is estimated at approximately $30 million over $3^1/_2$ years;

(b) Construction workforce salaries. The expenditure on construction salaries is likely to vary significantly during the construction stage, but is estimated to average approximately $3 million annually;

(c) Operational workforce salaries. Salaries of permanent employees will be the major ongoing economic impact of the development. Total expenditure on salaries once the mine reaches full production is estimated at $14 million per annum;

(d) Employment, output and income multipliers. Multipliers indicate likely direct and induced economic effects. However, little assessment has been undertaken of their validity and accuracy in practice, despite their application to new coal projects within the Upper Hunter Region of NSW (Garlick, 1979; Croft and Associates, 1986). In relation to the Bellbird South Project, the regional multipliers are likely to be in the general range of 1.3 to 1.5. The induced effects will be distributed widely throughout the Hunter Region, whereas a significant proportion of the direct effect will be concentrated in Cessnock.

(e) Government charges and revenue. Total revenue generated by the mine will be substantial. The Federal Government will derive income in the form of company tax, excise, income tax and export duty. The State Government will benefit through royalties, payroll tax and receipts from transport and port charges. Local Government will benefit through increases in its rate revenue.

The development of the Bellbird South Mine represents a significant addition to the economic base of Cessnock. It will be an important source of income, both direct and indirect, and will ensure the continuation of mining as a significant economic activity and employer within the Cessnock Local Government Area. Government revenues from the development will also be substantial.

Socio-economics

The Bellbird South Coal Mine will provide for a continuation of the established pattern of employment in the Cessnock area and will help alleviate unemployment. Employees will primarily be existing residents of Cessnock, many of whom presently work outside the area. Thus the development will not result in a significant population influx.

The Project will generate substantial economic benefits to government revenue within the Hunter Region.

4.11 Transport Networks

Rail, road and air services serve the Cessnock District (see Figure 3.8.2).

4.11.1 Regional Coal Transport

The Port of Newcastle is the nominated coal export terminal for mines in the Hunter Valley. It is Government policy that transportation of coal should be by rail and this will be complied with in the Bellbird South Project.

4.11.2 Existing Rail System

Details of the existing rail system are described in Section 3.8.

4.11.3 Existing Road System

Traffic generated by the proposal will come from employees vehicles and service vehicles associated with the mine's operations. Most of the mine's work force of about 340 are expected to travel to the site from the Cessnock direction. About one third of the workforce is expected to be drawn from surrounding villages.

There are 3 roads which can be expected to serve the proposed coal mine. These are:

- Main road 218 also known as Wollombi Road, which runs south-west from Cessnock to Wollombi via Bellbird and Pelton, which is expected to carry the bulk of the Bellbird South traffic.
- Annual average daily traffic counts have been recorded at 2 locations on the Wollombi Road in close proximity to the Bellbird South Project (Table 4.11.1).
- A small road between Pelton and Ellalong known as the Pelton-Ellalong Road. There are no traffic counts for this road, presumably because of its very localised use.
- Similarly there are no figures for the Pelton Road which traverses the Project site and has a very "localised" function.

TABLE 4.11.1

TRAFFIC COUNTS – WOLLOMBI ROAD – MR 218

	1 Bellbird	2 Millfield
1980	1070	610
1984	2140	550

4.11.4 Impact Assessment – Transport

It is not expected that the Bellbird South Project will have any major impact on the road or air services in the area.

The Wollombi Road from Cessnock to Pelton will carry much of the additional traffic generated by the Project. This road has adequate capacity to accommodate an estimated additional 200 car trips in each direction each day.

The Pelton-Ellalong Road between Pelton and the turn off to the Pit Top Site will need some upgrading at vulnerable intersection sites. The Company will liaise with Council on the detail of upgrading required at these sites.

The Project will have an impact on the rail services in that it ensures the rehabilitation and upgrading of an existing rail formation to link into the main rail network.

4.12 Housing and Community Services

4.12.1 Accommodation and Housing

As at March, 1987 there is adequate availability of land and housing in Cessnock and this situation is expected to continue (Fallding, M., (1987)). Since the majority of the expected workforce is already resident in the area, no significant additional demand is likely.

Rental and temporary accommodation is restricted, but this is not expected to be a particular problem. There is no requirement for significant provision of construction workforce

accommodation and therefore no competition for short term accommodation is expected between the needs of the construction workforce and those of other groups such as tourists and seasonal vineyard workers. (Cessnock City Council, 1987).

4.12.2 Community Services and Facilities

Education

Within the Cessnock area there are a total of 19 primary schools and 3 high schools. The total enrolment in primary schools in 1986 was 4,780 and in high schools was 3,298. The primary school enrolments are predicted by the Education Department to remain relatively static until at least 1991. High school enrolments are expected to decline slightly over the period to 1991.

Any of the relatively small influx of population arising from the proposed development will be spread evenly throughout the Cessnock area. Thus the existing education infrastructure will be able to readily accommodate any demands attributable to the Bellbird South Project.

Health Services

The Cessnock area is within the area covered by the Northumberland Area Health Service. Existing health care deficiencies in the area are primarily the result of the population characteristics, particularly the high incidence of socio-economically disadvantaged people. The existing hospitals at Cessnock and Kurri Kurri are adequate for basic health needs. Identified deficiencies in health services (Cessnock District Hospital, 1984) relate to community health and the aged. The existing problems will be unlikely to be affected by the proposed development.

Community Infrastructure

Although relevant authorities have identified some existing deficiencies in community infrastructure (such as emergency housing, youth support, family support, preschools and occasional care, in particular) the deficiencies largely affect the disadvantaged socio-economic groups.

The Cessnock area has established facilities and overall the existing community infrastructure is satisfactory. The proposed development is unlikely to result in additional demands for social infrastructure.

4.12.3 Impact Assessment – Housing and Community Services

Existing social and community infrastructure in the Cessnock area is generally adequate and the development is not expected to place excessive pressure on community facilities and services.

This situation largely reflects the expectation that the majority of new employees will already be resident in the area.

5.0 ENVIRONMENTAL MONITORING PROGRAMME

An ongoing environmental monitoring programme will continue to be conducted by the Company as required.

The background air and water quality monitoring programme (see Sections 4.2 and 4.3) will be continued until the Project commences. The results from this programme will provide important information for the SPCC when it determines licence conditions under the Clean Waters and Clean Air Acts.

Once operations commence, the environmental monitoring programme will address collection of the following data:

- climatic and dust fallout data;
- water quality in all potentially affected watercourses (with careful attention to the effects of mine water disposal and leachate generation);
- noise levels at nearest residences;
- subsidence and any noticeable effects on watercourses or other potentially vulnerable features (natural or man made);
- leachate generation from the waste disposal site;
- revegetation trials on washery reject material; and
- effectiveness of the progressive rehabilitation programme.

The Company considers its proposal to develop the Bellbird South Project is environmentally sound and should provide primarily beneficial effects on the local community as well as positive economic inputs to the State and Federal Governments.

The revitalisation of abandoned infrastructure, renovation of historically interesting buildings and, most significantly, the injection of new employment opportunities within the community are considered to be benefits that far outweigh any dislocation that many be experienced by the community or the environment.

Southland Coal is committed to maintaining a responsible and high standard of environmental management. It's ongoing monitoring programme and liaison with the local community and government representatives will be sensitive to and reflect this commitment.

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Appendices

APPENDIX 1

Geochemical Assessment of Drift Waste and Coal Reject and Implications for Waste Management

Stuart Miller & Associates Pty Ltd – June 1987

A.1 Results and Discussion

This section examines the results of laboratory investigations carried out on the drift waste and reject samples. The purpose for assessing the geochemical nature of mine wastes was to identify potentially toxic materials that may adversely affect rehabilitation and redevelopment works. The three major potential geochemical problem areas with coal mine waste are acid generation, high salinity/sodicity and toxic levels of heavy metals or specific elements.

Tables 1 and 2 present the results of the laboratory investigations with the ICP-MS elemental scan results for the reject samples. The results for the drift waste and the reject material are discussed separately and are followed by a short discussion on their respective toxicity classifications.

The net acid producing potential (NAPP), given in Table 1, is calculated from the total sulphur content and the inherent acid neutralising capacity (ANC). A negative NAPP indicates that there is excess ANC in the material. A positive result indicates that the material is acid or may become acid in the long term. This is a "worst case" assessment since the calculation assumes that all sulphur is present as reactive sulphides.

A.1.1 Drift Waste

The acid-based analysis and saturated paste parameter results for the six drift waste rock samples are summarised in Table 1. The results identify three distinct zones of material associated with the Greta Coal Measures. The first is the material occurring above the Greta Measures which has a low total sulphur content, a moderate to high ANC and thus a net negative NAPP, a neutral to slightly alkaline pH and an electroconductivity (EC) indicating moderate to high saline conditions. The second zone is the material associated with the Greta Measures themselves (the roof and floor of the Greta coal seam) which demonstrates a net positive NAPP, suggesting a low to moderate acidity potential, a slightly acid pH and high salinity. The third zone occurs below the Greta Coal Measures and has basically the same properties as the material occurring above the measures, with a net negative NAPP and moderate to high salinity.

A.1.2 Reject Material

The two reject samples demonstrate similar properties, with the finer fraction having a higher total sulphur content, higher NAPP, higher EC and a lower pH. Both samples have high sodium absorption ratio (SAR) values. The saturation extract analysis results presented in Table A2 also confirm the higher soluble constituent component in the finer fraction.

The sodic nature of the reject suggests that leaching will promote dispersion of the clay sized material and in exposed areas surface crusting could be expected. However, as a result of oxidation and any acid generation the salinity level is expected to increase and the sodic hazard would be expected to decrease.

The results of the multi-element analysis showed that the arsenic level of the whole rock samples were slightly greater than the trigger level. No other environmentally important metal or specific elements were above trigger levels. However solubility testing showed that arsenic was not soluble under natural pH conditions and is unlikely to be a concern at the disposal site. The level of soluble boron was also slightly elevated but unlikely to cause revegetation or water pollution problems. Even though the content of zinc, copper, nickel and chromium were below trigger levels in the total rock analysis, they are sufficiently high to cause leachate problems if the reject becomes acid.

A.1.3 Toxicity Classification

A summary of the toxicity status of the drift waste and reject material samples is shown on Table A3. These revegetation toxicity classes are based on established criteria for the assessment of such materials and have been used successfully in the past. The housing redevelopment classification is based on published criteria for the redevelopment of contaminated land. The materials are classified according to the final condition of waste as a plant growing medium and also the level of contamination with respect to housing redevelopment.

The potential for self-ignition or combustion of the reject has not been assessed in this investigation but would be an important consideration for any housing or industrial redevelopment.

TABLE A1

ACID-BASE ANALYSIS AND SATURATED PASTE PARAMETERS FOR DRIFT DEVELOPMENT WASTE ROCK AND COAL WASH PLANT REJECT MATERIALS

Sample Code	Sample Type	Sample Description	Sample Details	Total S %	ANC %$CaCO_3$	NAPP %$CaCO_3$	Saturation Moisture Ratio	Saturation pH	Paste EC (µS/cm)
BS1	Composite Chip	Drift Waste	DDH1: 3-192m	0.27	5.30	-4.46	0.35	7.9	4.98
BS2	Composite Core	Drift Waste	DDH1:350-383m	0.26	3.13	-3.10	0.25	7.5	9.15
BS3	Composite Core	Drift Waste	DDH1:383-408m	0.45	4.93	-3.52	0.29	7.0	9.68
			Top of Greta Measures						
BS4	Composite Core	Drift Waste	DDH1:408-426m	0.73	1.03	1.25	0.32	5.2	9.99
			Greta Seam: 426-431m						
BS5	Composite Core	Drift Waste	DDH1:431-438m	0.67	1.58	0.51	0.30	5.7	10.90
BS6	Composite Core	Drift Waste	DDH1:438-497m	0.34	6.40	-5.34	0.27	7.9	6.68
BS7	Bulk Reject	Pelton Colliery	<4mm Fraction	2.40	0.85	6.65	0.30	5.5	4.07
BS8	Bulk Reject	Pelton Colliery	>4mm Fraction	0.98	-0.28	3.34	0.31	7.1	2.08

TABLE A2

SATURATION EXTRACT ANALYSIS OF THE TWO COAL WASH PLANT REJECT SIZE FRACTIONS

Composite Waste Description	Saturation Moisture Ratio	pH mS/cm	EC mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	SO_4 mg/l	Cl mg/l	SAR mg/l
Reject <4mm Fraction	0.34	6.1	4.49	37	11	1,000	22	2,200	150	37
Reject <4mm Fraction	0.30	7.8	2.83	6.6	2.5	610	14	1,200	100	51

TABLE A3

TOXICITY CLASSIFICATION OF WASTE MATERIAL

Material	Revegetation			Housing Redevelopment
	Potential Acidity	Salinity/ Sodicity	Heavy Metals	
Drift Waste (above Greta Measures)	nil	medium	nd	nil
Drift Waste (Greta Coal Measures)	medium	high	nd	low (SO_4)
Drift Waste (below Greta Measures)	nil	medium	nd	nil
Fine Reject (<4mm mat.)	high	medium/high	As,B	low (SO_4)
Coarse Reject (>4mm mat.)	medium	low/high	As	low (SO_4)

A.2 Implications for Waste Disposal, Management and Rehabilitation

This section describes the implications of the characteristics of the waste materials for the waste disposal, management and final landform rehabilitation.

A2.1 Drift Waste Disposal and Rehabilitation

Waste material excavated from above the Greta Measures is expected to be moderately to highly saline. Waste from within the Measures is also highly saline but with a potential to generate acid. It is anticipated that the acid potential increases towards the roof of the Greta Seam.

The following recommendations are proposed for disposal and rehabilitation of the drift waste:

1. The potentially acid forming material from within the Greta Coal Measures should be buried at least 1m below the final surface of the waste dump. This material should not be used for construction works such as road base or for general surface fill.
2. If the quantity of material from within the Greta Measures is large, it is recommended that the acid potential be monitored during excavation so that the quality requiring selective handling is minimised and any material suitable as general construction fill identified.
3. Rehabilitation of the drift waste will be restricted due to the high salinity of the material. The rehabilitation strategy must consider the high salinity. Application of suitable topsoil will be beneficial.

A.2.2 Reject Disposal and Rehabilitation

The results of this limited investigation indicate that the reject is potentially acid forming and after a period of oxidised leaching, acid conditions are likely to be established. Fresh reject has a moderate salinity but if acid conditions become established the salinity is expected to increase. In addition, the level of arsenic is slightly elevated but at the pH of the fresh material it is not soluble. The high sulphate level also presents some restrictions to redevelopment through sulphate attack on construction materials.

The potential concerns identified are not major and can be adequately overcome by sound waste management practice and sensible land use planning. This should include:

1. All reject to be placed in a controlled disposal area and routinely compacted in small lifts to reduce infiltration. Surface drainage from the working areas and exposed reject must be effective and avoid ponding.
2. The active dumping area should be kept to a minimum to reduce the surface area exposed and thus minimise oxidised leaching.
3. Drainage from the disposal area should be collected and monitored to identify any treatment required if discharge to surface waters is anticipated.
4. Manage the disposal operation to allow for progressive covering and rehabilitation. This will minimise acid generation and long term seepage problems.
5. For revegetation purposes and long term control of acid generation, apply at least 1m of sub-soil cover and 150 to 200mm of topsoil. The non-acid drift waste would be suitable as a subsoil substitute.
6. The use of coarse rejects for embankment construction must be considered carefully to ensure that it is not located in active seepage zones and is satisfactorily isolated from oxidised leaching.

The recommendations presented above are based primarily on the assumption that the rejects are acid forming. However, the results of this preliminary investigation only suggest that the rejects are potentially acid forming. Additional geochemical and leaching tests would confirm the true acid nature of the rejects. The recommendations for reject disposal can then be reviewed, possibly supporting a less conservative cover and rehabilitation design.

APPENDIX 2

Soil Profile Descriptions

A.1 Duplex Soils

Coarse Duplex Soils Dy 3.22

Distribution

This soil is the most common within the study area. It occupies approximately 34.7ha of land with a widespread distribution.

Morphology

The A1 horizon ranges in depth to 170mm with a loamy sand or clayey sand texture. It is weakly structured with an earthy fabric and is reddish brown in colour. This horizon is hardsetting when dry.

The A2 horizon consists of a yellowish-red loamy sand. It has 6mm to 20mm sized conglomeratic material dispersed throughout. The A3 horizon below it also contains conglomerate. The A3 horizon is sometimes absent. These layers are found to depths of 350mm and are weakly structured with polyhedral peds.

The B horizon is a yellowish-red, sandy clay of moderate structure. Less than 2% conglomeratic material is dispersed throughout the horizon. It is moderately structured.

Erodibility

The coarse sandy nature of the A horizons and the texture contrast between the A and B horizons, together with the low permeability of the B horizon, means that this soil is highly susceptible to sheet and gully erosion when cleared.

Fine Duplex Soils Dr 3.42

Distribution

This soil type occupies 3.8ha of land and is found near to drainage lines.

Morphology

The A1 horizon is 140mm deep and has a loamy sand texture. It is weakly structured, has an earthy fabric and is hardsetting upon drying. It has a reddish-brown colour.

A sharp boundary divides the A1 from the bleached A2 horizon. The A2 horizon is a 60mm thick layer with a clayey, sand texture and has dispersed conglomeratic material throughout.

The B1 horizon is a reddish-brown, sandy clay with rough-faced peds and moderate structure. A sharp boundary separates the B1 and B2 horizons. The B2 is a yellowish-red, heavy clay. It has rough-faced peds and strong structure with conglomerate dispersed throughout. Permeability of this layer is low, occasionally causing mottling.

Erodibility

The coarse sandy nature of the upper horizons results in accelerated erosion. The texture contrast between the A and B horizons and the low permeability of the B horizon clay, mean that the soil is highly susceptible to sheet and gully erosion.

A.2 Uniform Soils

Uniform shallow soils Uc 4.13

Distribution

This soil type occupies a 4.6ha strip of land aligned in a north-west south-east direction in the southern part of the proposed Rail Loop Site.

Morphology

The A1 horizon consists of a yellowish-red or reddish-grey, loamy sand. It is similar to the other A horizons in the area as it is weakly structured and has an earthy fabric. It varies from the others due to the presence of dispersed conglomeratic material.

Gravel is often found at the surface and the surface is hard-setting.

The A2 horizon is similar to the A1 horizon but has a bleached appearance and contains more conglomerate of larger average size. The A2 horizon occurs to depths of 200mm where a sharp boundary to the C horizon is located. This horizon consists of weakly weathered conglomerate.

Erodibility

This coarse textured soil is highly susceptible to sheet and gully erosion especially on slopes. When undisturbed it is stable, which is also true for other soils in the area.

Medium Depth Uniform Soils Uc 4.24

Distribution

This soil type occurs near drainage lines over an area of 4.1ha.

Morphology

The A horizon consists of a reddish brown, clayey sand to 270mm in depth. It has weak pedality, an earthy fabric and has a low consistence. The surface is loose.

The boundary between the A1 and A2 horizons is diffuse. The A2 horizon is a yellowish-red, clayey sand with weak pedality and a sandy fabric. It consists of sub-angular blocky peds 8mm in diameter. The A2 horizon occurs to 650mm depth.

The B horizon consists of a pale yellow, loamy sand with weak pedality. It has less than 2% dispersed conglomerate and comprises 10mm prismatic peds.

Erodibility

This soil type is highly susceptible to sheet and gully erosion. Its location near watercourses increases its susceptibility to erosion when disturbed.

Deep Uniform Soils Uc 4.21

Distribution

This soil type occupies 26.8ha of land adjacent to intermittent watercourses which flow in a northerly direction.

Morphology

The A1 horizon is a dark, reddish-grey, loamy sand with weak structure and an earthy fabric. It occurs to a depth of 170mm.

The A2 horizon is a yellowish-red, loamy sand with similar characteristics to the A1 horizon.

It occurs to 900mm depth. A sharp boundary separates it from the B horizon which is a structureless yellow sand.

Erodibility

Similar to other soils in the area, the coarse nature of this soil results in a high susceptibility to sheet and gully erosion. Located adjacent to intermittent watercourses, it is likely to erode if disturbed.

APPENDIX 3

Water Quality Monitoring Results

TABLE A1

CONDUCTIVITY (umhos cm- AT 25°)

Station	Date 5/5/87	10/5/87	19/5/87	27/5/87	2/6/87
BW1	480	380	370	330	340
BW2	180	-	-	-	-
BW4	104	150	135	124	125
BW7	140	138	145	145	145

TABLE A2

pH

Station	Date 5/5/87	10/5/87	19/5/87	27/5/87	2/6/87
BW1	6.3	6.3	6.2	5.3	6.6
BW2	5.8	-	-	-	-
BW4	5.6	5.1	5.6	5.5	5.7
BW7	5.9	5.6	5.8	-	5.9

TABLE A3

TOTAL FILTERABLE RESIDUE (mg/l 180°C)

Station	Date 5/5/87	10/5/87	19/5/87	27/5/87	2/6/87
BW1	260	-	290	180	215
BW2	116	-	-	-	-
BW4	90	-	126	95	120
BW7	84	100	108	100	130

TABLE A4

POSITIVE ION CONCENTRATIONS

Station		5/5/87		10/5/87		19/5/87		27/5/87		2/6/87	
		mg/l	mEq/l	mg/l	mEq/l	mg/l	mEq/l	mg/l	mEq/l	mg/l	mEq/l
BW1	Na^+	58	2.523	49	2.132	40	1.740	45	1.958	45	1.958
	K^+	3.3	0.084	3.0	0.077	3.1	0.079	2.7	0.069	2.8	0.072
	Ca^{2+}	12	0.600	9.2	0.459	11	0.549	8.3	0.414	8.2	0.409
	Mg^{2+}	12	0.987	9.4	0.773	12	0.987	7.5	0.617	7.8	0.642
	Total		4.194		3.441		3.355		3.058		3.081
BW2	Na^+	19	0.827								
	K^+	5.8	0.148								
	Ca^{2+}	6.6	0.329								
	Mg^{2+}	3.7	0.304								
	Total		1.608								
BW4	Na^+	10	0.435	18	0.783	17	0.740	15	0.653	22	0.957
	K^+	3.8	0.097	5.2	0.133	5.1	0.130	4.6	0.118	3.6	0.092
	Ca^{2+}	3.2	0.160	3.4	0.170	3.7	0.185	3.0	0.150	5.5	0.275
	Mg^{2+}	2.6	0.214	2.9	0.239	5.8	0.477	2.1	0.173	2.3	0.189
	Total		0.906		1.325		1.532		1.094		1.513
BW7	Na^+	16	0.696	14	0.609	14	0.609	15	0.653	22	0.957
	K^+	4.5	0.115	4.0	0.102	4.5	0.115	3.9	0.100	4.5	0.115
	Ca^{2+}	5.2	0.260	4.6	0.230	5.6	0.279	5.8	0.289	3.3	0.165
	Mg^{2+}	3.0	0.247	3.2	0.263	3.6	0.296	3.2	0.263	3.1	0.255
	Total		1.318		1.204		1.299		1.305		1.492

TABLE A5

NEGATIVE ION CONCENTRATIONS

Station		5/5/87		10/5/87		19/5/87		27/5/87		2/6/87	
		mg/l	mEq/l	mg/l	mEq/l	mg/l	mEq/l	mg/l	mEq/l	mg/l	mEq/l
BW1	Cl^-	103	2.906	85	2.398	78	2.200	74	2.088	82	2.313
	SO_4^-	27	0.562	15	0.313	17	0.354	20	0.417	20	0.417
	Total Alkalinity (as $CaCO_3$)	45	0.899	35	0.699	32	0.639	17	0.340	26	0.520
	Total		4.367		3.410		3.193		2.845		3.250
BW2	Cl^-	20	0.564								
	SO_4^-	10	0.208								
	Total Alkalinity (as $CaCO_3$)	25	0.500								
	Total		1.272								
BW4	Cl^-	3.5	0.099	18	0.508	14	0.395	14	0.395	15	0.423
	SO_4^-	20	0.417	24	0.500	9	0.188	20	0.417	25	0.521
	Total Alkalinity (as $CaCO_3$)	20	0.400	20	0.400	29	0.579	20	0.400	23	0.460
	Total		0.916		1.408		1.162		1.212		1.404
BW7	Cl^-	15	0.423	18	0.508	14	0.395	21	0.592	21	0.592
	SO_4^-	10	0.208	3	0.063	7	0.146	9	0.187	12	0.250
	Total Alkalinity (as $CaCO_3$)	32	0.639	26	0.520	37	0.739	32	0.639	35	0.699
	Total		1.270		1.091		1.280		1.418		1.541

TABLE A6

NON-FILTERABLE RESIDUE (mg/l)

Station	Date 5/5/87	10/5/87	19/5/87	27/5/87	2/6/87
BW1	2	<1	1	2	2
BW2	20	-	-	-	-
BW4	205	50	120	62	40
BW7	10	2	37	5	5

TABLE A7

TURBIDITY (NTU)

Station	Date 5/5/87	10/5/87	19/5/87	27/5/87	2/6/87
BW1	<5	<5	<5	<5	<5
BW2	30	-	-	-	-
BW4	350	130	250	200	170
BW7	10	5	20	15	10

NTU – Nephelometric Turbidity Unit

APPENDIX 4

Air Quality

Current and Past Dust-Fallout Standards in the United States

State	Standard $gm^{-2}month^{-1}$
Arkansas	5.25 (maximum monthly)
Hawaii	6 (maximum monthly, based on $3.0gm^{-2}$ (14 days)$^{-1}$ maximum
Kentucky	5.25 (secondary standard, maximum monthly)
Louisana	7 (maximum monthly)
Mississippi	5.25 (monthly, not to exceed background on adjacent property by more than this)
New York	3 sparse population : 50% of values to not exceed 6 metropolitan these 30 day values in any year 4.5 sparse population : 84% of values not to exceed 9 metropolitan these 30 day values in any year
North Dakota	5.25 (maximum 3-month arithmetic mean in residential areas) 10.5 (maximum 3-month arithmetic mean in heavy industrial areas)
Pennsylvania	15 (30-day average) 8 (annual average)
Wyoming	5 (monthly maximum for residential areas) 10 (industrial areas)

Note: The "maximum monthly" standards of 5 to $7gm^{-2}month^{-1}$ are roughly equivalent to the SPCC's tentative criterion for the preservation of amenity, $4gm^{-2}month^{-1}$ (annual average)

Source: State Pollution Control Commission (1984)

Modelling Approach

Using the emissions inventory outlined in Table 4.3.5 estimates of long-term (annual average) dust fallout rates and dust concentrations have been made for Year 7.

The basis of the model used for the predictions is the sector average equation of Turner (1969), which can be used to estimate long-term (monthly, seasonal or annual) ground level concentrations of a pollutant from a point source. The basic assumption of Turner's model is that the dispersing plume carries material downwind so that the emissions are distributed evenly across each of the 16 sectors for which wind frequency information is available. The amount of dust carried downwind in each sector depends on the frequency with which the wind blows in that sector. As well as dispersion in the horizontal, the plume also undergoes dispersion in the vertical at a rate based on the dispersion curves of Pasquill (see Turner, 1969). In the model mixing in the vertical is limited by inversions, although in practice sensitivity tests show that the model is not sensitive to the mixing depths over the range of values that occur in practice. For this study mixing depths have been set at 1.500m.

Although the sector average model forms the basis for calculating dust concentrations, some modifications are applied to account for the fallout of particles and the resultant depletion of the plume as it travels downwind.

Deposition in the model is determined from the product of a deposition velocity and the particle concentration. The magnitude of deposition flux (expressed in $gm^{-2}month^{-1}$) depends on the size of the particles, the concentration and the wind speed.

A full technical description of the model is provided in the Environmental Impact Statement for the Northern Open Cut Extension of CSR's Lemington Mine, CSR (1984). This reference also presents the results of a model validation study in which predicted dust deposition rates have been compared with measured rates. Satisfactory agreement between predictions and measurements was obtained.

APPENDIX 5

Acoustics

Noise Level Surveys – Existing Background and Proposed Plant

A.1 Instrumentation

Instrument	Make/Model	Serial No
Modular Precision Sound Level Meter	Bruel & Kjaer 2231	1221076
Statistical Analysis Module	Bruel & Kjaer BZ7101	-
12mm Condenser Microphone	Bruel & Kjaer 4155	1239887
Octave Filter Set	Bruel & Kjaer 1624	1244938
Sound Level Calibrator	Bruel & Kjaer 4230	1274986
Portable 2-channel Tape-recorder	Marantz CP430	55A050098

A.2 Procedures

The surveys were conducted in accordance with the Australian Standard 1055-1984 "Acoustics - Description and Measurement of Environmental Noise, Part 1 - General Procedures" and "Part 2 - Application to Specific Situations" and with reference to Australian Standard 2436-1981 "Guideline to Noise Control on Construction, Maintenance and Demolition Sites", the NSW Noise Control Act, of 1975 and the State Pollution Control Commission (SPCC) Environmental Noise Control Manual.

A.3 Background Noise Levels

Noise level surveys were conducted at a number of residences closest to or potentially most affected by the proposed operation. The surveys were conducted on 30 April and 1st May, 1987. The sound level meter was calibrated before and after each survey, the measured level of the calibrator never varied by more than 0.1dB.

The measurement period of each survey was 20 minutes.

The results of the surveys are summarised below.

Monitoring Positions	Date and Time		Noise Levels (dBA) L_{eq}	L_1	L_{10}	L_{90}	Major Noise Sources	Weather Conditions
BG 1	30.4.87	12.00noon	38	46	41	31	Distant motor bikes (occasionally), birds, horses and wind – no road traffic.	Temperatures 19°C Relative Humidity 70%
BG 2	30.4.87	12.30pm	57	72	48	32	Traffic on Wollombi Road.	30% cloud cover Wind up to 9km/hr (ESE)
BG 3	30.4.87	1.05pm	36	44	37	31	Fauna, wind – no road traffic.	
BG 4	30.4.87	2.05pm	48	55	52	42	Motorised garden machine.	
BG 1	30.4.87	3.00pm	41	49	43	33	Birds, horses, wind – no road traffic.	Temperature 20°C Relative Humidity 40%
BG 2	30.4.87	3.30pm	62	76	57	33	Traffic on Wollombi Road children talking/fighting.	70% cloud cover Wind up to 17km/hr (SSE)
BG 3	30.4.87	4.05pm	43	53	43	35	Dog barking, traffic on Wollombi Road.	
BG 4	30.4.87	5.20pm	41	53	40	27	Motor bikes, voices and a dog in the distance.	
BG 1	30.4.87	10.34pm	43	55	43	38	Fauna, cars leaving residences.	Temperature 10°C Relative Humidity 60%
BG 2	30.4.87	11.08pm	56	74	51	32	Fauna, traffic on Wollombi Road and distant traffic, plant and dog.	60% cloud cover Wind up to 8km/hr (SSE)
BG 3	30.4.87	11.49pm	37	44	38	28	Fauna, distant traffic – steady, dog, car passbys.	
BG 4	1.5.87	00.32am	27	37	28	21	Fauna, distant traffic.	
BG 1	1.5.87	2.12am	33	39	36	29	Fauna, horses, distant traffic.	Temperature 8°C Relative Humidity 75%
BG 2	1.5.87	2.44am	32	38	34	30	Distant plant noise, dripping trees.	80% cloud cover Wind up to 6km/hr (SSE)
BG 3	1.5.87	3.18am	30	35	32	25	Fauna, distant traffic dog barking.	
BG 4	1.5.87	4.00am	28	34	24	20	Distant traffic.	
BG 1	1.5.87	7.05am	38	49	39	29	Fauna, voices, some light rain, distant traffic.	Temperature 17°C Relative Humidity 80%
BG 2	1.5.87	7.33am	64	78	62	37	Traffic on Wollombi Road – high volume.	100% cloud cover Wind up to 4km/hr (SSE)
BG 3	1.5.87	8.03am	43	56	41	33	Distant traffic, aircraft.	
BG 4	1.5.87	11.00am	41	52	40	24	Distant traffic, fauna, voices, cars passing.	

A.4 Noise Levels of Proposed Plant

Noise level surveys of similar plant comprising the major noise sources within the proposed operation at Bellbird South were conducted at the nearby Pelton and Ellalong Collieries.

The 1/1 octave band sound power levels of the major noise sources are given below.

	Linear Sound Power Levels (dB)								
31	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	**LIN**
1.	Exhaust Fans								
114	120	114	104	92	91	87	84	74	122
2.	ROM Coal Belt Conveyors – up drift								
101	96	101	105	106	107	103	87	78	112
3.	1000t ROM Surge Bin and Vibrating Feeder (200t measured)								
104	117	107	100	97	98	98	93	89	117
4.	Pre-treatment Crushing and Screening (enclosed)								
126	120	119	112	103	102	101	94	91	128
5.	Rotary Breaker and Scalping Screen								
119	110	106	103	102	104	103	100	95	119
6.	Reject Handling – Front End Loader								
106	104	111	110	108	104	99	93	87	116
7.	Raw Coal Stacker and Feed Conveyor								
114	110	108	106	106	101	99	94	84	117
8.	Raw Coal Reclaimer (as Stacker)								
114	110	108	106	106	101	99	94	84	117
9.	Preparation Plant Surge Bin and Vibrating Feeder								
104	117	107	100	97	98	98	93	89	117
10.	15t Dump Trucks – Washery to Reject Dump								
113	115	109	103	104	100	98	96	92	118
11.	Stacker Feeder and Slewing Boom Conveyor								
114	110	108	106	106	101	99	94	84	117
12.	1000t Reject Bin								
104	117	107	100	97	98	98	93	89	117
13.	Tracked Dozer/Loader – Reject Dump								
119	120	119	106	110	109	107	99	93	125
14.	Combined Coal Processing and Handling Plant (items 4, 5, 7, 9 & 12)								
127	123	120	114	108	107	103	98	88	129
15.	Coal Transport – Loaded Coal Train								
121	122	116	112	108	101	96	90	81	125

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Bellbird South coal project

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